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Improving cervical cancer screening rates: a scoping review of resources and interventions

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Abstract

Introduction—Cervical cancer mortality can be prevented through early detection with screening methods such as Pap and high-risk human papillomavirus (hrHPV) tests; however, only 81% of women aged 21–65 are up-to-date on screening. Many interventions to increase cervical cancer screening have been implemented, but there is limited understanding about which intervention components are most successful.

Methods—We conducted a scoping review of existing literature and available resources for cervical cancer screening interventions to identify gaps in the research. We used t tests and correlations to identify associations among intervention components and effect sizes.

Results—Out of nine studies, the mean overall effect size for interventions was 11.3% increase in Pap testing for cervical cancer screening (range = − 4–24%). Interventions that included community health workers or one-on-one interaction had the biggest effect size ($p < 0.05$). No associations with effect size were noted for literacy level, number of intervention components, or targeting by race/ethnicity.

Conclusions—Future interventions may include educational sessions with community health workers or one-on-one patient interaction to improve cervical cancer screening. Further research is needed to establish effect sizes for large-scale interventions and hrHPV screening interventions.

Keywords

Cervical cancer; Early detection of cancer; Program evaluation; Review; Evidence-based medicine

Introduction

In 2020, an estimated 13,800 women in the United States will be newly diagnosed with cervical cancer, and approximately, 4,300 women will die from the disease [1]. Overall, five-year relative survival is 66.1% [2]; however, five-year relative survival for cervical cancers diagnosed at a localized stage is 91.8%, emphasizing the promise of early detection for minimizing cervical cancer mortality [2]. The cornerstone of early detection of cervical

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cancer is routine screening with the Pap test and/or high-risk human papillomavirus (hrHPV) DNA testing [3]. However, national screening rates for women ages 21 to 65 have been falling since 2000, landing at 81% in 2018 [4]. This rate, while high, remains consistently lower in certain population subgroups, and is lower than the Healthy People 2030 goal of 84.3% [5]. Interventions are needed to ensure timely and consistent access to screening.

Many interventions focused on increasing cervical cancer screening (CCS) have been developed, implemented, and tested in various populations. These interventions vary in study design, target population, and intervention components, rendering them difficult to compare. There is a paucity of understanding regarding which intervention components are most effective for increasing CCS in future interventions. In particular, community organizations interested in participating in CCS promotion efforts may be hard-pressed to identify existing programs and their resources that would be most appropriate and effective.

The goal of this study is to identify which of these interventions are most effective in increasing CCS by analyzing and comparing effect sizes from published program evaluations with publicly available program resources. Additionally, we aim to identify which components of these interventions are associated with greatest effect sizes, to generate evidence about crucial components to include in future interventions. These findings can be used to select and design the best intervention (or intervention components) for a target population with a goal of increasing CCS and reducing cervical cancer incidence and mortality.

Resources and methods

We conducted a scoping review to recapitulate existing research while identifying gaps in evidence-based interventions promoting CCS [6]. The literature was collected by searching Google Scholar, PubMed, and reviewing the websites for American Cancer Society and the National Cancer Institute, without a restriction on the date of publication. An example search term is “Cervical cancer AND screen AND intervention.” We reviewed the citation lists for included studies to identify additional papers for review. We reviewed papers in English that described interventions to increase cervical cancer screening, included self-reported or EHR-verified screening as an outcome. Importantly, we limited the review to interventions that had program resources available for review. These final inclusion criteria were necessary to evaluate resource-specific details, such as resource type, literacy level, and language, which could influence intervention outcomes. Details regarding program resources were not readily available in the overall program evaluation manuscripts, making it necessary to review the materials themselves. Thus, this was a non-exhaustive list of interventions and was limited to studies for which we could access intervention resources.

When assessing each project, we gathered the peer-reviewed journal article along with the associated intervention resources used to encourage CCS. These resources included pamphlets, flyers, implementation manuals, discussion guides, and videos. Many of the projects’ resources were found either among the supplemental information of the journal article or online (e.g., on the senior author’s website). If the resources could not be located, we emailed the first and/or senior author of the manuscript to request a copy of all resources.

