



Review Article

Cervical cancer screening in the United States: Challenges and potential solutions for underscreened groups

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ABSTRACT

Cervical cancer screening rates in the United States are generally high, yet certain groups demonstrate disparities in screening and surveillance. Individuals at greatest risk for cervical cancer are often from marginalized or underserved groups who do not participate in regular screening for a variety of reasons. Using the Population-based Research to Optimize the Screening Process (PROSPR) Trans-Organ Conceptual Model, including concepts of individual-, provider-, facility-, system-, or policy-level factors, we provide a commentary to highlight reasons for low screening participation among subgroups in the U.S. These include racial and ethnic minorities, rural residents, sexual and gender minorities, those with limited English proficiency, those with particular religious beliefs, and various health conditions. We describe barriers and offer potential solutions for each group. In addition, we discuss cross-cutting barriers to screening including difficulty interacting with the healthcare system (limited knowledge and health literacy, lack of provider recommendation/contact), financial (cost, lack of insurance), and logistical barriers (e.g., lack of usual source of care, competing demands, scheduling issues). Solutions to address these barriers are needed to improve screening rates across all underscreened groups. Changes at state and national policy levels are needed to address health insurance coverage. Mobile screening, ensuring that interpreters are available for all visits, and targeted in reach at non-gynecological visits can further overcome barriers. Employing community outreach workers can increase community demand for screening, and patient navigators can improve adherence to both screening and follow-up diagnostic evaluation. HPV self-sampling can address multiple barriers to cervical cancer screening.

1. Background

Human papillomavirus (HPV) is the most prevalent sexually transmitted infection in the world, and causes nearly all cases of cervical cancer. (Prevention CfDCa, 2020) Worldwide, cervical cancer is a leading cause of cancer death for women, and in the United States (U.S.), approximately 13,000 cases of cervical cancer and 4000 deaths occur each year. (Prevention CfDCa, 2020) The World Health Organization has set a goal of significantly reducing cervical cancer by 2030 through multiple targets, including HPV vaccination among 90% of girls by age 15, cervical cancer screening among 70% of women by ages 35, and again by age 45, and the treatment of 90% of women with an identified cervical abnormality. (World Health Organization, 2020) While HPV

vaccination holds tremendous promise for prevention of HPV-related cancers, it is critical that early detection strategies continue to be utilized to achieve cervical cancer elimination. The use of guideline-concordant screening with HPV and cervical cytology (Pap) testing among all at-risk individuals is crucial to ensure continued reductions in cervical cancer morbidity and mortality.

While screening rates in the U.S. are generally considered to be high (at upwards of 80%), (Institute NC, 2020; Watson et al., 2017) additional analyses reveal that not all population subgroups participate equally in screening. This commentary focuses on U.S. subgroups with lower rates of participation in cervical cancer screening, (Branković et al., 2013; Brackertz, 2007) or what we refer to as “underscreened”, including racial or ethnic minorities, (Lin et al., 2015) rural area residents, (Studs

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et al., 2013; Majid et al., 2019) sexual or gender minorities, (Charkhchi et al., 2019) as well as those with particular religious beliefs, (Lofters et al., 2010; Lofters et al., 2017) limited English proficiency, (Ridgeway et al., 2020; Van Manh et al., 2020; Nguyen-Truong et al., 2018; Simon et al., 2015) and various health conditions (i.e., physical disabilities, (Chandrupatla et al., 2019; Horner-Johnson et al., 2014) comorbidities, (Liu et al., 2014) or mental health concerns (Xiang, 2015; Ackerson, 2010; Farley et al., 2002)). These individuals may be less likely to receive guideline concordant cervical cancer screening, or timely diagnosis and treatment for cervical pre-cancers, compared to the majority population. Regardless of the group, cross-cutting barriers, including difficulty interacting with the healthcare system (lack of knowledge/awareness, lack of provider recommendation/contact, limited health literacy), financial barriers (out of pocket costs, lack of insurance), and logistical concerns (e.g., no source of regular care, competing demands, lack of childcare, scheduling difficulties) may pose further challenges to prevention of cervical cancer for underscreened groups.

The Population-based Research to Optimize the Screening Process (PROSPR) Trans-Organ Conceptual Model for Breast, Cervical, and Colorectal Cancer Screening (Beaber et al., 2015) describes a unified screening process across these three cancers. The model is organized around various points in the processes for cancer risk assessment, detection, diagnosis, and treatment. For cervical cancer, the model highlights screening via Pap and/or HPV test, and the subsequent trajectory of care based on results, with recommendations for additional or repeat screening, colposcopy (typically with biopsy), excisional treatment, and/or oncology treatment, as needed. (Beaber et al., 2015) Barriers to cervical cancer screening and follow-up care after abnormal results may occur prior to or within this flow of events. This model highlights the individual-level characteristics, as well as provider-, facility-, system-, and policy-level characteristics that may impact screening and treatment. (Beaber et al., 2015) In the current paper, we will primarily focus on the role of these factors as they relate to screening for cervical cancer.

In this commentary, we provide an overview of unique barriers faced by various underscreened groups in the U.S. and possible solutions for improving cervical cancer screening. We discuss these unique groups and provide commentary and solutions framed through the lens of the screening process as described in the PROSPR model. We explore individual-, provider-, facility-, system-, and policy-level factors that may decrease screening participation, and outline possible solutions at these levels. We also discuss cross-cutting barriers that may contribute to lower cervical cancer screening rates across all groups, and related solutions.

2. Underscreened groups

2.1. Racial or ethnic minorities

Cervical cancer rates are higher for Black (8 per 100,000) and Hispanic (9 per 100,000) women compared to non-Hispanic, White women (7 per 100,000) in the U.S. (Centers for Disease Control and Prevention, 2020) Racial/ethnic minorities may have lower participation in screening and/or follow-up after abnormal results, although when controlling for other factors, the effect of race/ethnicity is often diminished or eliminated. Across three cycles of Health Information National Trends Survey data, non-Hispanic Blacks were more likely to report participation in cervical cancer screening, compared to non-Hispanic White and Hispanic women. Individual-level factors contribute to screening participation by race, including BMI, income, insurance status, and health literacy. (Hirth et al., 2016) Provider recommendation for cervical cancer screening often influences screening uptake. For example, Hispanic women who report a lack of recommendation also report lower screening. (Roman et al., 2014)

The impacts of systemic racism manifest in individual-, provider- and systems-level barriers. Individual perception of discrimination also

negatively influences adherence to cervical cancer screening, with Black, Asian, and Hispanic women who report experiencing general discrimination in their daily lives demonstrating lower participation in screening. (Jacobs et al., 2014) Lower trust in providers, in conjunction with a lack of provider recommendation, can often contribute to low cancer screening rates among Hispanic, non-Hispanic Black, and non-Hispanic White women in other cancer contexts. (Alexandraki and Mooradian, 2010; Berkowitz et al., 2008) Black women, in particular, cite trust in their provider and in the healthcare system as specific factors that contribute to cervical cancer screening behaviors. (Brown et al., 2011; Nolan et al., 2014)

2.1.1. Solutions for Racial and Ethnic Minorities

Persistent mortality gaps between Black and White women diagnosed with cervical cancer prompted a recent CDC-funded study to conclude there is “a need for targeted interventions and improved access to screening, timely treatment, and follow-up care, especially among Black women”. (Benard et al., 2017) Provider-, facility- and system-level solutions may be most effective for reaching underscreened individuals from racial and ethnic minority groups. For instance, Black women who receive care at health centers for underserved individuals (e.g., federally qualified health centers; FQHCs) are more likely than non-Hispanic Whites to receive cervical cancer screening. (Lee et al., 2020) Patient-centered relationships with a trusted provider and clinical system may help overcome or reverse racial/ethnic disparities. In addition, specific provider communication techniques implemented during the clinical visit can positively influence screening uptake among certain racial/ethnic groups. For example, Asian women who report discussions with providers reflecting elements of the teach back method to verify understanding during visits are more likely to receive Pap testing. (Kindratt et al., 2020) Interventions that include patient navigation with telephone support and education may be effective among racial and ethnic minorities for improving cervical cancer prevention, screening, diagnosis, and treatment. (Glick et al., 2012; Alimena et al., 2020)

Additional systems-level solutions can include targeted “in reach” at non-gynecologic visits (e.g. acute primary care visits, or specialty care visits like mammography) to promote cervical cancer screening in these groups. (Leyden et al., 2005) In reach and outreach to women with no record of a prior Pap or HPV test, particularly racial and ethnic minorities seen by safety-net systems, may be most effective for improving engagement, trust, and subsequent cervical cancer prevention for these women.

