American Journal of
Preventive Medicine

GUIDE TO COMMUNITY PREVENTIVE SERVICES

Engaging Community Health Workers to Increase Cancer Screening: A Community Guide Systematic Economic Review

Sharon Attipoe-Dorcoo, PhD, MPH,[1] Sajal K. Chattopadhyay, PhD,[1] Jacob Verughese, PhD,[1] Donatus U. Ekwueme, PhD, MS,[2] Susan A. Sabatino, MD, MPH,[2] Yinan Peng, PhD, MPH[1], the Community Preventive Services Task Force

Context: The Community Preventive Services Task Force recommends engaging community health workers to increase breast, cervical, and colorectal cancer screenings on the basis of strong evidence of effectiveness. This systematic review examines the economic evidence of these interventions.

Evidence acquisition: A systematic literature search was performed with a search period through April 2019 to identify relevant economic evaluation studies. All monetary values were adjusted to 2018 U.S. dollars, and the analysis was completed in 2019.

Evidence synthesis: A total of 19 studies were included in the final analysis with 3 on breast cancer, 5 on cervical cancer, 9 on colorectal cancer, and 2 that combined costs for breast and cervical cancers and for breast, cervical, and colorectal cancers. For cervical cancer screening, 2 U.S. studies reported incremental cost per quality-adjusted life year saved of $762 and $34,405. For colorectal cancer screening, 2 U.S. studies reported both a negative incremental cost and an increase in quality-adjusted life years saved with colonoscopy screening.

Conclusions: Engaging community health workers to increase cervical and colorectal cancer screenings is cost effective on the basis of estimated incremental cost-effectiveness ratios that were less than the conservative $50,000 per quality-adjusted life year threshold. In addition, quality-adjusted life years saved from colorectal screening with colonoscopy were associated with net healthcare cost savings.

Am J Prev Med 2021;60(4):e189–e197. Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine.

CONTEXT

In 2015, the rates of recent cancer screening in the U.S. were lower (71.5%, 83.0%, and 62.4%, respectively) than the *Healthy People 2020* targets (81.1%, 93.0%, and 70.5%) for breast, cervical, and colorectal cancers.[1] For the hard-to-reach populations, engaging patient navigators and community health workers (CHWs) is often recommended to increase cancer screening rates.[2] CHWs are trained frontline health workers who serve as a bridge between communities and healthcare systems.[3] They are from or have a close understanding of the communities they serve. They often receive on-the-job training and work without professional titles. They may be hired or recruited as volunteers to act in this role. CHWs may work alone or can be added as part of a team that includes healthcare professionals. In 2019, the Community Preventive Services

From the [1]Community Guide Office, Office of the Associate Director for Policy and Strategy, Centers for Disease Control and Prevention, Atlanta, Georgia; and [2]Division of Cancer Prevention and Control, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

Address correspondence to: Sajal K. Chattopadhyay, PhD, Centers for Disease Control and Prevention, 1600 Clifton Road, Northeast, MS V25-5, Atlanta GA 30329. E-mail: skc9@cdc.gov.

/$36.00
https://doi.org/10.1016/j.amepre.2020.08.011

Task Force (CPSTF), an independent, nonfederal, panel of population health experts, recommended interventions engaging CHWs to increase screening for breast (mammography), cervical (Pap test), and colorectal cancers (fecal occult blood test or colonoscopy) on the basis of strong evidence of their effectiveness.[3] CHW engagement in interventions to increase breast, cervical, or colorectal cancer screenings involves implementing ≥1 intervention components within 2 strategies reviewed by the CPSTF: (1) increase demand for screening services using group education, 1-on-1 education, client reminders, or small media and (2) improve access to screening services by reducing structural barriers. The intervention components from the review, definitions, and corresponding strategies are outlined in Appendix Table 1 (available online).

A previously published Community Guide systematic review focused on the economics of CHW engagement for cardiovascular disease prevention, type 2 diabetes prevention, and type 2 diabetes management.[4] The purpose of this systematic review is to examine the economic evidence of CHW engagement in interventions to promote cancer screening to inform decision makers about the financial feasibility and economic justification of implementing these interventions in communities. Specifically, the review looks at the following research questions:

1. What are the costs and the economic benefits of engaging CHWs to increase appropriate breast, cervical, and colorectal cancer screenings?
2. How do the costs compare with the economic benefits?
3. What is the incremental cost per additional person screened by engaging CHWs to increase appropriate breast, cervical, and colorectal cancer screenings?
4. What is the incremental cost per quality-adjusted life year (QALY) saved?

EVIDENCE ACQUISITION

The analytic framework that guided the systematic economic review and provided the basis for the economic research questions is provided in Appendix Figure 1 (available online). The analytic framework postulates the pathways leading from the interventions engaging CHWs to promote cancer screening to initial and downstream economic outcomes. The economic outcomes are the costs of the interventions, economic benefits, other economic outcomes, cost effectiveness, and cost benefit.