Collectively, we gathered nine manuscripts along with their respective resources for CCS promotion projects.

A data abstraction form was created in REDCap (https://www.project-redcap.org/) to document intervention details (e.g., sample size, target population, location), participant demographics (including age, race/ethnicity, etc., targeted by the intervention), characteristics of the CCS resources (e.g., type, literacy level, languages), the theoretical framework for the project design, and CCS outcomes [7]. We determined literacy level using the Flesch-Kincaid grade level calculation [8]. Theoretical framework elements were determined explicitly through text in the manuscript or by the study team's judgment of the ideas expressed in the manuscript. Following a training on the abstraction form, at least two of four study team members (MP, JM, KL, KS) evaluated each project before meeting to review and reconcile findings for a unanimous consensus on all projects.

We utilized the collected data to construct a narrative that summarizes relevant features of the CCS promotion projects. The effects of the interventions were calculated as the absolute percent difference in screening outcomes across different time points. The variation in reporting these effects, however, did not allow us to control for characteristics related to patient population, context, or intervention type. Where applicable, t tests or Pearson's correlation coefficients were calculated to evaluate the relationship between project characteristics and intervention effect sizes for dichotomous and continuous features, respectively. All analyses were performed in SAS version 9.4 (Cary, NC) using a two-sided p value of 0.05 for significance.

Results

A total of nine CCS promotional resources with associated manuscripts were included (Table 1) [9–17].

Study design and participant characteristics

Five projects compared CCS outcomes for one intervention group versus one control group [10, 11, 13, 14, 16]. The remaining four projects used additional comparison groups [9, 12, 15, 17]. All nine projects utilized an educational component in an attempt to increase CCS. Additional strategies utilized throughout the projects included patient navigation or community health workers (CHWs) [11, 13–17], phone calls [16], counseling [13], and systems-level interventions [13]. The reviewed projects used, on average, 2.3 strategies with a range of 1–3. All projects took place in the USA, with one project that had a second intervention location in Canada [15] (Table 1). The projects enrolled participants of various ages with an overall range of 18–65+ and targeted various racial and ethnic backgrounds including Asian [10, 12, 15, 16], African American [9, 13], Native Hawaiian/Pacific Islander [10], and Hispanic [11, 17].

Characteristics of CCS promotional resources

All projects utilized printed resources to promote CCS [9–17], and one project also used audio and video components [17]. All nine projects were available in English [9–17]; two were also available in Spanish [13, 17] and three in other languages (Tagalog, Cantonese, Mandarin, and Vietnamese) [12, 15, 16]. These resources, on average, had a 6.9-grade reading level with a range of 3.4–10.3.

CCS outcomes and interventions effects

Project outcomes differed in length of follow-up, data source, and analytic approach. All nine studies assessed group-level differences in CCS with a Pap test [9–17]; none of the papers assessed changes in CCS by hrHPV testing, which is a relatively new screening option. Across the nine papers, we collected 12 reported effect sizes (including comparisons across multiple arms within a single study).

Blumenthal et al. [9] reported change in pre-/post-intervention CCS by Pap testing over 18 months for participants in two intervention cities versus their comparison cities which received no intervention. The intervention cities received educational sessions, mass media campaigning with local partners, and community events promoting cancer screening. In one intervention city, the post-intervention CCS rate was higher (+ 2.5%, $p < 0.01$) than its paired comparison city. However, in the second intervention city, the post-intervention CCS rate was lower (– 3.7%, p = not significant) than its paired comparison city. Braun et al. [10] reported CCS over 24 months, where the control arm received nutrition education and relevant cancer education resources, while the intervention arm received patient navigation assistance. In the final assessment, CCS was higher in the intervention group than the control group by + 20.6% ($p < 0.01$). Fernandez et al. [11] reported CCS in the intervention compared to control group over 6 months, where the intervention group received in-home visits with CHWs, information about local providers, and a 2-week follow-up from CHWs; the control arm received no intervention (+ 15.9%, $p < 0.01$). Maxwell et al. [12] reported higher CCS testing over 3 months in the intervention group compared to the control group, where the intervention group received a cancer screening education module and a list of local facilities that offered free/low cost Pap testing, and the control group received a physical activity education module (+ 4%, $p = 0.2$).