2.2. Rural residents

Notable geographic disparities in cervical cancer incidence and mortality exist in the U.S. Individuals living in rural areas are less likely to complete cervical cancer screening. (Nuño et al., 2012) and are consequently diagnosed at later stages of the disease compared to women in urban counties. (Yu et al., 2019) In studies conducted in rural Appalachian Kentucky and rural Washington state, 33% of women reported not completing cervical cancer screening in the prior five years. (Hatcher et al., 2011) County-level socioeconomic status and primary care provider density have been found to mediate the relationship between urbanicity and cervical cancer incidence, indicating the role of access to care in cervical cancer incidence. (Moss et al., 2017) Potential contributors to the cervical cancer disparities seen in rural areas include lower provider density, (Moss et al., 2017) high rates of provider turnover, (Majid et al., 2019) lack of facilities, (Adunlin et al., 2019) long clinic waits, (Coronado et al., 2004) and lack of high-quality medical care. (Majid et al., 2019) Thus, women living in rural areas are faced with multiple barriers to screening at the provider-, facility-, and systems-levels.

2.2.1. Solutions for rural residents

Lack of access to cervical cancer screening appears to be a key barrier

in rural areas. Mobile screening units have been effective in increasing rural screening for other cancer types, although fewer studies have examined mobile cervical cancer screening solutions, in particular, in the U.S. and high income countries.(Greenwald et al., 2017) Travel vouchers may also improve screening for those residing in rural areas.(Daley et al., 2011) HPV self-sampling (discussed below) may be especially effective for reducing geographic access issues for rural residents who would otherwise have to travel long distances to receive screening. A systematic review has suggested that multilevel interventions may be an effective approach to increasing cervical cancer screening among rural residents, including components like group education, media campaigns, and reduction of structural barriers.(Rodríguez-Gómez et al., 2020)

2.3. Sexual and gender minorities

Sexual and gender minorities are less likely to receive timely cervical cancer screening.(Charkhchi et al., 2019) Women who identify as lesbian or gay are half as likely to participate in screening as women who identify as heterosexual.(Charkhchi et al., 2019) A recent national survey found that cervical cancer screening rates were nearly 30% lower among women not identifying as “completely heterosexual,” and 90% lower among those identifying as “lesbian”.(Charlton et al., 2011) Women who identify as lesbian often perceive themselves to be at a lower risk for cervical cancer than heterosexual or bisexual women.(Price et al., 1996) In addition, sexual minority women may be less likely to have a primary care physician; lack of provider referral or recommendation was the most commonly cited reason for non-participation in screening in one national survey.(Tracy et al., 2013) Several studies indicate that perceived stigmatization by the healthcare system is an important barrier to receiving cervical cancer screening among sexual minority women.(Hiestand et al., 2007; Clark et al., 2003) For transgender males who retain their cervix,(Gatos, 2018) vaginal and cervical atrophy induced by testosterone therapy makes speculum examinations physically uncomfortable, and the challenges to gender identity and privacy can be emotionally taxing.(Peitzmeier et al., 2017) As a result, cervical cancer screening rates are particularly low for transgender men.(Kiran et al., 2019; Seay et al., 2017)

2.3.1. Solutions for sexual and gender minorities

For sexual and gender minorities, trust and comfort with cervical cancer screenings could be improved by employing provider- and facility-focused solutions including training staff on best practices for addressing gender fluid or transgender individuals, incorporating more nuanced gender language into electronic health records and clinical interactions, and ensuring that waiting areas are welcoming and inclusive. As most individuals seeking gynecologic care are cis-gender females, providing non-stigmatizing care to transgender males necessitates significant adaptation of practice settings.(Gatos, 2018; Stewart et al., 2020) Perceived stigma may be improving with time, however. A small qualitative study of female veterans found that although those identifying as lesbian feared discrimination from healthcare providers, 80% did not perceive discriminatory practices in the facilities where they sought care and felt that the Veterans Health Administration was trying to create a welcoming environment for them.(Mattocks et al., 2015) One study of LGBT veterans found that high quality provider communication can improve health outcomes despite past discrimination that has eroded trust.(Ruben et al., 2019) In addition, self-sampling, either in-clinic or at home, may be appropriate for sexual and gender minorities who are uncomfortable receiving a pelvic exam. These are health system- or facility-, and provider-level solutions that can be implemented in a top-down fashion. Education regarding cervical cancer risk specific to sexual and gender minorities is important to enhance understanding of the importance of screening for these groups. Education provided by the clinic or system can increase individual-level knowledge.

2.4. Individuals with limited english proficiency

English language proficiency has been associated with health behavior and initiation of preventive healthcare among several groups in the U.S.(DuBard and Gizlice, 2008; Evenson et al., 2004; Lim, 2010) Among individuals with limited English proficiency, cervical cancer screening rates are often significantly lower.(Ridgeway et al., 2020) Immigrant women in the U.S. who are not proficient in English demonstrate a lower likelihood of receiving cervical cancer screenings due to discomfort communicating in English with healthcare providers.(Van Manh et al., 2020) These language barriers can prevent effective communication and information exchange between women eligible for screening and providers, which can lead to decreased engagement during the clinical visit. Studies of Vietnamese-American, Korean-American, and Hispanic women with limited English proficiency demonstrate that those with low levels of knowledge and awareness of cancer screening tests and their efficacy have lower likelihood of cervical cancer screening initiation.(Nguyen-Truong et al., 2018; Choi et al., 2020; Moore de Peralta et al., 2017)

2.4.1. Solutions for individuals with limited english proficiency

English proficiency is an individual-level factor that can be addressed with system-level solutions. Patient navigators and professional interpreters can play a role in assisting women in understanding medical information and can aid non-English speaking women in the decision-making process. Use of professional interpreters can positively impact patient comprehension and communication with providers, improve clinical outcomes, and improve satisfaction with care.(Karliner et al., 2007) Patient navigators can improve cervical cancer screening rates among various non-English speaking racial/ethnic groups such as Hispanic/Latino, Korean, Portuguese, and Russian.(Genoff et al., 2016) Navigators and interpreters assist by identifying and addressing healthcare access-related barriers in those with limited English proficiency and by assisting with conveying and translating important medical information that might otherwise be lost.(Genoff et al., 2016; Nelson et al., 2020) In addition, healthcare systems should consider having low literacy cervical cancer screening educational materials in multiple languages.

2.5. Individuals with particular religious beliefs

Religious beliefs do not have a consistent effect on screening participation as some studies note a positive association between religiosity and improved adherence.(Allen et al., 2014; Yeary et al., 2020) Religiosity may increase adherence and encourage proactive behaviors (i.e., “the body is a temple”).(Allen et al., 2014; Yeary et al., 2020; Drew and Schoenberg, 2011) However, for certain religious groups that have fatalistic beliefs or emphasize modesty, low rates of cervical cancer screening are noted.(Lofters et al., 2010; Lofters et al., 2017; Thomas et al., 2005) Some Muslim women may express fatalism around cancer diagnoses, expressing beliefs that a cancer diagnosis was in God’s hands or a punishment from God.(Padela et al., 2014) Some further believe that screening to prevent cancer indicates a lack of faith in God.(Rimande-Joel and Ekenedo, 2019) Among women who do participate in screening, discomfort and societal disapproval of screenings performed by male providers pose additional barriers.(Zorogastua et al., 2017)

2.5.1. Solutions for screening individuals with particular religious beliefs

Outreach to these groups with particular religious beliefs and their respective faith communities will be important for increasing screening.(Padela et al., 2014) Interventions targeted to one’s faith(Pratt et al., 2020) can be effective for providing education regarding the importance of screening and where to access it. For example, outreach events at churches and mobile screening have been successful.(White et al., 2012) Religious beliefs may be difficult to ascertain at the clinic- or system-

level. Thus, community-level outreach by healthcare systems to religious leaders or health ministries within a faith-based organization (Padela et al., 2014; Maxwell et al., 2019) is an important strategy to addressing screening disparities in these groups.

