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GUIDE TO COMMUNITY PREVENTIVE SERVICES: REVIEW

Breast and Cervical Cancer Screenings: A Systematic Economic Review of Patient Navigation Services

Sajal K. Chattopadhyay, PhD,[1] Akash Pillai, MPH,[2] Jeffrey Reynolds, MPH,[1] Verughese Jacob, PhD, MPH, MS,[1] Donatus Ekwueme, PhD,[3] Yinan Peng, PhD,[1] Alison E. Cuellar, PhD[4], the Community Preventive Services Task Force (CPSTF) [†]

Introduction: This paper examined the economic evidence of patient navigation services to increase breast and cervical cancer screenings among historically disadvantaged racial and ethnic populations and people with lower incomes.

Methods: The literature search strategy for this systematic review included English-language studies conducted in high-income countries that were published from database inception to December 2022. Studies on patients with existing cancer or without healthcare system involvement were excluded. Analysis was completed in January 2023. All monetary values reported are in 2022 U.S. dollars.

Results: The search yielded 3 breast cancer, 2 cervical cancer, and 2 multiple cancer studies that combined breast and cervical cancer with other cancer screenings. For breast cancer screening, the intervention cost per person ranged from $109 to $10,245. Two studies reported $154 and $740 as intervention cost per additional person screened. Changes in healthcare cost per person from 2 studies were $202 and $2,437. Two studies reported cost per quality-adjusted life year (QALY) gained of $3,852 and $39,159 while one study reported cost per life year (LY) gained of $22,889. For cervical cancer, 2 studies reported intervention cost per person ($103 and $794) and per additional person screened ($56 and $533) with one study reporting a cost per QALY gained ($924).

Discussion: All estimates of cost per QALY/LY saved for breast cancer screening were below a conservative threshold of $50,000 indicating that patient navigation services for breast cancer screening were cost-effective. There is limited evidence to determine cost-effectiveness of patient navigation services for cervical cancer screening.

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INTRODUCTION

In the United States, breast cancers accounted for 239,612 new cancer cases and over 42,000 deaths among females in 2020, while cervical cancers accounted for over 11,000 new cancer cases and over 4,000 deaths.[1] The U.S Preventive Services Task Force (USPSTF) recommends regular screening for these cancers among age-appropriate populations.[2,3] Regular screening helps to detect cancer at an earlier stage, which can reduce cancer mortality with appropriate follow-up and treatment.[2,3] Screening for cervical cancer can also prevent cancer through removal of pre-cancerous lesions. Screening prevalence for the eligible population was 75.6% for breast cancer and 73.9% for cervical cancer in 2021, both below *Healthy People 2030* targets of 80.3% and 79.2%, respectively.[4,5] Screening rates, in general, are also lower for people from historically disadvantaged racial and ethnic populations and people with

From the [1]The Community Guide Program, Office of Science, Centers for Disease Control and Prevention (CDC), Atlanta, Georgia; [2]City University of New York, Graduate School of Public Health and Health Policy, New York; [3]Division of Cancer Prevention and Control, CDC, Atlanta, Georgia; and [4]College of Health and Human Services, George Mason University, Fairfax, Virginia

Address correspondence to: Sajal K. Chattopadhyay, PhD, Office of Science, Centers for Disease Control and Prevention (CDC), 1600 Clifton Road, Mailstop H21-10, Atlanta GA 30329. E-mail: skc9@cdc.gov.

†Names and affiliations of CPSTF members are available at: www.thecommunityguide.org/task-force/community-preventive-services-task-force-members.