Paskett et al. [13] reported an increase in CCS over 30 months in an intervention group compared to a control group. The intervention group received community-level and clinic-level interventions including, but not limited to media campaigns, educational sessions, and one-on-one counseling (+ 21.0%, $p < 0.01$). Studts et al. [14] reported higher CCS over 8 months in the intervention group, which received educational sessions and patient navigation, compared to the control group, which received no intervention (+ 7.0%, $p = 0.04$). Taylor et al. [15] reported greater CCS over 6 months in two intervention groups compared to a control group. Compared to the control group, a direct mail intervention had a smaller improvement in CCS rates than a CHW intervention (+ 10.0%, $p = 0.03$ and + 24.0%, $p < 0.01$, respectively). Taylor et al. [16] reported higher CCS over the 6 month follow-up in the intervention group compared to the control group, where the intervention group attended educational sessions led by CHWs and the control group received information and resources on physical activity (+ 10.0%, $p = 0.07$). Finally, Thompson et al. [17] reported higher CCS rates in two intervention groups compared to the usual-care control group over a 7-month follow-up period. The low-intensity intervention arm included an educational video (+ 4.7%, $p = 0.4$), and the high-intensity intervention arm included an educational video and home visit by a healthcare worker (+ 19.4%, $p < 0.01$).

The mean effect size for CCS was + 11.3%, and the median effect size was + 10% (range − 4–24%). Effect sizes were greater for interventions that included CHWs (16.2% versus 6.4%, $t = -2.29$, $p = 0.045$) or one-on-one patient interaction (16.1% versus 3.5%, $t = -3.96$, $p < 0.01$). No other project characteristics were associated with intervention effect sizes.

Discussion

We conducted a scoping review of nine interventions that focused on increasing CCS through Pap testing. We found that interventions with CHWs or one-on-one patient interaction were associated with the greatest effect size for improving CCS. Interventions did not appear to be more effective based on literacy level of educational resources, follow-up duration, number of intervention components, or targeting by race/ethnicity.

CCS promotion intervention characteristics

CHWs are public health advocates that work directly with a group of people serving as liaisons between community, health care systems, and social service systems. CHWs are often members of the community that they serve and are able to impact change in health behaviors in ways that public health practitioners alone cannot [18]. Our review showed that interventions with CHWs or similar one-on-one patient interactions had the greatest effect sizes in increasing CCS. This success may be due to the fact that these interventions are intensive, targeting people who may face the most barriers and are known to not receive routine screening. However, interventions focused on CHWs or patient navigation require high effort and reach a small number of people [19]. Therefore, these intervention strategies may not be disseminable or sustainable on a large scale [19].

The Health Impact Pyramid proposes that interventions that take into account social determinants of health will be more effective and sustainable at a population level [19]. It is therefore important to focus on interventions and program designs that address disparities in social determinants of health affecting the target communities. The interventions reviewed through this scoping review were high intensity with small sample sizes. Future interventions should be designed to address social determinants of health, such as education and other relevant socioeconomic status factors, in an attempt to reduce healthcare burden in target populations. Interventions of this design may allow a larger number of patients to benefit from public health programming and from greater access to cancer prevention services. Focusing on social determinants of health is important because of the observable disparities that exist in cervical cancer burden, particularly for individuals of racial/ethnic minority groups, with low socioeconomic status, and residing in rural areas [20].

We expected effect sizes to vary by literacy level, follow-up duration, number of intervention components, and race/ethnicity of participants. We found that none of these factors were significantly associated with effect size. We anticipated that interventions utilizing lower literacy levels for printed resources would promote higher screening rates for cervical cancer because the resources would be able to reach a wider audience [21]. This was not the case across the included studies. This pattern of results may have emerged because of the strong positive association between CCS effect sizes and use of CHWs; that is, the literacy level of resources in interventions using CHWs may have been less important because another person was available to help participants read and comprehend the resources.