2.6. Individuals with various health conditions

2.6.1. Comorbid conditions and physical disabilities

Although women with chronic comorbid conditions frequently engage with the healthcare system, their rates of preventive care, specifically cervical cancer screening, are often lower than women without comorbid conditions. (Liu et al., 2014) For example, women with diabetes and hypertension are less likely to undergo cervical cancer screening. (Liu et al., 2014; Cofie et al., 2018) as are women with intellectual, physical, or developmental disabilities. (Chandrupatla et al., 2019; Horner-Johnson et al., 2014; Cobigo et al., 2013) A variety of barriers may contribute to disparities in those with comorbidities, including a focus of provider visits on the comorbid condition, as well as the preponderance of care being delivered by specialists who do not perform cervical cancer screening. Arthritis is also associated with decreased rates of cervical cancer screening. (Liu et al., 2014; Widdifield et al., 2017) which may be due in part to mobility issues and difficulty with positioning for pelvic exams. Obesity is independently associated with increased incidence of cervical cancer. (Poorolajal and Jenabi, 2016) Obese women are less likely to participate in screening. (Maruthur et al., 2009) which may be due in part to perceptions of stigmatization by the healthcare system, as well the lack of appropriately-sized equipment. (Aldrich and Hackley, 2010)

2.6.2. Mental health concerns

Although most women report little to no anxiety related to undergoing cervical cancer screening. (Basen-Engquist et al., 2003) high levels of anxiety are sometimes associated with lower levels of cervical cancer screening. (Xiang, 2015) However, findings on mental health and cervical screening have been inconsistent. (Kronman et al., 2012) Cervical cancer rates are also only marginally lower among women with an anxiety diagnosis compared to those without. (Liang et al., 2012) Additionally, sexual trauma presents unique mental health challenges related to cervical cancer screening. One in five women experience sexual violence in their lifetimes. (Center NSVR, 2010) and women with a history of sexual violence can find pelvic exams to be triggering events, leading them to avoid screening. (Ackerson, 2010) Specifically, screening rates are 20% lower among women who report a history of sexual violence and 50% lower among those who experienced an assault during childhood. (Farley et al., 2002)

2.6.3. Solutions for individuals with various health conditions

These individual health concerns affecting screening can be addressed with facility-, system-, or provider-level strategies. To improve screening for those who may be more engaged with care for comorbidities but who have not yet been screened for cervical cancer, it will be important to encourage attendance at regular, preventive primary care visits and/or refer to gynecological care as a strategy for cervical cancer prevention. (Leyden et al., 2005; Pruitt et al., 2018) Targeted in reach at non-gynecologic visits may be especially effective for these groups who are already seeing a provider for a chronic physical or mental health condition. (Leyden et al., 2005) There is also strong evidence indicating that one-on-one education about, and client reminders for, cervical cancer screening are effective for increasing screening. (Sabatino et al., 2012) Those with both physical health and mental health concerns may also benefit from HPV self-sampling.

2.7. Intersectionality

Although the underscreened groups discussed thus far have been presented separately, they are not always mutually exclusive. For

example, a woman with limited English proficiency (and subsequent difficulty communicating with office staff or providers) may also live with comorbid conditions that dominate her medical appointments, leaving little time or perceived need for cervical cancer screening. Intersectionality of these groups may be even further complicated by difficulty interacting with the healthcare system, concerns about cost, or logistical barriers (e.g., competing demands, lack of childcare, scheduling issues). The intersection of these individual characteristics and barriers is common and must be acknowledged in order to develop effective solutions that cut across barriers at the individual-, provider-, facility-, system-, and policy-levels.

2.8. Cross-cutting barriers for underscreened groups

2.8.1. Difficulty interacting with the healthcare system

At the individual level, awareness and knowledge of cervical cancer screening may be an important barrier to engaging in screening. In a large study of FQHCs, less than a quarter of women were adhering to guidelines at the time surrounding two to three-year screening intervals, with 60% unnecessarily completing annual screening. (Hawkins et al., 2013) More than half of these women misunderstood the purpose of Pap testing. (Hawkins et al., 2013) and in a similar study exploring cervical cancer screening knowledge, only about 25% understood the purpose of Pap testing. (Kasting et al., 2017) In a systematic review of predictors of cervical cancer screening of women from diverse backgrounds, screening knowledge was associated with uptake among Asian women. (Limmer et al., 2014) In one study examining cervical cancer screening barriers in uninsured women, Black and Hispanic women were twice as likely to indicate that lack of knowledge was a barrier, compared with White women. (Akinlotan et al., 2017) Lack of provider recommendation and contact are also important interpersonal barriers. One systematic review found that provider recommendation was positively associated with screening rates. (Plourde et al., 2016) In a study of underserved Black, Latina, and Arab women in the U.S., lack of provider recommendation to Latina women was associated with significantly lower odds of Pap testing. (Roman et al., 2014)

These challenges may be further exacerbated by limited health literacy. Cervical cancer screening uptake is lower among those with lower health literacy scores. (Roman et al., 2014; Heberer et al., 2016) Health literacy is a critical component of medical decision making. (McCaffery et al., 2013; Van Der Heide et al., 2015) and low or limited health literacy can often result in delays in important cancer screening tests, (Oldach and Katz, 2014) misunderstanding of medical information, and underutilization of health services. (Berkman et al., 2011) In contrast, higher health literacy is associated with an increased likelihood of Pap testing. (Kim and Han, 2019; Flores and Acton, 2013; Scarinci et al., 2010) Characteristics of health literacy such as functional literacy (ability to read, speak, write, and understand numbers) and cultural literacy (ability to understand and participate fluently in a given culture) are particularly relevant in the context of cancer screening. Women who demonstrate poor functional and cultural health literacy experience worse health outcomes, lack of empowerment and confidence during clinical visits, and low uptake of cancer screening tests. (Zarcadoolas et al., 2009) Spanish-speaking women with poor functional health literacy are significantly less likely to have received a Pap test. (Garbers and Chiasson, 2004) Higher oral literacy (asking providers for medical advice), written literacy (understanding educational materials), and listening skills (understanding health-related information) can often result in an increased likelihood of Pap testing. (Kim and Han, 2019) Hispanic women with low health literacy are also more likely to demonstrate lower likelihood of Pap testing compared to other groups, (Flores and Acton, 2013) which is particularly concerning as Hispanic women are among those at a higher risk for developing cervical cancer. (Scarinci et al., 2010) In a study of Korean-American women, those who demonstrated high levels of health literacy, along with other psychosocial factors, were more likely to receive Pap tests. (Kim et al., 2018)

2.8.2. Solutions for difficulty interacting with the healthcare system

Healthcare interactions can be improved at the individual- provider-facility- and system levels. Community-based programs can work within communities to increase understanding and utilization of screening services at the individual level.(Shah et al., 2020) Community-based education programs have been especially effective in Latinx populations, possibly due to their ability to address both knowledge and language barriers.(Calderón-Mora et al., 2020; Cheun and Loomis, 2018; Fleming et al., 2018) Use of theory-based educational interventions for patients are effective in increasing cervical cancer screening rates, particularly when they include culturally and linguistically sensitive components tailored for each community.(Musa et al., 2017) Providers can be trained to ensure that records are reviewed for cervical cancer screening history and recommendations made at all opportunities.(Eun and Perkins, 2020) A systematic review and meta-analysis indicated that even contact such as invitation letters sent to women overdue for screening, follow-up phone calls, and reminder calls and letters can significantly improve cervical cancer screening rates.(Musa et al., 2017) Creation of low literacy educational materials and programming in preferred language is an important strategy at the individual level.