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lower incomes.[6–8] Based on 2018 National Health Insurance Survey (NHIS) data, the percentage of age-eligible U.S. women, who were up to date with breast cancer screening, was 70.7% for Hispanic compared to 72.6% for Non-Hispanic women. For cervical cancer, the percentages were 81.4% and 83.2%, respectively, while the percentage for American Indian/Alaska Native women was 73.6% compared to 83.2% for white women. Screening percentages were also lowest for women with income below 138% of Federal poverty threshold, with 58.6% for breast cancer and 73.7% for cervical cancer.[8] These screening disparities can increase the likelihood of late-stage cancer diagnoses and mortality among these populations.[9,10]

Patient navigation services, including those that increase access to cancer screenings, provide culturally and linguistically appropriate healthcare services to help underserved communities[11] and may involve providing client reminders, reducing structural barriers, informing patients about cancer screenings, and reducing patients' out-of-pocket costs.[12] Services may be provided by community health workers, healthcare professionals, nurses, patient navigators, social workers, or others.[12] The Community Preventive Services Task Force (CPSTF) recommends patient navigation services to increase breast and cervical cancer screening based on evidence of their effectiveness.[12] Patient navigation services may reduce cancer-related disparities seen among historically disadvantaged racial and ethnic populations with appropriate follow-up care and treatment.

This paper is a systematic review of economic evaluation studies of patient navigation services to increase breast and cervical cancer screenings and advance health equity with a specific focus on historically disadvantaged racial and ethnic populations and people with low incomes. The review will help program implementors and public health policy decision makers to better understand the costs and economic benefits of using patient navigation services to increase screenings.

METHODS

IRB approval was not required for this review as it is based on secondary literature. This study was conducted using established methods for systematic economic reviews developed by CDC and approved by the CPSTF.[13] The review coordination team included: subject matter expert from the Division of Cancer Prevention and Control at the Centers for Disease Control and Prevention (CDC); members of the CPSTF; CPSTF liaisons; and experts in systematic economic reviews from the Community Guide Program at CDC.

For the economic review, the effectiveness review search terms were supplemented with economic search terms for papers published from database inception to December 2022. Studies were also collected from those identified by the effectiveness review, informal searches, and suggestions from the coordination team. Databases for this review included Medline, Embase, PsycINFO, Cochrane, Sociological Abstracts, CINAHL, and Scopus. The detailed search strategy within the supporting materials available from the Community Guide website[14] is reported in the Appendix.

The intervention components and associated economic outcomes are presented in the analytic framework (Figure 1) that postulates the pathway leading from the effectiveness of patient navigation services to the associated economic outcomes. The interventions improve patient knowledge, attitude, and skills about screening and resources available to them, leading to increased screening uptake. Early detection and follow-up treatment reduce cancer incidence and cancer-related morbidity and mortality. Implementing patient navigation services requires labor and other resources, of which the navigator wages and benefits constitute the main driver of magnitude. Cost per additional person screened captures the incremental cost of each additional screening resulting from the intervention. Besides treatment cost savings due to earlier detection of cancer net of additional screening and diagnosis costs, intervention benefits include increase in productivity. For cervical cancer, there is also a possibility of averted treatment costs through prevention of cancer. The framework conceptualizes summary economic outcomes as cost-effectiveness and cost-benefit. Cost-effectiveness is intervention cost net of averted healthcare cost per quality-adjusted life year gained or disability-adjusted life year averted. Cost-benefit is the difference between benefits and cost or the benefits-to-cost ratio.

Studies were included if they evaluated patient navigation services to increase screenings for breast and cervical cancer; included historically disadvantaged racial and ethnic populations and people with lower incomes; reported at least one economic outcome related to cost, economic benefit, cost-benefit, or cost-effectiveness; compared interventions with usual or alternate care groups; reported recent or repeat screening using tests recommended by UPSTF;[2,3] were conducted in a World Bank-designated high-income country;[15] and published in English. Studies were excluded if they were conducted without any healthcare system involvement; focused on patients with previously diagnosed cancer; or were conference proceedings.

Two review team members independently screened search results and abstracted the qualifying studies.