Literature Search

The economic literature search was performed as a 2-step process: the first step comprised screening the search from the effectiveness review and the second step was a focused search on economic evaluations of these interventions. The databases used for the search from the inception of the database through April 2019 were PubMed, MEDLINE, Embase, CINAHL, PsycINFO, Cochrane Library, and EconLit. The search strategy is provided in Appendix Table 2 (available online).

Inclusion Criteria

Studies were included in the review if they met the intervention definition (CHW intervention to increase the demand for or improve access to appropriate screening for breast, cervical, and colorectal cancers); were written in English; were conducted in a high-income economy (identified by the World Bank); evaluated the screening outcomes recommended by the U.S. Preventive Services Task Force for recent and repeat screenings for breast, cervical, and colorectal cancers[5]; and contained any information on costs, economic benefits, cost benefit, or cost effectiveness. The Community Guide reviews focus on high-income countries only because of their better comparability in economic and epidemiologic terms.

Methods (Economic Measures and Analysis)

This study was conducted using established methods for systematic economic reviews approved by the CPSTF.[6] Study characteristics including population, intervention, comparison, outcome, study design, and length of follow-up period were checked using PRISMA.[7] The systematic review focused on studies that reported cost, economic benefit, cost–benefit, or cost-effectiveness estimates. The intervention cost provides program planners with an estimate of the cost of implementing interventions. Intervention cost includes materials used in the intervention, personnel wages and benefits, overhead used to deliver screening services, and other consumables. The cost was converted to per-capita cost by dividing the total intervention cost by the number of people to standardize the cost estimates among studies. The economic benefit is the monetized benefit of the intervention. The cost–benefit estimate compares the monetized benefit of the intervention with the cost. The cost-effectiveness estimate represents the economic merit of an intervention compared with an alternative approach of care in terms of cost per unit of a health measure. Commonly, it is represented as the incremental cost-effectiveness ratio (ICER) calculated as

$$\frac{\Delta\text{Cost}}{\Delta\text{Effectiveness}} = \frac{\text{Cost of Intervention} - \text{Cost of Comparator}}{\text{Effectiveness in Intervention Arm} - \text{Effectiveness in Comparator}}.$$

In calculating the cost effectiveness of any intervention, there are usually several outcome measures, which include intermediate- and final- or long-term outcomes. In this review, the intermediate outcome in physical units is measured as the change in screening, and the corresponding ICER is expressed as

$$\frac{\text{Cost of Intervention} - \text{Cost of Comparator}}{\text{screened in Intervention Arm} - \text{screened in Comparator}}.$$

Although cases prevented or cancer deaths averted could be used as long-term outcomes, QALY saved is the most common measure in cost-effectiveness analysis[8] with a final outcome, where ICER is expressed as

$$\frac{\text{Cost of Intervention} - \text{Cost of Comparator}}{\text{QALY saved in Intervention Arm} - \text{QALY saved in Comparator}}.$$

The QALY is the product of life expectancy (number of years lived) and utility (health-related quality of life).[8] This estimate goes beyond additional screening and captures both the morbidity and mortality associated with screening,[8] and a conventional conservative threshold (ICER ≤$50,000 per QALY) is used to rate this estimate. Medians, along with interquartile interval (IQI) values, are used to report a summary of these estimates instead of the means that are affected by the skewness of data. The analysis was completed in 2019.

Quality of Estimates

Wages of the CHWs and their supervision and training costs constitute the drivers of the intervention costs. Similarly, the drivers of monetized benefits include averted healthcare costs resulting from reduced inpatient, outpatient, and emergency room visits as well as costs of medications, surgeries, and radiation therapies. The quality of the economic estimates is assessed on the basis of how well cost and benefit drivers are accounted for in the estimate. In addition, the appropriateness of the methods and techniques—such as the time horizon, perspective of the analysis, the population in consideration, valuation method, modeled outcomes, and the intervention effect—are assessed. Studies are assigned a good, fair, or limited quality rating on the basis of how well their reported estimates capture cost and benefit drivers and the appropriateness of methods. The final quality assignment is the lower of the 2 assigned qualities. Full-text studies that are considered limited from the assessment of the quality of the estimates are excluded from the body of evidence.

Currency Conversion and Adjustments

For non-U.S. studies, estimates denominated in foreign currencies were converted to U.S. dollars using the Purchasing Power Parity Index from the World Bank.[9] All dollar values were adjusted for inflation to 2018 U.S. dollars using the Consumer Price Index.[10] For inflation adjustment, the starting year, if not specified, was assumed to be 1 year before the publication date.