2.9. Financial (insurance coverage, out of pocket costs)

Financial barriers to cervical cancer screening have been noted across multiple studies and many underscreened groups described above. Financial concerns may especially be a barrier to cervical cancer screening among women with fewer financial resources, particularly the un- and under-insured.(Studts et al., 2013; Majid et al., 2019; Adunlin et al., 2019; Daley et al., 2011; Akinlotan et al., 2017; Villani and Mortensen, 2013; Tejeda et al., 2013; Hope et al., 2017; Boom et al., 2019) Although county health departments and FQHCs offer no-cost or low-cost cervical cancer screening, cost may still be a barrier for some women. Uninsured women and those with public insurance are less likely to have had a Pap test in the prior three years compared to those with private or military insurance,(Hall et al., 2018; Silvera et al., 2020; Bonafede et al., 2019) and lack of coverage for follow-up testing after an abnormal screening result may further complicate the issue. Medicaid-insured women have lower rates of Pap testing and HPV co-testing compared to those with private insurance.(Bonafede et al., 2019) In addition, a higher proportion of women with Medicaid experience a 3.5 year or greater gap between Pap tests compared to those with private insurance.(Bonafede et al., 2019) Cost is a particular barrier among women in rural areas.(Coronado et al., 2004; McAlearney et al., 2010; Collins et al., 2015; Reding et al., 1997; Ely et al., 2014) Of note, although cost has been identified as a barrier to screening, some women may not be aware of the actual out of pocket cost. For example, in a study conducted among women living in Appalachian counties in Ohio, 81% reported that they did not know the cost of a Pap test.(McAlearney et al., 2010) Of those that suggested a numerical value for the cost of a Pap test, 42% overestimated the cost.(McAlearney et al., 2010)

2.9.1. Solutions for financial barriers

Concerns about cost, having fewer financial resources, and lack of insurance coverage can be viewed as individual-level factors that influence screening, but also function at the provider-, system-, and even policy-levels. These women may best be targeted for improvements in screening through outreach at the community level (community events that promote or provide screening), via individual healthcare systems (health fairs or events sponsored by the health system), and promotion of lower cost or free screening at FQHCs. The Affordable Care Act (ACA) mandates coverage for screening tests, but cost-sharing is commonly required for follow-up and diagnostic testing. Although screening has largely increased since ACA-related Medicaid expansion occurred in many states,(Huguet et al., 2019; Sabik et al., 2018) further insurance reform could address insurance coverage for the spectrum of services from screening through diagnosis and treatment. Increasing price

transparency for HPV and Pap testing may also be a simple solution for those who are concerned about cost.

2.10. Logistical barriers

Engaging in regular interactions with a healthcare provider and communication about cervical cancer screening are important factors in completing screening. Compared to those with a usual source of care, those without a usual source were less likely to complete a Pap test according to guidelines.(Tracy et al., 2013; Hall et al., 2018) Furthermore, source of care (e.g., a county health clinic vs. another type of clinic) has been associated with receiving follow-up care after an abnormal Pap test (65% receiving care at a county clinic vs. 85% at a non-county clinic returned for follow-up care). Having regular contact with a healthcare provider is associated with completion of cervical cancer screening.(Roman et al., 2014; Tracy et al., 2013; Cyrus-David et al., 2002; Nuño et al., 2011) Women who have not had a primary care provider visit or OB/GYN visit in the prior year are less likely to complete cervical cancer screening.(Hall et al., 2018; Guo et al., 2017)

Other individual-level logistical barriers to cervical cancer screening include: lack of time due to competing demands,(Daley et al., 2011; Bakemeier et al., 1995) inability to take time away from work,(Adunlin et al., 2019; Coronado et al., 2004; Daley et al., 2011; Reding et al., 1997; Bakemeier et al., 1995) difficulty finding childcare,(Daley et al., 2011; Ely et al., 2014; Bakemeier et al., 1995) difficulty with scheduling appointments,(Hope et al., 2017) remembering to make and/or attend an appointment given the significant time between tests,(Fletcher et al., 2014) and lack of availability of convenient clinic hours.(Cyrus-David et al., 2002) Similar barriers (e.g., transportation, limitation in the numbers of providers/high provider turnover, lack of time, competing demands such as work or childcare) to cervical cancer screening have been noted in other high-income countries.(Cyrus-David et al., 2002) Various underserved groups in the U.S. (e.g., rural residents, immigrants, racial/ethnic minority groups, unemployed women, those who speak a language other than English) may experience these barriers to cervical cancer screening at different rates.(Tejeda et al., 2013)

2.10.1. Solutions to logistical barriers

One solution that may simultaneously address several logistical barriers for underscreened groups, is the provision of HPV self-sampling kits for home or in-clinic use. HPV self-sampling is the use of self-collected vaginal specimens to obtain samples for testing for HPV. The self-sampling process involves providing eligible women with collection kits and self-sampling instructions, having them collect their own samples using a vaginal swab either at home or in the clinic setting, and returning the samples for processing upon completion while at the clinic, or to laboratory or clinic via mail. Self-sampling has both advantages and disadvantages.(Jeronimo et al., 2019) Self-sampling can increase access to screening for many women and is convenient and private, directly addressing geographic, logistic, physical limitations/disabilities, and mental health barriers. However, self-sampling does not necessarily overcome all psychosocial barriers (fatalism, anticipatory fear of results).(Jeronimo et al., 2019) It could also have unintended consequences; women who regularly attend appointments for in-person screening may stop attending preventive care visits altogether and miss out on other important services (e.g., breast exams, vaginal exams that detect visible tumors, or in-person screening for anxiety, depression, or abuse).(Jeronimo et al., 2019) Although cervical cancer screening via self-collection is not currently recommended as the standard of care in professional guidelines, one review particularly focused on underscreened women found that HPV self-sampling is acceptable to patients, and feasible and valid in terms of carrying out self-collection and sensitivity of results.(Madzima et al., 2017) Another review reported that the majority of women (in 8 of 13 studies) preferred self-collection compared with clinician-collected sampling.(Huynh et al., 2010) In an RCT of over 19,000 women implemented in one large health

system,(Winer et al., 2018) the intervention group received mailed HPV test kits compared with a control group who received the usual care annual reminder and outreach to schedule screening.(Winer et al., 2019) Results demonstrated increased screening in the intervention group compared with the control group, along with shorter time to screening uptake in the intervention group.(Winer et al., 2019) One systematic review and meta-analysis also indicated that offering women an option for self-sampling almost doubled cervical cancer screening rates.(Musa et al., 2017) The widespread success of HPV self-sampling implementation in the future will be largely dependent upon the health system, their strategies for roll-out, and for follow-up after abnormal self-collected sample. Importantly, ensuring that women with abnormal results attend follow-up visits for diagnostic and treatment services will be critical to reducing cervical cancer burden.

3. Conclusions and future directions

Invasive cervical cancer is prevented through population-wide screening and evaluation of abnormal screening test results to allow for detection and treatment of cervical pre-cancer. In high income countries like the U.S., organized screening programs have reduced cervical cancer rates by up to 80%.(Landis et al., 1999; Wingo et al., 2003) The World Health Organization goal of significantly reducing cervical cancer by 2030 through HPV vaccination among 90% of girls by age 15, cervical cancer screening among 70% of women by ages 35 and 45, and the treatment of 90% women with an identified cervical abnormality(World Health Organization, 2020) is an attainable goal, particularly for countries with well-established screening programs. However, the benefits of screening are not uniformly experienced by all groups. Indeed, several populations remain underscreened based on a variety of barriers. This commentary highlights key subgroups, discusses unique challenges they face, along with specific solutions. We also describe complex cross-cutting healthcare interaction, financial, and logistical barriers, and suggest solutions. While our commentary was focused on the U.S., many of our proposed solutions are applicable across high-, middle-, and low-income countries.