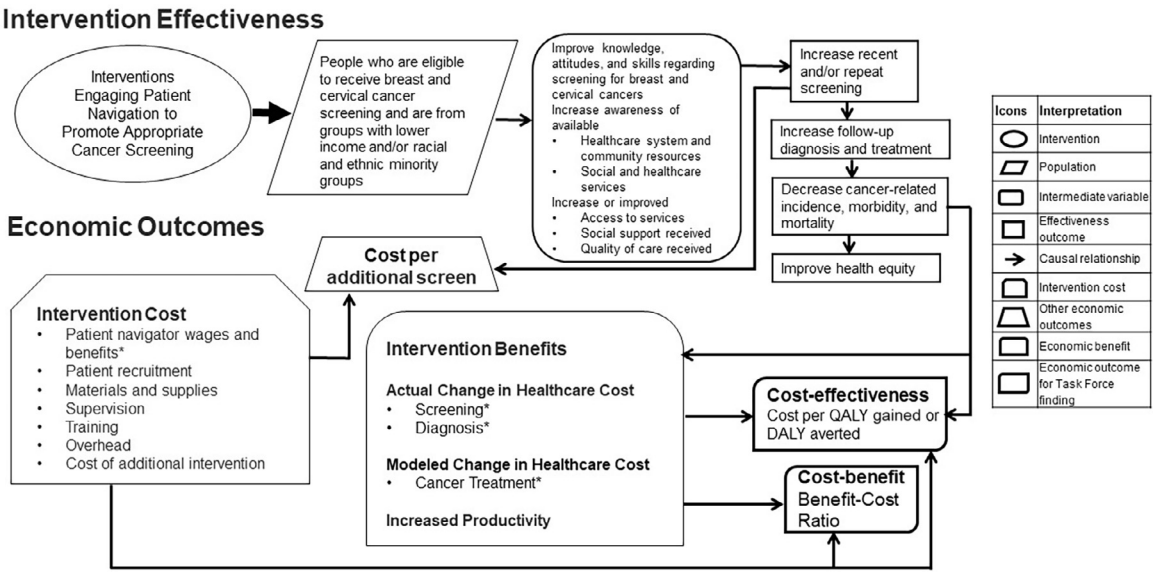

Figure 1. Analytic framework. *Components that are drivers of magnitude for cost or benefit estimates.
DALY, disability-adjusted life year; QALY, quality-adjusted life year.

Unresolved differences were brought to the full review team to reach a majority consensus. To standardize the data, all estimates were expressed in per person terms, and monetary values were converted to 2022 U.S. dollars using the Consumer Price Index.[16] The CPSTF economic finding required evidence for cost-benefit or cost-effectiveness. Quality of economic estimates was assessed based on capture of drivers of costs and benefits and the quality of their measurement methods.[13] Patient navigator wages and benefits constituted the driver of program cost while drivers of changes in healthcare cost were captured through immediate changes in screening and diagnostic costs and modeled cancer treatment costs. Quality of measurement methods for program costs was assessed along 4 dimensions: intervention group size used in trials or simulation studies; whether costs were based on modeled or program records; appropriate duration of intervention (≥ 6 months), and appropriate valuation and unit prices. Intervention cost estimates were assigned a good, fair, and limited quality rating if the number of limitations was ≤2, 3, and 4, respectively. Quality of measurement methods for healthcare cost and QALY was assessed along 14 dimensions, including simulation size of participants, patient age aligned with USPSTF screening recommendations, randomization, appropriate valuation, appropriate comparison, pre to post measures, outcomes modeled from screening findings, parameters, appropriate standard model, appropriate utility or disability weights, appropriate input sources for models, discounting of future costs and benefits, sensitivity, and statistical methods. A good, fair, or limited quality rating was assigned based on <5, 5–9, and ≥10 limitations, respectively. Two raters used the tool to independently assign and later reconcile quality points related to intervention cost, healthcare cost, QALY, and net cost per QALY gained. The final quality score for an estimate was the lower of the quality scores for capture and measurement. Estimates that received a limited quality score were removed from further consideration.