EVIDENCE SYNTHESIS

Literature Search Yield

Figure 1 summarizes the search process. The economic literature search identified 48,946 articles. The body of evidence included 21 studies[11–29] distributed as 5 studies[11–15] for breast cancer, 5 studies for cervical cancer,[11,16–19] and 9 studies[11,20–27] for colorectal cancer. A total of 2 studies had cost analyses for multiple cancers: a study for both breast and cervical cancers,[28] and another for breast, cervical, and colorectal cancers.[29] After a

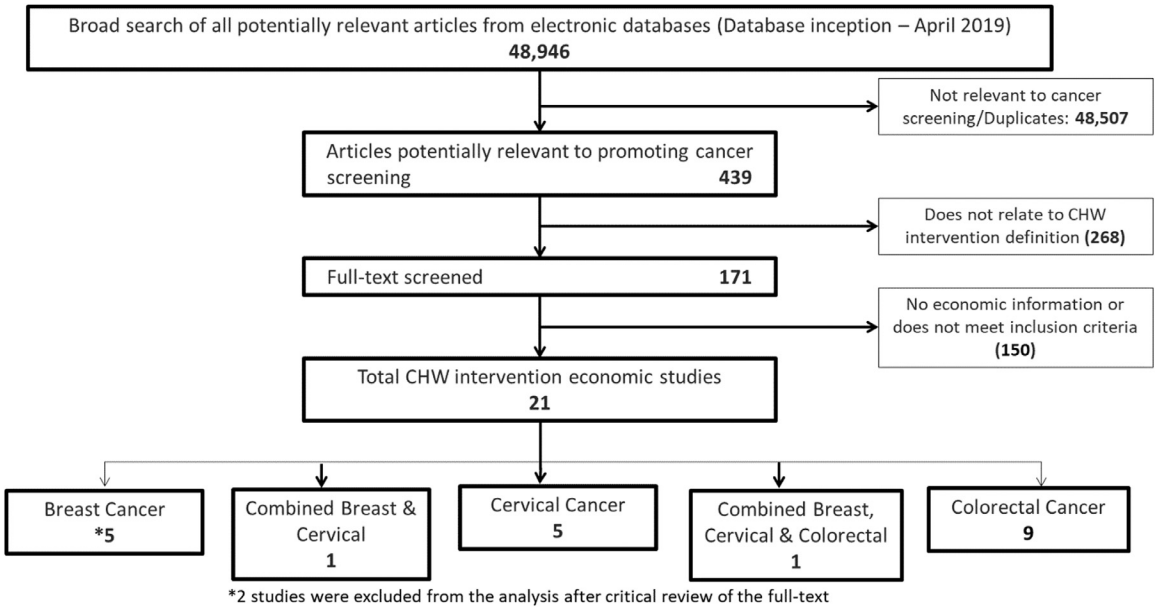

Figure 1. Economic literature search results.
CHW, community health worker.

critical review of the full-text studies, 2 studies were excluded from the economic review (1 reported the combined cost for intervention and control groups,[13] and the other used a modeling assumption of a high [76%] baseline screening rate for breast cancer screening[12]). A total of 19 studies were included in the analysis.

Study Characteristics

Of the 19 studies included in the analysis, 15 studies[14–24,26–29] were conducted in the U.S., and 4 studies[11,25] were conducted in the United Kingdom (UK) and France. The international studies described national[11] or regional[25] screening programs where service delivery and reimbursement mechanisms of CHWs were different from those in the U.S. Most included cost-effectiveness analyses with intermediate or final outcomes,[11,14–19,23–25,27] whereas some reported only cost estimates.[21,22,26,28,29] Only 1 study reported cost–benefit estimates.[20]

Breast cancer screenings were done through mammography, and cervical cancer by Pap test. For colorectal cancer, identified studies focused on increasing screening through a fecal occult blood test,[25] colonoscopy,[20–23,27] and a combination of colonoscopy for high-risk patients and fecal immunochemical test for average-risk patients.[24,26] Across all the 3 cancers, the intervention strategies utilized were either a combination of increasing both community demand and access[14,19–21,23,24,26,27] or increasing community demand only.[11,15–18,22,25,28,29] The majority of studies across all the 3 cancers had CHWs working on a team.[15,17,20–24,26,27] Across all the studies, the most common intervention component used to increase demand was 1-on-1 education. The most common component to increase access was reducing structural barriers by appointment scheduling assistance.[14,19–21,23,24,26,27]

Intervention Cost

Breast cancer. The median intervention cost per person was $58 (IQI=$22–$373) across all U.S. studies[14,15] and $1,578 (IQI=$1,245–$1,969) for the UK study, which reported costs of CHWs within 3 different salary grades as well as 3 different increases in screening rates.[11] The roles of the CHWs in the UK studies included providing services that would be more costly if a general practitioner performed these activities instead.

Cervical cancer. The median intervention cost per person was $177 (IQI=$142, $237) across all U.S. studies[14–19] and $738 (IQI=$589, $1,071) for the UK study, which reported costs of CHWs within 3 different salary grades as well as 3 different increases in screening rates.[11] The roles of the CHWs in the UK study included providing services that would be more expensive if a general practitioner performed these activities instead.

Colorectal cancer. The median intervention cost per person was $90 (IQI=$66–$564) across all U.S. studies[20–24,26,27] and $1,150 (IQI=$776–$1,693) for the UK and France studies.[11,25] In addition to cancer screenings, in the UK study, the CHWs played a role in managing other chronic conditions.