The PROSPR Trans-Organ Conceptual Model for Breast, Cervical, and Colorectal Cancer Screening(Beaber et al., 2015) describes the screening process and highlights points along the continuum where screening may be interrupted. This model notes the individual-, provider-, facility-, system-, and policy-level characteristics that may impact screening, diagnosis, and treatment, and also serves as an excellent framework for developing multilevel interventions for increasing cervical cancer screening.(Beaber et al., 2015) While we focus on underscreened groups and barriers to screening, it is important to also recognize other points along the PROSPR continuum that are likely to have an impact on ultimately reducing the burden of cervical cancer. Specifically, even if solutions and interventions to promote screening are successful, it will be critical to ensure appropriate management of abnormal results. Our commentary highlights the importance of expanding consideration of unique needs from racial and ethnic minority groups to those that experience disparities in cervical cancer screening due to rural residence, sexual/gender minority status, limited English proficiency, religious beliefs, and various health conditions. Regardless of the target group, there are also cross-cutting barriers that impact screening. The potential to dramatically reduce cervical cancer by 2030 will only be realized if, as a public health community, we understand and address both the unique and cross-cutting barriers for underscreened groups.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose in relation to this submission.

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References

- Ackerson, K., 2010. Personal influences that affect motivation in pap smear testing among African American women. *J. Obstet. Gynecol. Neonatal. Nurs.* 39 (2), 136–146.
- Adunlin, G., Cyrus, J.W., Asare, M., Sabik, L.M., 2019. Barriers and facilitators to breast and cervical cancer screening among immigrants in the United States. *J. Immigr. Minor. Health* 21 (3), 606–658.
- Akinlotan, M., Bolin, J.N., Helduser, J., Ojinnaka, C., Lichorad, A., McClellan, D., 2017. Cervical cancer screening barriers and risk factor knowledge among uninsured women. *J. Community Health* 42 (4), 770–778.
- Aldrich, T., Hackley, B., 2010. The impact of obesity on gynecologic cancer screening: an integrative literature review. *J. Midwif. Women's Health* 55 (4), 344–356.
- Alexandraki, I., Mooradian, A.D., 2010. Barriers related to mammography use for breast cancer screening among minority women. *J. Natl. Med. Assoc.* 102 (3), 206–218.
- Alimena, S., Manning-Geist, B., Pena, N., Vitonis, A.F., Feldman, S., 2020. Outcomes by race among women referred to an academic colposcopy clinic with a patient navigation program. *J. Women's Health*. <https://doi.org/10.1089/jwh.2020.8381>.
- Allen, J.D., Pérez, J.E., Pischke, C.R., et al., 2014. Dimensions of religiousness and cancer screening behaviors among church-going Latinas. *J. Relig. Health* 53 (1), 190–203.
- Bakemeier, R.F., Krebs, L.U., Murphy, J.R., Shen, Z., Ryals, T., 1995. Toward Breast and Cervical Cancer Screening in Hispanic Women. *Cancer Research in Hispanic Populations in the United States: Preliminary Findings of Studies from Cooperative Agreement 89-CA-15 and Other Studies Targeting Hispanic Americans, 1985–1995*, p. 95 (18).
- Basen-Engquist, K., Shinn, E.H., Warneke, C., et al., 2003. Patient distress and satisfaction with optical spectroscopy in cervical dysplasia detection. *Am. J. Obstet. Gynecol.* 189 (4), 1136–1142.
- Beaber, E.F., Kim, J.J., Schapira, M.M., et al., 2015. Unifying screening processes within the PROSPR consortium: a conceptual model for breast, cervical, and colorectal cancer screening. *J. Natl. Cancer Inst.* 107 (6), djv120.
- Benard, V.B., Watson, M., Saraiya, M., et al., 2017. Cervical cancer survival in the United States by race and stage (2001–2009): findings from the CONCORD-2 study. *Cancer*. 123, 5119–5137.
- Berkman, N.D., Sheridan, S.L., Donahue, K.E., Halpern, D.J., Crotty, K., 2011. Low health literacy and health outcomes: an updated systematic review. *Ann. Intern. Med.* 155 (2), 97–107.
- Berkowitz, Z., Hawkins, N.A., Peipins, L.A., White, M.C., Nadel, M.R., 2008. Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. *J. Am. Geriatr. Soc.* 56 (2), 307–314.
- Bonafede, M.M., Miller, J.D., Pohlman, S.K., et al., 2019. Breast, cervical, and colorectal Cancer screening: patterns among women with Medicaid and commercial insurance. *Am. J. Prev. Med.* 57 (3), 394–402.
- Boom, K., Lopez, M., Daheri, M., et al., 2019. Perspectives on cervical cancer screening and prevention: challenges faced by providers and patients along the Texas–Mexico border. *Perspect. Public Health* 139 (4), 199–205.
- Brackertz, N., 2007. Who is Hard to Reach and Why?
- Branković, I., Verdonk, P., Klinge, I., 2013. Applying a gender lens on human papillomavirus infection: cervical cancer screening, HPV DNA testing, and HPV vaccination. *Int. J. Equity Health* 12 (1), 14.
- Brown, D.R., Wilson, R.M., Boothe, M.A., Harris, C.E., 2011. Cervical cancer screening among ethnically diverse black women: knowledge, attitudes, beliefs, and practices. *J. Natl. Med. Assoc.* 103 (8), 719–728.
- Calderón-Mora, J., Byrd, T.L., Alomari, A., et al., 2020. Group versus individual culturally tailored and theory-based education to promote cervical Cancer screening among the underserved Hispanics: a cluster randomized trial. *Am. J. Health Promot.* 34 (1), 15–24.
- Center NSVR, 2010. NISVS 2010 Summary Report–Sexual Violence by Any Perpetrator. <https://www.nsvrc.org/statistics>.
- Centers for Disease Control and Prevention, 2020. HPV-Associated Cervical Cancer Rates by Race and Ethnicity. <https://www.cdc.gov/cancer/hpv/statistics/cervical.htm>.
- Chandrupatla, S.G., Khalid, I., Tavares, M., 2019. Oral HPV prevalence and HPV vaccination among special needs population in the US. *Papillomavirus Res.* 8, 100182.
- Charkhchi, P., Schabath, M.B., Carlos, R.C., 2019. Modifiers of cancer screening prevention among sexual and gender minorities in the behavioral risk factor surveillance system. *J. Am. Coll. Radiol.* 16 (4), 607–620.
- Charlton, B.M., Corliss, H.L., Missmer, S.A., et al., 2011. Reproductive health screening disparities and sexual orientation in a cohort study of US adolescent and young adult females. *J. Adolesc. Health* 49 (5), 505–510.
- Cheun, A.S.A., Loomis, J., 2018. A culturally sensitive approach to cervical cancer prevention in the Latina population using the Promotora model. *Nursing Women's Health* 22 (4), 338–345.
- Choi, Y.J., Lee, H.Y., An, S., Yoon, Y.J., Oh, J., 2020. Predictors of cervical Cancer screening awareness and literacy among Korean-American women. *J. Racial Ethn. Health Disparities* 7 (1), 1–9.