RESULTS

The search strategy identified 4,304 studies from a broad search of all potentially relevant studies from electronic databases, of which 198 underwent title and abstract screens. An additional 43 studies were identified from informal searches and previous Community Guide systematic review on the effectiveness of patient navigation services (Figure 2). Overall, 7 economic studies of patient navigation met the inclusion criteria, with 3 studies reporting breast cancer screening,[17–19] 2 reporting cervical cancer screening,[20,21] and 2 reporting multiple cancer screenings including breast and cervical cancer screenings.[22,23] The main reasons for exclusion during full-text screening were: did not meeting intervention definition; did not meet study population requirements; were not conducted in a high-income country; did not include economic outcomes; or were duplicate studies.

The results from the 2 multiple cancer screening studies are not summarized with those from the breast and cervical cancer screening studies but are discussed separately for their economic outcomes.

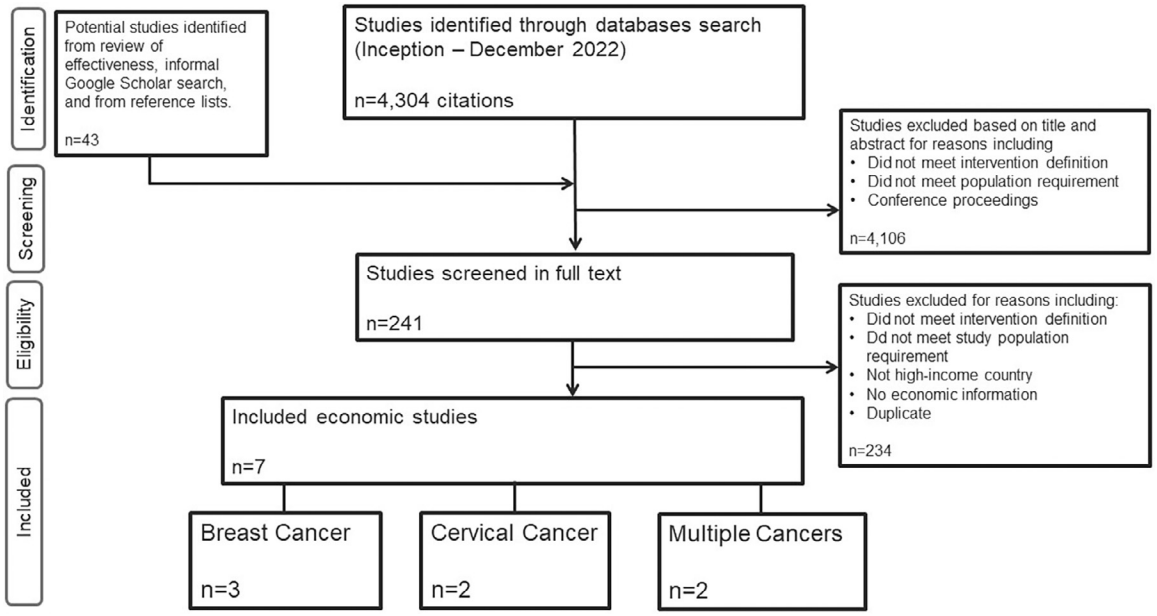

Figure 2. Search yield. Multiple Cancers, studies where patient navigation facilitated screening for breast, cervical, colorectal, and other cancers.

Characteristics of studies on breast and cervical screenings are displayed in Table 1. All studies were conducted in the U.S. and were distributed in the following regions: Northeast,[19] South,[18,20] West,[21] and nationwide.[17] Study designs included randomized control trials[19,21] and microsimulation modeling.[17,18,20] The study populations included age-appropriate women who were not up to date with their breast or cervical cancer screenings. The majority of studies focused on underinsured or uninsured women,[17,18,20,21] and 3 studies were exclusively on Hispanic women.[18,20,21] Studies were conducted in health systems[17,18,20] or primary care clinics.[19,21] Review findings were considered applicable across these settings. Patient navigation services were delivered face-to-face,[18,21] remotely,[20] or both.[19] One study[17] did not report methods of navigation service delivery. Screening rates increased when services were delivered either face-to-face or remotely.