Multiple cancers. The median intervention cost per person for the intervention that combined breast and cervical screenings was $113 for the arm in which the intervention was delivered in a group and $430 for the arm in which the intervention was delivered to individuals.[29] The median intervention cost per person for the intervention that combined breast, cervical, and colorectal cancer screenings was $53.[28] Both studies of multiple cancers were conducted in the U.S. Although this median cost for the combined intervention was lower than that of any single screening intervention, the limited number of studies makes it difficult to make a conclusion about economies of scope—the case when the cost of joint delivery of all the 3 cancer screenings is less than the sum of the costs of individual screening interventions.

Incremental Cost-Effectiveness Ratio With Intermediate Outcome

Breast cancer. The median incremental cost per additional woman screened was $215 in the U.S. study, which reported costs of CHWs within 3 different salary grades,[14] and $7,891 (IQI=$4,150–$22,819) in the UK study, which reported costs of CHWs within 3 different salary grades as well as 3 different increases in screening rates.[11] The intervention strategy and components were increased demand with 1-on-1 education,[11] increased demand with 1-on-1 or group education, and increased access through the reduction of structural barriers with appointment scheduling, and provision of transportation and translation services.[14]

Cervical cancer. The median incremental cost per additional woman screened was $868 (IQI=$642–$1,132) in the U.S. studies[16,19] and $3,824 (IQI=$2,011–$11,057) in the UK study, which reported costs of CHWs within 3 different salary grades as well as 3 different increases in screening rates.[11] The intervention strategy and components included increased demand with 1-on-1 education[11,16] as well as a combination of increased access and demand with 1-on-1 education, client reminders, and reducing structural barriers.[19]

Colorectal cancer. The median incremental cost per additional person screened was $117 (IQI=$111–$128) in a U.S. study that provided the intervention in individual or group sessions using 3 intervention modalities (flipchart, video, and combination of flipchart and video)[23] and $5,752 (IQI=$2,930–$16,931) in the UK and France studies.[11,25] Intervention strategy and components were a combined increased demand and access with 1-on-1 education, group education, client reminders, reducing out-of-pocket costs, and structural barriers.[24] In addition, there was increased demand with 1-on-1 education alone[11] and combining with client reminders.[25]

Incremental Cost-Effectiveness Ratio With Final Outcome of Incremental Cost per Quality-Adjusted Life Year Saved

Breast cancer. There were no studies that reported incremental cost per QALY.

Cervical cancer. A total of 2 good-quality studies with a societal perspective reported incremental cost per QALY saved: Li et al.[17] and Scoggins et al.[18] Li et al.[17] used a simulated model of a community-based patient navigation program in Texas that targeted Hispanic women aged ≥18 years and reported an ICER of $762 per QALY saved. The study by Scoggins et al.[18] was based on an RCT in Seattle, Washington, which used lay health workers to conduct 1-on-1 education for Vietnamese American women aged 20–79 years and reported an ICER of $34,405 per QALY saved. These ICERs are represented inTable 2 and Figure 2. Both incremental cost per QALY estimates for cervical cancer fell below a conservative threshold of $50,000 per QALY, implying that the interventions were cost effective. These U.S.-based studies adopted a societal perspective with target populations aged ≥18 years, using existing QALY calculation methods from the literature, and the authors conducted sensitivity analyses. For the Li et al.[17] study, the incremental cost was $45.70 and the incremental QALY saved was 0.06 years. For the Scoggins et al.[18] study, the incremental cost was $120.42 and the incremental QALY saved was 0.0035 years. The incremental cost reported in the Scoggins et al.[18] study was 2.6 times that of the Li et al.[17] study, primarily because the intervention involved home visits by lay health workers; however, the incremental QALY saved was 17 times greater for the Li et al.[17] study. The methodologies utilized to compute QALY gains over the lifetime of the patients differed between the 2 studies. Specifically, for the Scoggins et al.[18] study, the QALY for women with cervical cancer was the average health and activity limitation index for genital cancer, whereas for the Li et al.[17] study, the QALY for women with cervical cancer was dependent on the stage of the cancer. The higher incremental cost and lower QALY led to a 45-fold increase in incremental cost per QALY saved estimate for the Scoggins et al.[18] study.

Colorectal cancer. A total of 2 studies reported incremental cost and QALYs saved from colorectal cancer screening with colonoscopy: Ladabaum et al.[27] and Wilson et al.[23] (Table 2 and Figure 2). The Ladabaum et al.[27] study, based on an intervention program in New York that targeted African Americans and Hispanics who were aged ≥50 years, reported a 25-percentage point increase in screening, a negative incremental cost of $144, and a 0.014 increase in QALYs saved.[27] The Wilson et al.[23] study, based on an intervention in Texas that targeted Hispanic men aged ≥50 years, reported a 64-percentage point increase in screening, a negative incremental cost of $1,219, and a 0.3 increase in QALYs saved.[23] Both

Table 1. Intervention Cost per Person and Incremental Cost per Additional Person Screened for CHW Interventions to Increase Breast, Cervical, and Colorectal Cancer Screenings (in 2018 U.S. Dollars)

Intervention cost per person, $, median (IQI)	Country	Incremental cost per additional person screened, $, median (IQI)
Breast cancer, $		
58 (22–373)	U.S.	215
1,578 (1,245–1,969)	UK	7,891 (4,150–22,819)
Cervical cancer, $		
177 (142–237)	U.S.	868 (642–1,132)
738 (589–1,071)	UK	3,824 (2,011–11,057)
Colorectal cancer, $		
90 (66–564)	U.S.	117 (111–128)
1,150 (776–1,693)	UK and France	5,752 (2,930–16,931)

CHW, community health worker; IQI, interquartile interval; UK, United Kingdom.