Additionally, we hypothesized that interventions with a longer follow-up duration would increase the likelihood of getting screened. Longer follow-up periods allow more time for the participants to interact with intervention resources/activities, think about how to get screened, and complete the screening. However, we found no evidence for an association between follow-up duration and screening rates. We also predicted that interventions with more components would increase the likelihood of screening for participants. Higher number of intervention components would increase the intervention dose by maximizing the interaction that a participant has with intervention resources. This was not the case, as the number of intervention components was not associated with effect size. It is possible that both follow-up duration and number of intervention components have threshold effects on CCS effect sizes such that, after a certain duration or a certain number of components, adding more (time or components) to the intervention does not meaningfully impact participants’ behavior.

Finally, we hypothesized that designing an intervention for a specific racial/ethnic group would help target the intervention for that group and increase relevance to the target population [22], thereby increasing the screening rates. In this review, 8 out of the 9 interventions were targeted by race/ethnicity, but we did not find difference in effect size according to this variable. However, we did find that intervention design varied based on the targeted race/ethnicity. Studies focused on the African American women leveraged community engagement for their interventions as compared to those focused on Hispanic women, where the focus was on one-on-one interaction in the home of the participant by a CHW [9, 11, 13, 17]. Future research studies should continue to evaluate the effects of literacy level, follow-up duration, number of intervention components, and focus on race/ethnicity on interventions aiming to increase CCS.

Strengths and limitations

A strength of this scoping review is that we were able to review existing literature on CCS interventions that have peer-reviewed results and available promotional resources. Using the resources, we were able to analyze more specific components of the intervention (i.e., the participant-facing resources) than with the research literature alone. This allowed us to analyze effect sizes for the intervention itself, as well as how the effect sizes might be related to characteristics of the promotional resources. The interventions we reviewed were diverse in target race, ethnicity, and location, which increases the generalizability of the results.

The study has limitations; first, the studies we evaluated varied greatly in sample size, ranging from 234 to 3,914. This large variation makes it difficult to accurately compare effect sizes and make overall conclusions about CCS interventions. Next, only nine studies met the inclusion criteria for the present study, which was largely due to the lack of available intervention resources to accompany the peer-reviewed manuscripts. Only four of the included studies looked at underrepresented populations, including African American and Latinx women, who are most affected by cervical cancer morbidity and mortality. Publication bias may also play a role in the lack of literature surrounding CCS interventions, as results with positive findings are more likely to be published [23]. This means we were not able to identify intervention characteristics that may be detrimental to (or have no effect on) CCS. Finally, all of the interventions took place in the USA which indicates that the review lacks international application.

Gaps in the literature

As previously mentioned, the most impactful interventions included in this review require high intensity, one-on-one patient interaction. These approaches are likely insufficient to create large-scale behavior change [19]. There is a lack of literature on interventions that use a population health approach and address social determinants of health to increase CCS. Additionally, none of the studies utilized hrHPV testing (either in a clinical setting or through self-sampling) as a method to increase CCS, which could also increase the scale of behavior change. Self-sampling for hrHPV tests involves a patient collecting a cell sample from her own cervix with a small stick or brush, then delivering the sample to a lab to be tested for the presence of hrHPV DNA [24]. These tests offer autonomy and convenience to patients because they do not have to visit a healthcare provider to complete CCS. Current research on hrHPV self-sampling show promising results for increasing CCS, particularly among underserved and under-screened populations [24].

In this review, we found that most interventions focused on one particular race or ethnic group. Of greater concern, only four of the included studies focused on underrepresented populations, particularly African American and Latinx women. This is relevant because while the burden of disease from cervical cancer has decreased in recent years, it remains a significantly disparate issue for minority groups in the USA [25]. For example, when compared to white women, the five-year survival rate for African American women diagnosed with cervical cancer is 13% lower [26]. In light of such disparities, significant emphasis needs to be placed on research aimed at developing population-based interventions for these communities so screening can be increased at a large scale. It is also notable that none of the papers reported conducting a needs assessment of their respective community to help inform the design of their intervention. It is possible that such an assessment would have resulted in improved effect size especially when addressing excess burden of disease in minority populations. Future interventions focusing on both minority populations and social determinants of health could lead to wide-spread increases in CCS.