- Clark, M.A., Bonacore, L., Wright, S.J., Armstrong, G., Rakowski, W., 2003. The cancer screening project for women: experiences of women who partner with women and women who partner with men. *Women Health* 38 (2), 19–33.
- Cobigo, V., Ouellette-Kuntz, H., Balogh, R., Leung, F., Lin, E., Lunsky, Y., 2013. Are cervical and breast cancer screening programmes equitable? The case of women with intellectual and developmental disabilities. *J. Intellect. Disabil. Res.* 57 (5), 478–488.
- Cofie, L.E., Hirth, J.M., Wong, R., 2018. Chronic comorbidities and cervical cancer screening and adherence among US-born and foreign-born women. *Cancer Causes Control* 29 (11), 1105–1113.
- Collins, T., Stradtman, L.R., Vanderpool, R.C., Neace, D.R., Cooper, K.D., 2015. A community-academic partnership to increase pap testing in Appalachian Kentucky. *Am. J. Prev. Med.* 49 (2), 324–330.
- Coronado, G.D., Thompson, B., Koepsell, T.D., Schwartz, S.M., McLerran, D., 2004. Use of pap test among Hispanics and non-Hispanic whites in a rural setting. *Prev. Med.* 38 (6), 713–722.
- Cyrus-David, M.S., Michielutte, R., Paskett, E.D., D'Agostino Jr., R., Goff, D., 2002. Cervical cancer risk as a predictor of pap smear use in rural North Carolina. *J. Rural Health* 18 (1), 67–76.
- Daley, E., Alio, A., Anstey, E.H., Chandler, R., Dyer, K., Helmy, H., 2011. Examining barriers to cervical cancer screening and treatment in Florida through a socio-ecological lens. *J. Community Health* 36 (1), 121–131.
- Drew, E.M., Schoenberg, N.E., 2011. Deconstructing fatalism: ethnographic perspectives on women's decision making about cancer prevention and treatment. *Med. Anthropol.* Q. 25 (2), 164–182.
- DuBard, C.A., Gizlice, Z., 2008. Language spoken and differences in health status, access to care, and receipt of preventive services among US Hispanics. *Am. J. Public Health* 98 (11), 2021–2028.
- Ely, G.E., White, C., Jones, K., et al., 2014. Cervical cancer screening: exploring Appalachian patients' barriers to follow-up care. *Soc. Work Health Care* 53 (2), 83–95.
- Eun, T.-J., Perkins, R.B., 2020. Screening for cervical Cancer. *Med. Clin.* 104 (6), 1063–1078.
- Evenson, K.R., Sarmiento, O.L., Ayala, G.X., 2004. Acculturation and physical activity among North Carolina Latina immigrants. *Soc. Sci. Med.* 59 (12), 2509–2522.
- Farley, M., Golding, J.M., Minkoff, J.R., 2002. Is a history of trauma associated with a reduced likelihood of cervical cancer screening? *J. Fam. Pract.* 51 (10), 827–830.
- Fleming, K., Simmons, V.N., Christy, S.M., et al., 2018. Educating Hispanic women about cervical cancer prevention: feasibility of a promotor-led charla intervention in a farmworker community. *Ethn. Dis.* 28 (3), 169.
- Fletcher, F.E., Buchberg, M., Schover, L.R., et al., 2014. Perceptions of barriers and facilitators to cervical cancer screening among low-income, HIV-infected women from an integrated HIV clinic. *AIDS Care* 26 (10), 1229–1235.
- Flores, B.E., Acton, G.J., 2013. Older Hispanic women, health literacy, and cervical cancer screening. *Clin. Nurs. Res.* 22 (4), 402–415.
- Garbers, S., Chiasson, M.A., 2004. Peer Reviewed: Inadequate functional health literacy in Spanish as a barrier to cervical cancer screening among immigrant Latinas in New York City. *Prev. Chronic Dis.* 1, 4.
- Gatos, K.C., 2018. A literature review of cervical cancer screening in transgender men. *Nursing Women's Health* 22 (1), 52–62.
- Genoff, M.C., Zaballa, A., Gany, F., et al., 2016. Navigating language barriers: a systematic review of patient navigators' impact on cancer screening for limited English proficient patients. *J. Gen. Intern. Med.* 31 (4), 426–434.
- Glick, S.B., Clarke, A.R., Blanchard, A., Whitaker, A.K., 2012. Cervical cancer screening, diagnosis and treatment interventions for racial and ethnic minorities: a systematic review. *J. Gen. Intern. Med.* 27 (8), 1016–1032.
- Greenwald, Z.R., El-Zein, M., Bouten, S., Ensha, H., Vazquez, F.L., Franco, E.L., 2017. Mobile screening units for the early detection of cancer: a systematic review. *Cancer Epidemiol. Prevent. Biomark.* 26 (12), 1679–1694.
- Guo, F., Hirth, J.M., Berenson, A.B., 2017. Human papillomavirus vaccination and pap smear uptake among young women in the United States: role of provider and patient. *J. Women's Health* 26 (10), 1114–1122.
- Hall, L.J., Tangka, F.K., Sabatino, S.A., Thompson, T.D., Graubard, B.I., Breen, N., 2018. Peer reviewed: patterns and trends in Cancer screening in the United States. *Prev. Chronic Dis.* 15.
- Hatcher, J., Studts, C.R., Dignan, M., Turner, L.M., Schoenberg, N.E., 2011. Predictors of cervical cancer screening for rarely or never screened rural Appalachian women. *J. Health Care Poor Underserved* 22 (1), 176.
- Hawkins, N.A., Benard, V.B., Greek, A., Roland, K.B., Manninen, D., Saraiya, M., 2013. Patient knowledge and beliefs as barriers to extending cervical cancer screening intervals in federally qualified health centers. *Prev. Med.* 57 (5), 641–645.
- Heberer, M.A., Komenaka, I.K., Nodora, J.N., et al., 2016. Factors associated with cervical cancer screening in a safety net population. *World J. Clin. Oncol.* 7 (5), 406.
- Hiestand, K., Horne, S., Levitt, H., 2007. Effects of gender identity on experiences of healthcare for sexual minority women. *J. LGBT Health Res.* 3 (4), 15–27.
- Hirth, J.M., Laz, T.H., Rahman, M., Berenson, A.B., 2016. Racial/ethnic differences affecting adherence to cancer screening guidelines among women. *J. Women's Health* 25 (4), 371–380.
- Hope, K.A., Moss, E., Redman, C.W., Sherman, S.M., 2017. Psycho-social influences upon older women's decision to attend cervical screening: a review of current evidence. *Prev. Med.* 101, 60–66.
- Horner-Johnson, W., Dobbertin, K., Andresen, E.M., Iezzoni, L.I., 2014. Breast and cervical cancer screening disparities associated with disability severity. *Women's Health Issues* 24 (1), e147–e153.
- Huguet, N., Angier, H., Rdesinski, R., et al., 2019. Cervical and colorectal cancer screening prevalence before and after affordable care act Medicaid expansion. *Prev. Med.* 124, 91–97.