All studies reported intervention costs. Most reported cost per QALY gained.[17-20] For both breast and cervical cancer, the most common intervention activities implemented to increase screening rates consisted of reducing structural barriers by reducing administrative barriers,[17,19] assisting with appointment scheduling,[19,21] reducing out-of-pocket costs,[18,20] providing transportation assistance,[17,19] and offering one-on-one[17,19-21] or group education.[18]

All estimates from the included studies were rated as good quality. All studies captured the drivers of intervention cost and changes in healthcare cost. A few studies had some limitations in measurement methods based on the count of shortfalls, but all estimates were still rated as good quality (Table 2).

Economic outcomes are summarized in Table 2. For breast cancer screening, 3 studies reported intervention costs per person of $109,[19] $3,251,[18] and $10,245,[17] respectively. There were large cost differences across studies because each study considered different costs as part of the patient navigation services. The study with the lowest cost only included the personnel cost for six community health educators and a small expenditure for mailing, transportation, and nonmonetary incentives.[19] The study with the highest cost evaluated the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) and included screening, diagnostic, and treatment costs.[17] The lowest and highest cost programs reported a patient navigation cost per person of $100[19] and $147,[17] respectively. Two studies reported the incremental cost per additional person screened to be $154[18] and $740.[19] Two studies reported that changes in healthcare costs per person were $202[17] and $2,437.[19]

Two breast cancer studies that used microsimulation models calculated cost per QALY gained of $3,852[18] and $39,159[17] with lifetime horizons (Table 2). The third study used results from their program evaluation to provide cost per life year gained.[19] Based on diagnostic follow-up tests of 3.4% for all abnormal screening results, a cancer detection rate of 0.8%, and a mortality reduction of 25% through the prevention of terminal cancer, the intervention led to a cost per life year gained (LYG) of

Table 1. Intervention and Patient Characteristics and Economic Outcomes

Study Type of cancer type of screening Study design	Location	Patient navigator type Setting Interaction with patients	Patient navigation activities	Population of focus Sample size Intervention (Control)	Economic outcomes
Allaire 2019[17] Breast Mammogram Modeled	National, USA	Non-clinical Health System NR	Reduce structural barriers by reducing administration barriers, assisting with transportation and translation services, one-on-one or group education	Uninsured/ underinsured women of all races aged 40-64 years with annual income ≤ 250% of federal poverty level income 2 million women randomly drawn from NBCCEDP (NA)	Intervention cost, Cost per QALY gained
Li 2019[18] Breast Mammogram Modeled	San Antonio, Texas, USA	Lay Patient Navigator University Health System Face-to-face	Reduce structural barriers through a set of unspecified activities, reducing out of pocket cost, mass media campaign, group education	Uninsured Hispanic women, 40 years and older, enrolled in financial assistance program for people without insurance 2,100 women (NA)	Intervention cost, Cost per QALY gained
Weber 1997[19] Breast Mammogram RCT	Rochester, New York, USA	Lay Health Educator Primary Care Clinics Remote and Face-to-face	Reduce structural barriers by reducing administrative barriers, assisting with appointment scheduling, transportation, and childcare, client reminder, one-on-one education	Women aged 52 to 77 years in primary care clinics that serve diverse, socioeconomically disadvantaged patient populations 163 (190) women	Intervention cost, Healthcare cost, Cost per LY gained
Li 2017[20] Cervical Pap Smear Modeled	San Antonio, Texas, USA	Patient Navigator University Health System Remote	Reduce structural barriers through a set of unspecified activities, reducing out of pocket cost, mass media campaign, one-on-one education	Uninsured Hispanic women, 18 years and older, enrolled in financial assistance program for people without insurance 4,500 women (NA)	Intervention cost, Cost per QALY gained
Thompson 2017[21] Cervical Pap Smear RCT	Yakima Valley, Washington, USA	Promotora Primary Care Clinic Face-to-face	Reduce structural barriers by assisting with appointment scheduling, one-on-one education, small media	Rural, predominantly uninsured (75%) Hispanic women, aged 21 to 64 years 146 (147) women	Intervention cost

RCT: Randomized Control Trial; NR, not reported; NA, not applicable; NBCCEDP, National Breast and Cervical Cancer Early Detection Program; QALY, quality-adjusted life year; LY, life year.