Table 2. Incremental Cost Per QALY Saved for CHW Interventions to Increase Breast, Cervical, and Colorectal Cancer Screenings (in 2018 U.S. Dollars)

Intervention details	Cervical cancer	Cervical cancer	Colorectal cancer	Colorectal cancer
Study	Li et al. (2017)[17]	Scoggins et al. (2010)[18]	Wilson et al. (2015)[27]	Ladabaum et al. (2015)[23]
Screening test	Pap test	Pap test	Colonoscopy	Colonoscopy
Target population	>18 years Hispanic women in Texas	20–79-year-old Vietnamese American women in Seattle	≥50-year-old Hispanic men in Texas	≥50-year-old African Americans and Hispanics in New York
Perspective	Societal perspective	Societal perspective	Societal perspective	Societal perspective
Comparator	Status quo: no intervention	Control arm: mailed pamphlets	Status quo: no intervention	Status quo: no intervention
Type of intervention strategy and components	Increased demand with OE	Increased demand with OE	Increased demand and access with GE, OE, ROPC, and RSB	Increased demand and access with OE and RSB
Extent of CHW involvement	CHW on a team	CHW alone	CHW on a team	CHW on a team
Modeling	Microsimulation	Markov	Markov	Markov
Incremental cost (Δcost), $	45.70	120.42	1,219	144
Incremental QALY (ΔQALY), years	0.06	0.0035	0.3	0.014
ICER (Δcost)/(ΔQALY)	$762/QALY	$34,405/QALY	Dominant over comparator[a]	Dominant over comparator[a]

[a]Dominance implies that QALYs are higher and net costs are lower for the intervention relative to the comparator.
CHW, community health worker; GE, group education; ICER, incremental cost-effectiveness ratio; OE, 1-on-1 education; QALY, quality-adjusted life year; ROPC, reducing out-of-pocket cost; RSB, reducing structural barrier.

studies had a comparator status quo of no intervention, and both were considered good-quality studies with a societal perspective. The incremental cost savings were 8.5 times higher in the Wilson et al.[23] study than in the Ladabaum et al.[27] study, whereas the incremental QALYs saved was 21 times higher.[23,27] Along with being labeled as cost effective, any estimate on the bottom right of the incremental cost per QALY plane, seen in Figure 2, can be described as cost saving. For each study, the intervention was dominant over the comparator because higher QALYs saved from screening were associated

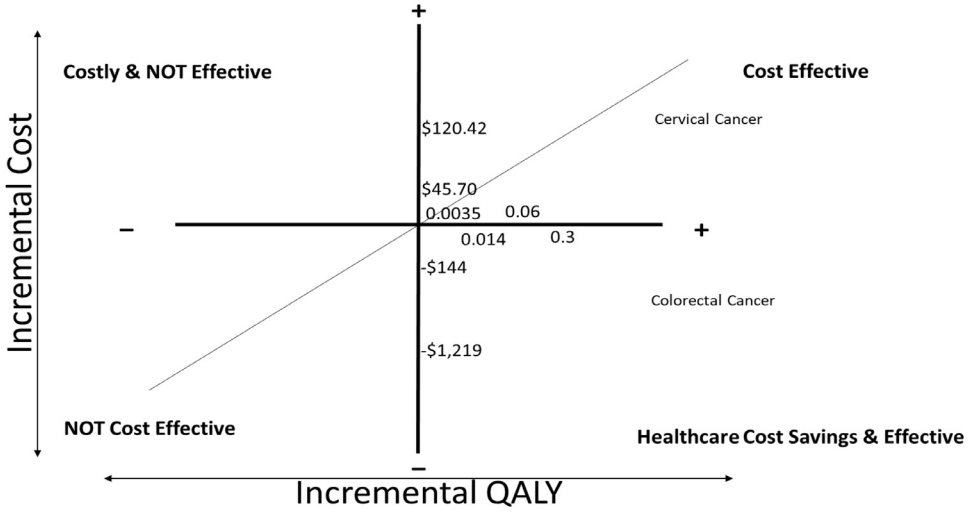

Figure 2. Studies reporting incremental cost and incremental QALYs saved (final outcome).
QALY, quality-adjusted life year.

with treatment cost savings that outweighed the intervention costs. The findings indicate that interventions engaging CHWs in a team to increase colorectal cancer screening are not only cost effective but also generate net cost savings. The authors of both studies also conducted sensitivity analyses. Ladabaum et al.[27] found that for the cost savings to disappear, either the screening increase had to go down from 25 to 10 percentage points or the cost per person had to increase 10 fold. Wilson et al.[23] only considered the cost of screening and found that if the increase in screening rate remained the same, a 2.5-fold increase in cost per person would cause the cost savings to disappear.

