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Acceptability of self-sampling and human papillomavirus testing among non-attenders of cervical cancer screening programs in El Salvador

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ABSTRACT

In a cross-sectional study carried out in El Salvador between February 2016 and July 2017, self-sampling and human papillomavirus (HPV) testing was found to be highly acceptable among 2019 women who had not attended a cervical cancer screening in at least 3 years. Within this population, HPV positivity rates differed according to age, marital status, number of children, and lifetime sexual partners. The proportion of women who tested HPV positive or who were diagnosed with cervical intraepithelial neoplasia grade 2 (CIN2) or more severe diagnoses (CIN2+) was similar to the general population of the area. Among the reasons for failing to participate in previous screening programs, non-attending women described logistic concerns, but also erroneous beliefs regarding HPV and cervical cancer, misconceptions regarding the screening procedure, discomfort with male providers, and confidentiality fears. The aim of this study was to identify opportunities and challenges that emerged from the use of self-sampling and HPV testing as part of a public cervical cancer control effort in a low-resource setting.

1. Introduction

Cervical cancer is preventable but remains one of the most commonly diagnosed cancers around the world (Vaccarella et al., 2013). More than 80% of new cases occur in low- and middle-income countries (LMICs), which bear 90% of cervical cancer mortality (Ferlay et al., 2014). Since cervical cancer is preceded by persistent infections with specific (high-risk) types of the human papillomavirus (HPV), several screening tests have been developed to detect the presence of these high-risk HPV types. HPV testing is more sensitive than the traditional cervical cancer screening modality, cytology (Pap smear) (Mayrand et al., 2007; Ronco et al., 2010). Unlike cytology, HPV testing can use either a provider-collected cervical swab or, with appropriate instruction, a vaginal specimen that can be collected by the woman (self-sampling). Self-sampling can potentially improve access to and uptake of screening (Snijders et al., 2013), particularly among under-screened women and non-attenders of clinic appointments (Broberg et al., 2014; Darlin et al., 2013; Gök et al., 2010; Sancho-Garnier et al., 2013; Szarewski et al., 2011).

The cost of HPV testing assays has restricted the use of this method to high-income countries. The careHPV test (QIAGEN, Gaithersburg, MD, USA) was developed to be a lower-cost assay, and has facilitated the introduction of HPV screening to LMICs (Jeronimo et al., 2014; Labani et al., 2014; Qiao et al., 2008). In El Salvador, a country with one of the highest cervical cancer mortality rates in the world (11.9%, age-standardized) (Ferlay et al., 2014), careHPV was recently utilized in the Cervical Cancer Prevention in El Salvador (CAPE) program. This 3-phase initiative was designed to assess the feasibility of a screen-and-treat approach as an alternative to conventional colposcopy and cytology management (Ferlay et al., 2014; Cremer et al., 2016; Cremer

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Fig. 1. Self-sampling visual aid used to explain the procedure to non-attending women performing the HPV test at home in El Salvador, 2016–2017.

et al., 2017). In CAPE Phase 1, a sub-sample of participants who underwent both self-sampling and provider-sampling reported acceptance of screening via self-sampling, and viewed it as equally or more desirable than provider-sampling (Rosenbaum et al., 2014). However, data also revealed that approximately 12% of targeted women who attended a CAPE Phase 1 informational session did not schedule screenings appointments or failed to show up (Alfaro et al., 2015). A pilot study of these non-attending women demonstrated the feasibility of self-sampling to increase screening uptake in this population, as 41 out of 60 women (68%) accepted the method (Laskow et al., 2017). Studies in other LMICs (e.g., Argentina, Mexico, Uganda, Kenya, Thailand) have also shown that self-sampling is acceptable to most women (Arrossi et al., 2015; Arriba et al., 2010; Ogilvie et al., 2013; Rositch et al., 2012; Trope et al., 2013), although preference for the method over provider-sampling may be mediated by education level and lack of knowledge about cervical cancer prevention (Berner et al., 2013; Tisci et al., 2003; Oranratanaphan et al., 2014).

The purpose of this study, conducted by the non-profit organization Basic Health International (BHI) in partnership with the Ministry of Health (MOH) of El Salvador, was to assess whether availability of self-

sampling and HPV testing increased screening uptake among non-attenders of public screening programs, and to determine factors associated with acceptability of this alternative screening strategy. Secondary aims were to measure the proportion of HPV positivity and cervical intraepithelial neoplasia grade 2 or higher (CIN2+) in this population, and to investigate if an association exists between HPV positivity and knowledge and perceptions of HPV and cervical cancer.

2. Methods

This cross-sectional study was conducted between February 2016 and July 2017. Participants were 2019 women drawn from rural areas in four departments (San Vicente, La Paz, Cabañas, and Cuscatlán) of the Paracentral region of El Salvador. These areas were chosen because they have been targeted by the MOH for previous cervical cancer screening campaigns. However, high-rates of gang-related violence at the time of the study posed a serious danger to the research team.