$22,889. A LYG can be converted to QALY after multiplication by the health utility score associated with a disease. A recent meta-regression analysis estimated utility scores from patients' responses for early and late-stage breast cancers using different utility assessment methods and found these were all above 0.5.[24] Assuming a worst-case scenario where health utility per LYG was 0.5 or less, $22,889 per LYG would translate to ≤ $45,778 per QALY gained. Thus, for breast cancer screening, all 3 estimates of cost per QALY gained fell below the conservative cost-effectiveness threshold of $50,000.[25]

Two studies evaluating patient navigation services to increase cervical cancer screening reported intervention costs per person of $103 and $794, and costs per additional person screened of $533[21] and $56,[20] respectively. The studies did not report patient navigation costs nor estimates of change in healthcare cost per person separately.

Table 2. Intervention Cost, Change in Healthcare Cost, Cost-effectiveness

Study Type of cancer and screening	Intervention cost per patient (quality)	Intervention cost components[a] (quality)	Intervention cost per additional patient screened (quality)	Patient navigation cost per patient (quality)	Change in healthcare cost per patient per year (quality)	Healthcare cost components[a]	Cost per QALY gained time horizon (quality)
Allaire 2019[17] Breast (Mammogram)	$10,245 (Good)	PN, Sc, Dx, Tr	NR	$147 (Good)	$202 (Good)	Sc, Dx, Tr	$39,159 Lifetime (Good)
Li 2019[18] Breast (Mammogram)	$3,251 (Good)	PN, Sc	$154 (Good)	NR	NR	NA	$3,852 (Good)
Weber 1997[19] Breast (Mammogram)	$109 (Good)	PN	$740 (Good)	$100 (Good)	$2,437 (Good)	Sc, Dx, averted terminal cancer cases	$22,889 per LY gained translated to cost per QALY of ≤ $45,778 Lifetime (Good)
Li 2017[20] Cervical (Pap Smear)	$794 (Good)	PN, Sc	$56 (Good)	NR	NR	NA	$924 Lifetime (Good)
Thompson 2017[21] Cervical (Pap Smear)	$103 (Good)	PN	$533 (Good)	NR	NR	NA	NR

[a]PN, patient navigation; Sc, screening; Dx, diagnostic resolution; Tr, treatment; NR, not reported; NA, not applicable.

One of the cervical cancer screening studies reported a cost per QALY of $924.[20] The remaining cervical cancer study did not report information about cost-effectiveness.

For the 2 studies on multiple cancer screenings, one focused on breast, cervical, and colorectal cancer screenings for a call center-based patient navigator program in 2 Texas cities.[22] Ninety percent of program participants for this study were women, 41% were Hispanics, and 77% had household income lower than $20,000. The other study[23] looked at 6 sites across different regions in the U.S. that implemented patient navigation services to increase breast, cervical, colorectal, lung, and prostate cancer screenings for Medicare beneficiaries. The percentage of female participants in the sites ranged from 52% to 73%. Two sites focused on African American populations, 2 on Hispanics, and one each on Native Americans and Asian and Pacific Islander populations, respectively. The percentage of population in the 65–74 years age group ranged from 44% to 65% across the 6 sites in this study. The Lairson et al.[22] study showed an intervention cost of $355 per person. The intervention cost per additional person screened was not reported by the authors. For the Mitchell 2012 study,[23] median intervention cost per person, patient navigation cost per person, and change in healthcare cost per person across the 6 sites were approximately $5,000, $590, and $35 respectively. The cost of each individual cancer screening cannot be isolated from the overall cost of multiple cancer screenings that were reported in the 2 studies. Additionally, these studies do not present any evidence on cost-effectiveness of integrated cancer screening delivery.