Cost Benefit

An intervention to increase colonoscopy screening at 3 urban public hospitals increased demand and access through education and appointment scheduling assistance provided by CHWs. The reported benefit–cost ratios were >1 for 2 of the 3 hospital sites.[20]

DISCUSSION

Summary of Findings

Intervention cost. The median intervention cost per person for engaging CHWs to increase screening in the U.S. was $58 (IQI=$22–$373) for breast cancer, $177 (IQI=$142–$237) for cervical cancer, and $90 (IQI=$66–$564) for colorectal cancer. Although the median intervention cost per person for cervical cancer was greater than that of breast or colorectal cancer, the third quartile value was lower, and the IQI indicated less variation around its median value. For breast cancer screening, interventions mostly engaged CHWs alone to increase demand and access. For cervical cancer screening, interventions engaged CHWs alone or on a team to increase demand and access. Finally, for colorectal cancer screening, CHWs were on a team and increased demand and access. However, there were 3 possible screening tests that could apply: colonoscopy, fecal immunochemical test, or fecal occult blood test.

Incremental cost-effectiveness ratio with intermediate outcome. The median incremental cost per additional person screened in the U.S. was $215 in a single study reporting the costs of CHWs within 3 different salary grades for breast cancer, $868 (IQI=$642–$1,132) for cervical cancer, and $117 (IQI=$111–$128) for colorectal cancer. The study from the UK reported costs of CHWs within 3 different salary grades as well as 3 different increases in screening rates.[11] The CHWs in the UK study were involved in managing different chronic conditions, which included cancer. The national study from France evaluated interventions in which CHWs used 1-on-1 education and client reminders to increase colorectal cancer screening.[25]

Incremental cost-effectiveness ratio with final outcome. There were no studies reporting incremental cost per QALY saved for breast cancer. This might be attributable to a demonstration of reductions in mortality because of increased screening rates of breast cancer at a reasonable cost per life year saved.[12] Therefore, there would be limited studies capturing the cost effectiveness. For cervical cancer screening, both of the studies reported incremental cost per QALY saved from a societal perspective falling below the cost-effectiveness threshold value, implying that the interventions were cost effective.[17,18] Both studies were from the U.S. and targeted underserved populations. This shows that engaging CHWs in targeted cancer screenings is cost effective. The impact of the quality of life benefits of cervical cancer screening is difficult to capture in experimental studies; therefore, both studies utilized economic modeling methods to examine the long-term screening benefits. The Scoggins et al.[18] study constructed a state-transition Markov model with yearly intervals beyond the trial to a lifetime perspective. The Li et al.[17] study used an evidence-based microsimulation model to assess improvements in long-term patient outcomes. These modeling methods were based on actual behavioral observations, incorporating knowledge from previous cancer decision models with input parameters and utility weights from the literature derived from the U.S. population. The authors also performed sensitivity analyses.

Both of the studies on interventions that engaged CHWs to increase colorectal cancer screening by colonoscopy in underserved populations showed that QALYs saved from screening were associated with treatment cost savings that outweighed intervention costs.[23,27] Colonoscopy can be used for screening, diagnosis, and treatment; therefore, its use can lead to the identification and removal of polyps at earlier stages, resulting in higher averted treatment costs.[23] Both studies used models with input parameters and utility weights from the literature derived from the U.S. population and performed sensitivity analyses. The Ladabaum et al.[23] study constructed a state-transition Markov model in which the cohort was followed until 100 years or death. Wilson et al.[27] study constructed a state-transition Markov model in which the cohort was followed for over a 40-year period. The interventions

engaging CHWs in cervical and colorectal cancer screenings are shown to be cost effective in U.S. settings.

Limitations

This economic review included RCTs,[14–16,18,19,21,25,28] quasi-experimental,[24,26] cohort,[22] pre–post,[20,29] and modeled[11,17,23,27] studies. Additional screening owing to the intervention was reported in all but 2 studies,[28,29] and QALY values were reported in the cost-effectiveness analyses.[17,18,23,27] The sample size, comparator, and the length of follow-up were reported consistently. In general, there was a low risk of bias on selection, performance, attrition, detection, and reporting categories.[30] However, the studies varied in the reporting of information summarized in this review, such as the description of intervention activities, participant characteristics, and cost and benefit drivers. Differences in the intervention effectiveness associated with the gender of CHWs and population targeted for screening could not be identified. Most studies only reported incremental cost per additional person screened, which cannot be used for an absolute determination of cost effectiveness owing to the lack of an existing threshold. This creates a challenge in comparing cost-effectiveness estimates on the basis of intermediate outcomes. Some studies only reported incremental costs without enough information required to ascertain the per-capita intervention cost. Another limitation is that modeling studies differed in assumptions, inputs, and parameter values, although sensitivity analyses were performed by study authors to assess the impact of key cost and effectiveness parameters. Sources for the modeling parameters were also derived from the literature.