- Huynh, J., Howard, M., Lytwyn, A., 2010. Self-collection for vaginal human papillomavirus testing: systematic review of studies asking women their perceptions. *J. Lower Genital Tract Dis.* 14 (4), 356–362.
- Institute NC, 2020. Cervical Cancer Screening.
- Jacobs, E.A., Rathouz, P.J., Karavolos, K., et al., 2014. Perceived discrimination is associated with reduced breast and cervical cancer screening: the study of Women's health across the nation (SWAN). *J. Women's Health* 23 (2), 138–145.
- Jeronimo, J., Perkins, R.B., Scalici, J., Pierce, J.Y., 2019. Should self-sampling be an option for women in the United States? *J. Lower Genital Tract Dis.* 23 (1), 54.
- Karliner, L.S., Jacobs, E.A., Chen, A.H., Mutha, S., 2007. Do professional interpreters improve clinical care for patients with limited English proficiency? A systematic review of the literature. *Health Serv. Res.* 42 (2), 727–754.
- Kasting, M.L., Wilson, S., Zollinger, T.W., Dixon, B.E., Stupiansky, N.W., Zimet, G.D., 2017. Differences in cervical cancer screening knowledge, practices, and beliefs: An examination of survey responses. *Prev. Med. Rep.* 5, 169–174.
- Kim, K., Han, H.-R., 2019. The association between health literacy and breast and cervical Cancer screening behaviors: findings from the behavioral risk factor surveillance system. *Nurs. Res.* 68 (3), 177–188.
- Kim, K., Xue, Q.-L., Walton-Moss, B., Nolan, M.T., Han, H.-R., 2018. Decisional balance and self-efficacy mediate the association among provider advice, health literacy and cervical cancer screening. *Eur. J. Oncol. Nurs.* 32, 55–62.
- Kindratt, T., Dallo, F.J., Allicock, M., Atem, F., Balasubramanian, B.A., 2020. The influence of patient-provider communication on cancer screenings differs among racial and ethnic groups. *Prev. Med. Rep.* 101086.
- Kiran, T., Davie, S., Singh, D., et al., 2019. Cancer screening rates among transgender adults: cross-sectional analysis of primary care data. *Can. Fam. Physician* 65 (1), e30–e37.
- Kronman, A.C., Freund, K.M., Heeren, T., Beaver, K.A., Flynn, M., Battaglia, T.A., 2012. Depression and anxiety diagnoses are not associated with delayed resolution of abnormal mammograms and pap tests among vulnerable women. *J. Gen. Intern. Med.* 27 (4), 452–457.
- Landis, S.H., Murray, T., Bolden, S., Wingo, P.A., 1999. Cancer statistics, 1999. *CA Cancer J. Clin.* 49 (1), 8–31.
- Lee, D.-C., Liang, H., Chen, N., Shi, L., Liu, Y., 2020. Cancer screening among racial/ethnic groups in health centers. *Int. J. Equity Health* 19, 1–7.
- Leyden, W.A., Manos, M.M., Geiger, A.M., et al., 2005. Cervical cancer in women with comprehensive health care access: attributable factors in the screening process. *J. Natl. Cancer Inst.* 97 (9), 675–683.
- Liang, J.-A., Sun, L.-M., Su, K.-P., et al., 2012. A nationwide population-based cohort study: will anxiety disorders increase subsequent cancer risk? *PLoS One* 7, 4.
- Lim, J.-W., 2010. Linguistic and ethnic disparities in breast and cervical cancer screening and health risk behaviors among Latina and Asian American women. *J. Women's Health* 19 (6), 1097–1107.
- Limmer, K., LoBiondo-Wood, G., Dains, J., 2014. Predictors of cervical cancer screening adherence in the United States: a systematic review. *J. Adv. Pract. Oncol.* 5 (1), 31.
- Lin, L., Benard, V.B., Greek, A., Hawkins, N.A., Roland, K.B., Saraiya, M., 2015. Racial and ethnic differences in human papillomavirus positivity and risk factors among low-income women in federally qualified health centers in the United States. *Prev. Med.* 81, 258–261.
- Liu, B.Y., O'Malley, J., Mori, M., et al., 2014. The association of type and number of chronic diseases with breast, cervical, and colorectal cancer screening. *J. Am. Board Fam. Med.* 27 (5), 669–681.
- Lofters, A.K., Hwang, S.W., Moineddin, R., Glazier, R.H., 2010. Cervical cancer screening among urban immigrants by region of origin: a population-based cohort study. *Prev. Med.* 51 (6), 509–516.
- Lofters, A.K., Vahabi, M., Kim, E., Ellison, L., Graves, E., Glazier, R.H., 2017. Cervical Cancer screening among women from Muslim-majority countries in Ontario, Canada. *Cancer Epidemiol. Prevent. Biomark.* 26 (10), 1493–1499.
- Madzima, T.R., Vahabi, M., Lofters, A., 2017. Emerging role of HPV self-sampling in cervical cancer screening for hard-to-reach women: focused literature review. *Can. Fam. Physician* 63 (8), 597–601.
- Majid, U., Kandasamy, S., Farrah, K., Vanstone, M., 2019. Women's preferences and experiences of cervical cancer screening in rural and remote areas: a systematic review and qualitative meta-synthesis. *Rural Remote Health* 19 (4), 5190.
- Maruthu, N.M., Bolen, S.D., Brancati, F.L., Clark, J.M., 2009. The association of obesity and cervical cancer screening: a systematic review and meta-analysis. *Obesity*. 17 (2), 375–381.
- Mattocks, K.M., Sullivan, J.C., Bertrand, C., Kinney, R.L., Sherman, M.D., Gustason, C., 2015. Perceived stigma, discrimination, and disclosure of sexual orientation among a sample of lesbian veterans receiving care in the Department of Veterans Affairs. *LGBT Health* 2 (2), 147–153.
- Maxwell, A.E., Lucas-Wright, A., Santifer, R.E., Vargas, C., Gatson, J., Chang, L.C., 2019. Promoting Cancer Screening in Partnership with Health Ministries in 9 African American Churches in South Los Angeles: An Implementation Pilot Study.
- McAlearney, A.S., Song, P.H., Rhoda, D.A., et al., 2010. Ohio Appalachian women's perceptions of the cost of cervical cancer screening. *Cancer*. 116 (20), 4727–4734.
- McCaffery, K.J., Holmes-Rovner, M., Smith, S.K., et al., 2013. Addressing health literacy in patient decision aids. *BMC Med. Informatics Decision Making* 13 (S2), S10.
- Moore de Peralta, A., Holaday, B., Hadoto, I.M., 2017. Cues to cervical cancer screening among US Hispanic women. *Hispanic Health Care Int.* 15 (1), 5–12.
- Moss, J.L., Liu, B., Feuer, E.J., 2017. Urban/rural differences in breast and cervical cancer incidence: the mediating roles of socioeconomic status and provider density. *Women's Health Issues* 27 (6), 683–691.