To standardize participant inclusion in the chosen catchment areas, we utilized number of homicides per year in the last six years (2010 through 2015) as a proxy for violence risk and coded the 63 target municipalities according to six levels: extreme risk (> 150), very high risk (> 100–150), high risk (> 75–100), moderate risk (> 50–75), low risk (> 25–50), and least risk (< 25). Extreme and very high risk areas municipalities were excluded, with the exception of two locations included to obtain a sufficient number of participants. This resulted in a total of 32 participating municipalities, encompassing approximately 30% of the total population of the region. Records from local health care units were used to identify eligible women who fulfilled the following criteria: 1) aged 30 to 59 years, 2) had not undergone cytology screening within the last three years, HPV screening within the last five years, or had never been screened, and 3) had not undergone procedures associated with treatment of CIN related to cervical cancer prevention (e.g., cryotherapy, cold knife conization, or hysterectomy) or did not have a history of cervical cancer.

Eligible women were visited at home by teams consisting of one MOH community health promoter and a BHI research assistant, and invited to participate in the study. If a woman was not at home, the visit was attempted two more times before she was excluded. Informed consent procedures were explained and carried out by the study coordinator. If a woman expressed that she could not or did not want to read the informed consent form, this was read in the presence of a relative or another witness who was familiar to her. All materials were presented in Spanish. After study procedures were explained, research assistants administered a questionnaire to consenting participants. This first instrument collected sociodemographic information, health and sexual history, previous screening history, cervical cancer and HPV risk perception, and reasons for non-participation in previous screening programs. To confirm that women met the under-screened eligibility criteria, women were asked about both their last pelvic exam ("How often do you visit the doctor for check-ups - when you are not sick or pregnant, only with the intention of seeing if everything is all right?") and specifically about their last cervical cancer screening ("When was the last time you did a check-up to detect cervical cancer?"). Following the questionnaire, research assistants explained self-sampling verbally and with the use of a visual aid (Fig. 1). Women were then invited to perform unsupervised self-sampling at a location of their choosing in the home, usually a bedroom or a bathroom. Finally, separate sets of questions were administered to women who accepted and those who declined self-sampling to explore the reasons underlying their decision.

Test tubes were transported via cold chain and stored at the BHI offices in San Salvador at temperatures between 4 and 8 °C. In these conditions, samples can remain stable for up to 30 days. Once 90 specimens (a batch) were collected, the batch was sent to a private laboratory at which a trained technician tested the specimens for HPV using the careHPV machine. Women received results at their home about six weeks after self-sampling. Research assistants recommended a one-year follow-up screening within the MOH public health system to women testing HPV-negative. While the WHO recommends a five-year screening interval for provider-sampled HPV testing (WHO, 2013), we chose a more conservative schedule because HPV self-sampling is not a WHO-endorsed screening modality. Women testing HPV-positive were visited by the research coordinator who explained the recommended follow-up protocol and, if women accepted, scheduled an appointment at a MOH colposcopy clinic within three to five days.

The follow-up visit included colposcopy, biopsy, and, if not contraindicated, cryotherapy treatment with nitrous oxide. Women ineligible for cryotherapy underwent loop electrosurgical excision procedure (LEEP) in the same visit or were referred for appropriate follow-up, as per El Salvador clinical guidelines (Ministerio de Salud, Viceministerio de Politicas de Salud, 2015). All biopsies were reviewed by an expert gynecologic pathologist. Treated women were advised to return one year later for a check-up. An incentive in the form of a supermarket voucher was offered to women who completed their clinical follow-up.

All participants provided informed consent and study procedures were approved by the Cleveland Clinic Internal Review Board and the National Committee on Health Research Ethics of the Higher Health Council of El Salvador.

2.1. Sample size and statistical analysis

Sample size was calculated taking into account the number of women between 30 and 59 years old in the four departments according to the national census (n = 49,898), and the number of women within that age range (n = 14,768) in the included municipalities (those deemed sufficiently safe). The study aimed to approach up to 2049 women in order to recruit approximately 1637 women agreeing to participate, assuming an 80% participation rate. Given these assumptions, the study would be able to estimate the proportion of women accepting self-sampling with a precision (i.e. half-width of the 95% confidence interval) of 1.7%. That is, the 95% confidence interval would be 78.3% to 81.7%. In addition, if 80% of women performed self-sampling (1637 women) and 2% of these women have CIN2+, this study would be able to estimate the CIN2+ rate with a precision of approximately 0.7%, thus, the 95% confidence interval would be 1.3% to 2.7%. Under the same participation rate assumptions, if 12% of the women test HPV positive, the study would be able to estimate HPV positivity with a precision of 1.6%, that is, with a 95% confidence interval of 10.4% to 13.6%.

We calculated percentages to describe sociodemographic and clinical characteristics, perception of cervical cancer and HPV risk, and reasons for not attending previous screenings. Univariate analyses were conducted to compare associations between HPV status and demographic and risk perception variables; significance tests were performed using chi-square and Fisher's exact test as appropriate. The overall proportion of CIN2+ among the study population was estimated from the sub-sample of women who tested HPV positive and returned for colposcopy and any of the possible treatments (cryotherapy or LEEP). Diagnoses were determined through biopsy readings. All statistical analyses were performed using Stata v. 14.1.