Conclusion

The findings from this review can help guide organizations aiming to increase CCS in their community. Through our analysis, we found that the most successful interventions included a CHW or one-on-one patient interaction with a healthcare employee. Organizations can use educational interventions with CHWs to help increase CCS rates in a small target population or at a particular clinic. However, this type of intervention may not be sustainable on a large scale due to resource constraints. Therefore, it is imperative that future research is conducted on interventions focusing on large-scale change using population health theory.

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Data availability

Enquiries about data availability should be directed to the authors.

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Table 1

Study characteristics for peer-reviewed papers on increasing cervical cancer screening

First author (Year)	Location	Final sample size	Participant characteristics	Intervention description	Types of components						Effect sizes for Pap test
					Education	Patient navigation	Phone call	Counseling	Systems	Other	
Blumenthal (2005)	Tennessee and Georgia, USA	3914	Age 18+, African American living in predominantly black census tracts of 4 study cities	Educational sessions, mass media campaigning with local partners, and community events	X					Mass media, CBPR	Tenn.: + 2.5% Georg.: − 3.7%
Braun (2015)	Hawaii, USA	488	Age not specified, Asian and Pacific Islander, Medicare beneficiaries	Patient navigators assisted with breast, cervical, colorectal, and prostate screening	X	X	X				+ 20.6%
Fernandez (2009)	New Mexico, Texas, and California, USA	243	Age 50+, Hispanic, low-income, farmworker, no cancer history, not up-to-date for cervical or breast cancer screening	LHW presented in-home educational session, provided local screening information, and followed-up after 2 weeks	X					Community health worker	+ 15.9%
Maxwell (2003)	California, USA	530	Age 40+, Filipino women	Female Filipino health educator led a group educational session and provided information on local facilities and free testing	X						+ 4.0%
Paskett (1999)	North Carolina, USA	302	Age 40+, predominantly African American, living in low-income housing communities in the 2 study cities	Educational programs with LHWs (group and individual), targeted mailings, mass media campaigns, and in clinic services (posters, literature, counseling, follow-up)	X			X	X		+ 21.0%
Studts (2012)	Kentucky, USA	345	Age 40–64, living in rural Appalachian counties in Kentucky, overdue for cervical cancer screening	Educational lunch, home visits with lay health advisor, and newsletters addressing barriers to treatment	X	X					+ 7.0%
Taylor (2002)	Washington, USA and British Columbia, Canada	482	Age 20–69, Chinese, living in 2 study cities, under-utilizers of Pap testing, spoke Cantonese, Mandarin or English, no history of cervical cancer, no hysterectomy	*Intervention 1*: outreach worker provided tailored counseling and assistance with logistics of screening *Intervention 2*: direct mail of educational resources	X	X				Home visits, transportation	+ 10.0% + 24.0%

First author (Year)	Location	Final sample size	Participant characteristics	Intervention description	Types of components						Effect sizes for Pap test
					Education	Patient navigation	Phone call	Counseling	Systems	Other	
Taylor (2010)	Washington, USA	234	Age 20–79, Vietnamese, speak Vietnamese or English, living in Seattle during study, has a uterus, not up-to-date for Pap test	Vietnamese-American community health workers made home visits, provided education with video and print resources, and addressed cultural barriers to screening	X		X			Community health worker home visit	+ 10.0%
Thompson (2016)	Washington, USA	443	Age 21–64, Latina, living in the Yakima Valley, seen by one of the FQHCs in the past 5 years, not up-to-date for Pap test, no prior hysterectomy	*Intervention 1:* low-intensity intervention, educational video sent to participants' homes *Intervention 2:* high-intensity intervention, video plus in-home *promo-tora* education session	X	X					+ 4.7% + 19.4%