DISCUSSION

Based on this systematic economic review, patient navigation services increased breast and cervical cancer screenings, but also increased costs. For breast cancer screening, the intervention was found to be cost-effective as the estimated costs per QALY gained from 3 good quality studies fell below the conservative threshold ($50,000). However, the cost-effectiveness of cervical cancer screening could not be determined based on evidence from a single study.

Though integrated models for implementing cancer screening could offer cost-effective approaches to reduce healthcare disparities,[26] currently there are no studies to demonstrate cost-effectiveness of delivering multiple cancer screenings. Combining delivery of multiple cancer screenings can offer both a patient-centered approach by allowing screenings for multiple cancers during a single visit that can reduce the total number of visits and time spent associated with separate visits for different cancer screenings and by providing synergies and efficiencies to enable resource-constrained health systems to sustain evidence-based interventions.[26]

Evidence from the systematic review of effectiveness suggests that patient navigation services adjusted to fit local needs and resources can increase cancer screenings among people from historically disadvantaged racial or ethnic groups and people with lower incomes.[12] Considerations for implementation and other details on the effectiveness review of patient navigation services are available on the Community Guide website.[12] The evidence in this economic review indicates that programs with different intervention characteristics implemented in different settings will be cost-effective for breast cancer screening.

Patient navigation services examined in this review were delivered by a wide array of deliverers, including community health workers, trained lay patient or professional navigators, nurses, case managers, or clinic staff. Studies suggested delivery could be enhanced when deliverers had local knowledge, provided language-appropriate and culturally competent services, had flexible working hours to better fit patients' schedules, and worked closely with healthcare providers.

The cancer care continuum begins with prevention and appropriate screening and extends through follow-up diagnostic testing and treatment as appropriate.[27] Patient navigation services that increase screenings can be provided at every stage on the continuum to guide patients through the healthcare system and reduce cancer mortality, and in some cases, incidence. This can allow healthcare systems to better reach historically underserved populations to avoid costly treatment of late-stage cancer with timely follow-up treatment and advance health equity by reducing breast and cervical cancer screening disparities.

Limitations

One limitation of this systematic review was the heterogeneity in what was included in costs and benefits reported in the included papers. Also, the economic results from one study on breast cancer screening[19] were rather dated compared to those based on more recent papers.

For cervical cancer screening, included studies recruited participants with a median age of 59.5 years. Since USPSTF recommends women start cervical cancer screening at age 21,[3] there is a need for future research on economic evaluations of cervical cancer screening for younger women.

The studies have limited information in several other areas that can be evaluated in future research. This

includes the effectiveness and cost-effectiveness of patient navigation services to increase repeat screenings and the proportion of patients with positive screening tests who receive follow-up diagnostic tests. In addition, more studies are required to determine the precise economic impact of patient navigation services within comprehensive health promotion interventions, and the specific activities within a set of all activities that are pivotal to the economic justification for the patient navigation program.

CONCLUSIONS

The systematic economic review finds patient navigation services to increase breast cancer screening are cost-effective. However, there is insufficient evidence to determine cost-effectiveness of cervical cancer screening. More studies should assess the economic outcomes of patient navigation services to increase cervical cancer screenings.

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CREDIT AUTHOR STATEMENT

Sajal K. Chattopadhyay: Conceptualization, Formal analysis, Methodology, Supervision, Validation, Visualization, Writing — original draft, Writing — review & editing. Akash Pillai: Formal analysis, Investigation, Writing — original draft. Jeffrey Reynolds: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing — review & editing. Verughese Jacob: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing — review & editing. Donatus Ekwueme: Methodology, Validation, Writing — review & editing. Yinan Peng: Methodology, Validation, Writing — review & editing. Alison E. Cuellar: Conceptualization, Methodology, Supervision, Writing — review & editing.

SUPPLEMENTAL MATERIAL

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