Evidence Gaps

The lack of studies reporting incremental cost per QALY saved for engaging CHWs to increase breast cancer screening is an evidence gap. In addition, there was a lack of studies conducted in rural settings for breast, cervical, and colorectal cancer screenings. For colorectal cancer screening, there were no cost-effectiveness studies for screening tests other than colonoscopy. Finally, there were limited cost–benefit studies across all the 3 cancers. Studies addressing these gaps will better inform systematic economic reviews to help decision making on engaging CHWs to increase breast, cervical, and colorectal cancer screenings.

CONCLUSIONS

All the 4 cost-effectiveness studies focused on underserved and low-income populations. Overall, along with the finding of effectiveness,[2] interventions engaging CHWs to increase cervical and colorectal cancer screenings among hard-to-reach populations were found to be cost effective. Furthermore, the increase in colorectal cancer screening from these interventions demonstrated net cost savings from averted healthcare costs. CHWs worked either in a team or alone across the breast and cervical cancer screenings studies. However, the colorectal cancer screening studies had CHW involvement in a team. When implementing interventions in low-income, uninsured populations, such as the population eligible in the Centers for Disease Control and Prevention's National Breast and Cervical Cancer Early Detection,[31] it is especially important to understand the clients' needs and barriers. Interventions engaging CHWs can provide educational and navigational support to help overcome these barriers. Engaging CHWs to address the cancer screening needs of underserved populations can be beneficial to healthcare organizations and policymakers who want to reach these populations and avoid future treatment costs associated with later stages of disease. The evidence from this review indicates that engaging CHWs in cancer screening can be cost effective or may even generate net cost savings while simultaneously promoting health equity.

ACKNOWLEDGMENTS

The authors appreciate the helpful comments and suggestions from the 3 anonymous reviewers. The authors also acknowledge Christine So at the Community Guide Office, Centers for Disease Control and Prevention (CDC), and Giridhar Mohan at the National Center for Environmental Health, CDC, for their contributions toward reviewing background literature for this manuscript.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of CDC.

No financial disclosures were reported by the authors of this paper.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2020.08.011.

REFERENCES

1. White A, Thompson TD, White MC, et al. Cancer screening test use - United States, 2015. *MMWR Morb Mortal Wkly Rep.* 2017;66(8):201–206. https://doi.org/10.15585/mmwr.mm6608a1.
2. Roland KB, Milliken EL, Rohan EA, et al. Use of community health workers and patient navigators to improve cancer outcomes among patients served by federally qualified health centers: a systematic literature review. *Health Equity.* 2017;1(1):61–76. https://doi.org/10.1089/heq.2017.0001.