- Musa, J., Achenbach, C.J., O'Dwyer, L.C., et al., 2017. Effect of cervical cancer education and provider recommendation for screening on screening rates: a systematic review and meta-analysis. *PLoS One* 12 (9), e0183924.
- Nelson, H.D., Cantor, A., Wagner, J., et al., 2020. Effectiveness of patient navigation to increase Cancer screening in populations adversely affected by health disparities: a meta-analysis. *J. Gen. Intern. Med.* 1–10.
- Nguyen-Truong, C.K.Y., Hassouneh, D., Lee-Lin, F., et al., 2018. Health care providers' perspectives on barriers and facilitators to cervical cancer screening in Vietnamese American women. *J. Transcult. Nurs.* 29 (5), 441–448.
- Nolan, J., Renderos, T.B., Hynson, J., et al., 2014. Barriers to cervical cancer screening and follow-up care among black women in Massachusetts. *J. Obstet. Gynecol. Neonatal. Nurs.* 43 (5), 580–588.
- Nuño, T., Castle, P.E., Harris, R., Estrada, A., 2011. García fTYPTT, Francisco. Breast and cervical cancer screening utilization among Hispanic women living near the United States-Mexico border. *J. Women's Health* 20 (5), 685–693.
- Nuño, T., Gerald, J.K., Harris, R., Martinez, M.E., Estrada, A., García, F., 2012. Comparison of breast and cervical cancer screening utilization among rural and urban Hispanic and American Indian women in the southwestern United States. *Cancer Causes Control* 23 (8), 1333–1341.
- Oldach, B.R., Katz, M.L., 2014. Health literacy and cancer screening: a systematic review. *Patient Educ. Couns.* 94 (2), 149–157.
- World Health Organization, 2020. Eliminating Cervical Cancer.
- Padela, A.I., Peek, M., Johnson-Agbakwu, C.E., Hosseinian, Z., Curlin, F., 2014. Associations between religion-related factors and cervical cancer screening among Muslims in greater Chicago. *J. Lower Genital Tract Dis.* 18 (4), 326.
- Peitzmeier, S.M., Agénor, M., Bernstein, I.M., et al., 2017. "It can promote an existential crisis": factors influencing pap test acceptability and utilization among transmasculine individuals. *Qual. Health Res.* 27 (14), 2138–2149.
- Plourde, N., Brown, H.K., Vigod, S., Cobigo, V., 2016. Contextual factors associated with uptake of breast and cervical cancer screening: a systematic review of the literature. *Women Health* 56 (8), 906–925.
- Poorolajal, J., Jenabi, E., 2016. The association between BMI and cervical cancer risk: a meta-analysis. *Eur. J. Cancer Prev.* 25 (3), 232–238.
- Pratt, R., Mohamed, S., Dirie, W., et al., 2020. Testing a religiously tailored intervention with Somali American Muslim women and Somali American imams to increase participation in breast and cervical Cancer screening. *J. Immigr. Minor. Health* 22 (1), 87–95.
- Prevention CfDca, 2020. HPV, the Vaccine for HPV, and Cancers Caused by HPV. CDC.
- Price, J.H., Easton, A.N., Telljohann, S.K., Wallace, P.B., 1996. Perceptions of cervical cancer and pap smear screening behavior by women's sexual orientation. *J. Community Health* 21 (2), 89–105.
- Pruitt, S.L., Werner, C.L., Borton, E.K., et al., 2018. Cervical cancer burden and opportunities for prevention in a safety-net healthcare system. *Cancer Epidemiol. Prevent. Biomark.* 27 (12), 1398–1406.
- Reding, D., Lappe, K., Krueger, M., Kolehouse, B., Steneil, D., Leer, R., 1997. Cancer screening and prevention in rural Wisconsin: the greater Marshfield experience. *Wis. Med. J.* 96 (8), 32–37.
- Ridgeway, J.L., Njeru, J.W., Breitkopf, C.R., et al., 2020. Closing the gap: participatory formative evaluation to reduce Cancer screening disparities among patients with limited English proficiency. *J. Cancer Educ.* 1–9.
- Rimande-Joel, R., Ekenedo, G.O., 2019. Knowledge, belief and practice of cervical Cancer screening and prevention among women of Taraba, north-East Nigeria. *Asian Pac. J. Cancer Prev.* 20 (11), 3291–3298.
- Rodríguez-Gómez, M., Ruiz-Pérez, I., Martín-Calderón, S., Pastor-Moreno, G., Artazcoz, L., Escribà-Agüir, V., 2020. Effectiveness of patient-targeted interventions to increase cancer screening participation in rural areas: a systematic review. *Int. J. Nurs. Stud.* 101, 103401.
- Roman, L., Meghea, C., Ford, S., et al., 2014. Individual, provider, and system risk factors for breast and cervical cancer screening among underserved black, Latina, and Arab women. *J. Women's Health* 23 (1), 57–64.
- Ruben, M.A., Livingston, N.A., Berke, D.S., Matza, A.R., Shipherd, J.C., 2019. Lesbian, gay, bisexual, and transgender Veterans' experiences of discrimination in health care and their relation to health outcomes: a pilot study examining the moderating role of provider communication. *Health Equity* 3 (1), 480–488.
- Sabatino, S.A., Lawrence, B., Elder, R., et al., 2012. Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers: nine updated systematic reviews for the guide to community preventive services. *Am. J. Prev. Med.* 43 (1), 97–118.
- Sabik, L.M., Tarazi, W.W., Hochhalter, S., Dahman, B., Bradley, C.J., 2018. Medicaid expansions and cervical cancer screening for low-income women. *Health Serv. Res.* 53, 2870–2891.
- Scarinci, I.C., Garcia, F.A., Kobetz, E., et al., 2010. Cervical cancer prevention: new tools and old barriers. *Cancer: Interdisc. Int. J. Am. Cancer Soc.* 116 (11), 2531–2542.
- Seay, J., Ranck, A., Weiss, R., Salgado, C., Fein, L., Kobetz, E., 2017. Understanding transgender men's experiences with and preferences for cervical cancer screening: a rapid assessment survey. *LGBT Health* 4 (4), 304–309.
- Shah, S.K., Nakagawa, M., Lieblong, B.J., 2020. Examining aspects of successful community-based programs promoting cancer screening uptake to reduce cancer health disparity: a systematic review. *Prev. Med.* 141, 106242.
- Silvera, S.A.N., Bandera, E.V., Jones, B.A., Kaplan, A.M., Demisse, K., 2020. Knowledge of, and beliefs about, access to screening facilities and cervical cancer screening behaviors among low-income women in New Jersey. *Cancer Causes Control* 31 (1), 43–49.
- Simon, M.A., Tom, L.S., Nonzee, N.J., et al., 2015. Evaluating a bilingual patient navigation program for uninsured women with abnormal screening tests for breast and cervical cancer: implications for future navigator research. *Am. J. Public Health* 105 (5), e87–e94.
- Stewart, T., Lee, Y.A., Damiano, E.A., 2020. Do transgender and gender diverse individuals receive adequate gynecologic care? An analysis of a rural academic center. *Transgend. Health* 5 (1), 50–58.
- Studs, C.R., Tarasenko, Y.N., Schoenberg, N.E., 2013. Barriers to cervical cancer screening among middle-aged and older rural Appalachian women. *J. Community Health* 38 (3), 500–512.
- Tejeda, S., Darnell, J.S., Cho, Y.L., Stolley, M.R., Markossian, T.W., Calhoun, E.A., 2013. Patient barriers to follow-up care for breast and cervical cancer abnormalities. *J. Women's Health* 22 (6), 507–517.
- Thomas, V.N., Saleem, T., Abraham, R., 2005. Barriers to effective uptake of cancer screening among black and minority ethnic groups. *Int. J. Palliat. Nurs.* 11 (11), 562–571.
- Tracy, J.K., Schluterman, N.H., Greenberg, D.R., 2013. Understanding cervical cancer screening among lesbians: a national survey. *BMC Public Health* 13 (1), 442.
- Van Der Heide, I., Uiters, E., Jantine Schuit, A., Rademakers, J., Fransen, M., 2015. Health literacy and informed decision making regarding colorectal cancer screening: a systematic review. *Eur. J. Pub. Health* 25 (4), 575–582.
- Van Manh, A.L., Blondeau-Lecomte, E., Makoni, N., Jandorf, L., Perumalswami, P., 2020. Identifying factors associated with Cancer screening in immigrant populations living in New York City. *J. Community Health* 25, 1027–1029.
- Villani, J., Mortensen, K., 2013. Patient-provider communication and timely receipt of preventive services. *Prev. Med.* 57 (5), 658–663.
- Watson, M., Benard, V., King, J., Crawford, A., Saraya, M., 2017. National assessment of HPV and pap tests: changes in cervical cancer screening, National Health Interview Survey. *Prev. Med.* 100, 243–247.
- White, K., Garces, I.C., Bandura, L., McGuire, A.A., Scarinci, I.C., 2012. Design and evaluation of a theory-based, culturally relevant outreach model for breast and cervical cancer screening for Latina immigrants. *Ethn. Dis.* 22 (3), 274.
- Widdifield, J., Ivers, N.M., Bernatsky, S., et al., 2017. Primary care screening and comorbidity management in rheumatoid arthritis in Ontario, Canada. *Arthritis Care Res.* 69 (10), 1495–1503.
- Winer, R.L., Tiro, J.A., Miglioretti, D.L., et al., 2018. Rationale and design of the HOME trial: a pragmatic randomized controlled trial of home-based human papillomavirus (HPV) self-sampling for increasing cervical cancer screening uptake and effectiveness in a US healthcare system. *Contemp. Clin. Trials* 64, 77–87.
- Winer, R.L., Lin, J., Tiro, J.A., et al., 2019. Effect of mailed human papillomavirus test kits vs usual care reminders on cervical Cancer screening uptake, Precancer detection, and treatment: a randomized clinical trial. *JAMA Netw. Open* 2 (11), e1914729.
- Wingo, P.A., Cardinez, C.J., Landis, S.H., et al., 2003. Long-term trends in cancer mortality in the United States, 1930–1998. *Cancer.* 97 (12 Suppl), 3133–3275.
- Xiang, X., 2015. Serious psychological distress as a barrier to cancer screening among women. *Womens Health Issues* 25 (1), 49–55.
- Yeary, K.H., Alcaraz, K.I., Ashing, K.T., et al., 2020. Considering religion and spirituality in precision medicine. *Transl. Behav. Med.* 10 (1), 195–203.
- Yu, L., Sabatino, S.A., White, M.C., 2019. Peer reviewed: rural-urban and racial/ethnic disparities in invasive cervical Cancer incidence in the United States, 2010–2014. *Prev. Chronic Dis.* 16.
- Zarcadoolas, C., Pleasant, A., Greer, D.S., 2009. Advancing Health Literacy: A Framework for Understanding and Action. Vol 45. John Wiley & Sons.
- Zorogastua, K., Sriphanlop, P., Reich, A., Aly, S., Cisse, A., Jandorf, L., 2017. Breast and cervical Cancer screening among US and non US born African American Muslim women in New York City. *AIMS Public Health* 4 (1), 78.