3. Cancer screening: interventions engaging community health workers. Guide to Community Preventive Services. https://www.thecommunityguide.org/topic/cancer. Updated September 30, 2020. Accessed September 3, 2019.
4. Jacob V, Chattopadhyay SK, Hopkins DP, et al. Economics of community health workers for chronic disease: findings from Community Guide Systematic Reviews. *Am J Prev Med.* 2019;56(3):e95–e106. https://doi.org/10.1016/j.amepre.2018.10.009.
5. Cancer screening recommendations. U.S. Preventive Services Task Force. https://www.uspreventiveservicestaskforce.org/uspstf/search_results?searchterm=cancer%20screening. Accessed September 10, 2020.
6. Economic reviews. Guide to Community Preventive Services. https://www.thecommunityguide.org/about/economic-reviews . Accessed December 10, 2019.
7. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol.* 2009;62(10):e1–e34. https://doi.org/10.1016/j.jclinepi.2009.06.006.
8. Whitehead SJ, Ali S. Health outcomes in economic evaluation: the QALY and utilities. *Br Med Bull.* 2010;96(1):5–21. https://doi.org/10.1093/bmb/ldq033.
9. Purchasing power parity index conversion 2019. World Bank. https://data.worldbank.org/indicator/PA.NUS.PPP. Accessed September 3, 2019.
10. U.S. Bureau of Labor Statistics. Consumer Price Index. https://www.bls.gov/cpi/.. Accessed September 3, 2019.
11. Hayhoe B, Cowling TE, Pillutla V, Garg P, Majeed A, Harris M. Integrating a nationally scaled workforce of community health workers in primary care: a modelling study. *J R Soc Med.* 2018;111(12):453–461. https://doi.org/10.1177/0141076818803443.
12. Mandelblatt JS, Schechter CB, Yabroff KR, et al. Benefits and costs of interventions to improve breast cancer outcomes in African American women. *J Clin Oncol.* 2004;22(13):2554–2566. https://doi.org/10.1200/JCO.2004.05.009.
13. Marshall JK, Mbah OM, Ford JG, 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. https://doi.org/10.1007/s11606-015-3484-2.
14. Schuster AL, Frick KD, Huh BY, Kim KB, Kim M, Han HR. Economic evaluation of a community health worker-led health literacy intervention to promote cancer screening among Korean American women. *J Health Care Poor Underserved.* 2015;26(2):431–440. https://doi.org/10.1353/hpu.2015.0050.
15. Stockdale SE, Keeler E, Duan N, Derose KP, Fox SA. Costs and cost-effectiveness-effectiveness of a church-based intervention to promote mammography screening. *Health Serv Res.* 2000;35(5 Pt 1):1037–1057.
16. Lairson DR, Chang YC, Byrd TL, Lee Smith J, Fernandez ME, Wilson KM. Cervical cancer screening with AMIGAS: a cost-effectiveness analysis. *Am J Prev Med.* 2014;46(6):617–623. https://doi.org/10.1016/j.amepre.2014.01.020.
17. Li Y, Carlson E, Villarreal R, Meraz L, Pagán JA. Cost-effectiveness of a patient navigation program to improve cervical cancer screening. *Am J Manag Care.* 2017;23(7):429–434.
18. Scoggins JF, Ramsey SD, Jackson JC, Taylor VM. Cost effectiveness of a program to promote screening for cervical cancer in the Vietnamese-American population. *Asian Pac J Cancer Prev.* 2010;11(3):717–722.
19. Thompson B, Carosso EA, Jhingan E, et al. Results of a randomized controlled trial to increase cervical cancer screening among rural Latinas. *Cancer.* 2017;123(4):666–674. https://doi.org/10.1002/cncr.30399.
20. Elkin EB, Shapiro E, Snow JG, Zauber AG, Krauskopf MS. The economic impact of a patient navigator program to increase screening colonoscopy. *Cancer.* 2012;118(23):5982–5988. https://doi.org/10.1002/cncr.27595.
21. Jandorf L, Stossel LM, Cooperman JL, et al. Cost analysis of a patient navigation system to increase screening colonoscopy adherence among urban minorities. *Cancer.* 2013;119(3):612–620. https://doi.org/10.1002/cncr.27759.
22. Kim KE, Randal F, Johnson M, et al. Economic assessment of patient navigation to colonoscopy-based colorectal cancer screening in the real-world setting at the University of Chicago Medical Center. *Cancer.* 2018;124(21):4137–4144. https://doi.org/10.1002/cncr.31690.
23. Ladabaum U, Mannalithara A, Jandorf L, Itzkowitz SH. Cost-effectiveness of patient navigation to increase adherence with screening colonoscopy among minority individuals. *Cancer.* 2015;121(7):1088–1097. https://doi.org/10.1002/cncr.29162.
24. Lairson DR, Kim J, Byrd T, Salaiz R, Shokar NK. Cost-effectiveness of community interventions for colorectal cancer screening: low-income Hispanic population. *Health Promot Pract.* 2018;19(6):863–872. https://doi.org/10.1177/1524839917750815.
25. De Mil R, Guillaume E, Guittet L, et al. Cost-effectiveness analysis of a navigation program for colorectal cancer screening to reduce social health inequalities: a French cluster randomized controlled trial. *Value Health.* 2018;21(6):685–691. https://doi.org/10.1016/j.jval.2017.09.020.
26. Shokar NK, Byrd T, Lairson DR, et al. Against colorectal cancer in our neighborhoods, a community-based colorectal cancer screening program targeting low-income Hispanics: program development and costs. *Health Promot Pract.* 2015;16(5):656–666. https://doi.org/10.1177/1524839915587265.
27. Wilson FA, Villarreal R, Stimpson JP, Pagán JA. Cost-effectiveness analysis of a colonoscopy screening navigator program designed for Hispanic men. *J Cancer Educ.* 2015;30(2):260–267. https://doi.org/10.1007/s13187-014-0718-7.
28. Meghea CI, Williams KP. Aligning cost assessment with community-based participatory research: the Kin Keeper[SM] intervention. *Health Educ Behav.* 2015;42(2):148–152. https://doi.org/10.1177/1090198114557126.
29. Larkey LK, Herman PM, Roe DJ, et al. A cancer screening intervention for underserved Latina women by lay educators. *J Womens Health (Larchmt).* 2012;21(5):557–566. https://doi.org/10.1089/jwh.2011.3087.
30. Viswanathan M, Ansari MT, Berkman ND, et al. *Assessing the risk of bias of individual studies in systematic reviews of health care interventions*. Agency for Healthcare Research and Quality Methods Guide for Comparative Effectiveness Reviews. Rockville, MD: Agency for Healthcare Research and Quality; 2012. https://effectivehealthcare.ahrq.gov/products/methods-guidance-bias-individual-studies/methods. Published 2012. Accessed July 10, 2020.
31. National Breast and Cervical Cancer Early Detection Program (NBCCEDP). Centers for Disease Control and Prevention. https://www.cdc.gov/cancer/nbccedp/index.htm. Accessed September 5, 2020.