3. Results

Of 2019 participants, 22 enrolled women were excluded from the analyses because their age made them ineligible for the study (patient flow is shown in Fig. 2). Of the remaining 1989 women, 1869 (93.96%) agreed to participate and provided informed consent, while 120 either refused or could not be contacted. Self-sampling was performed by all but two of the 1867 consented women. One of these women declined self-sampling after consenting to the study and the other woman's husband did not allow her to perform the procedure. Given that there was virtually no variation in the decision to self-sample among

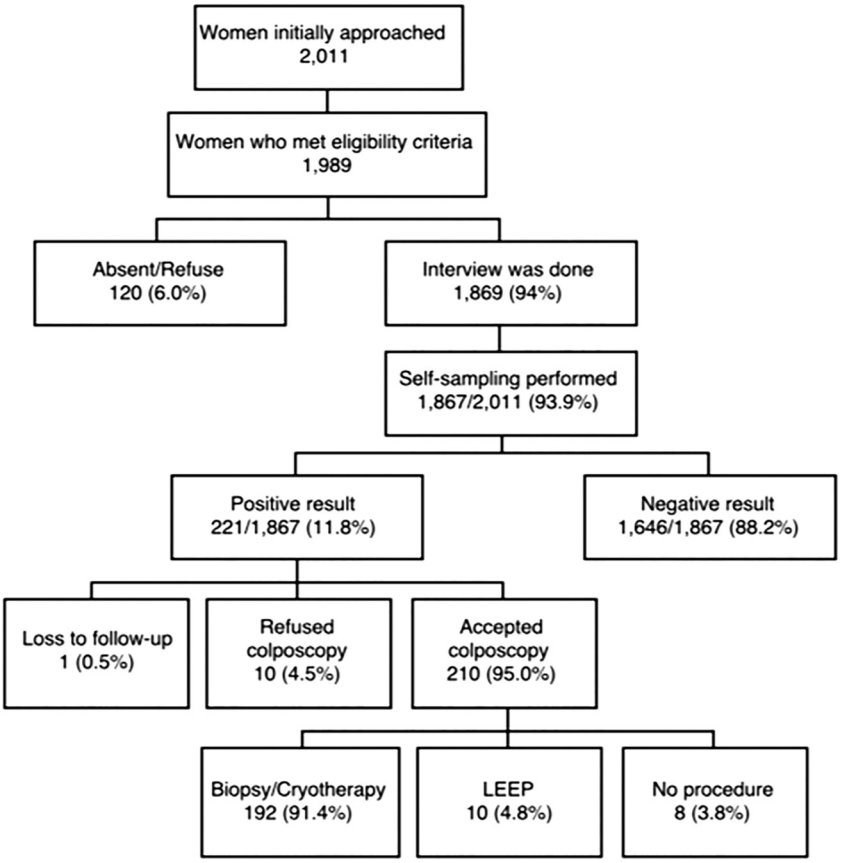

Fig. 2. Flow diagram of study participants in El Salvador, 2016–2017.
Note: Women younger than 30 years (n = 22) were excluded from the initial sample of 2011.

consented women, it was not possible to detect statistical associations between participation in HPV screening and other study variables.

Overall, 221 (11.8% [95% CI: 10.4, 13.3]) women tested HPV positive. Sociodemographic characteristics of participants and their association with HPV status are shown in Table 1. Mean age was 42.86 ± 8.38, with 59.5% participants over 40 years old. Most women had an elementary level of formal education or less (71.6%); reported being married, widowed, or partnered (70.4%); and had more than three children (64.4%). Significant differences by HPV status were found among women of different age groups, education levels, marital status, number of children, lifetime sexual partners, and those who worked outside home.

Among women who tested HPV positive, 210 (95.0%) accepted colposcopy, 10 (4.5%) declined colposcopy, and 1 (0.45%) was lost to follow-up. Most women who attended the follow-up visit underwent biopsy and endocervical curettage (ECC) followed by cryotherapy (n = 192). LEEP was performed on ten women with contraindications for cryotherapy. Of the eight women who did not receive biopsy, cryotherapy or LEEP, three were referred to the district hospital for further care, three had medical conditions that prevented treatment, and two refused to receive cryotherapy or LEEP treatment.

Out of 202 women testing HPV-positive who attended colposcopy and received biopsies or LEEP, histopathology analyses identified 1 (0.5%) adenocarcinoma, 21 CIN grade 3 (CIN3) (10.4%) and 9 CIN grade 2 (CIN2) (4.5%). Detailed disease proportions are shown in Table 2. Therefore, the yield of CIN2+ in this population of 1989 women who had not attended screening and were offered self-sampling HPV testing was 1.6% (95% CI: 1.0, 2.1). HPV positivity was significantly associated with a screening history of more than five years since last screen, but not with knowledge or risk perception of HPV and cervical cancer (Table 3).

Out of 27 items, the reasons most commonly cited (indicated by > 20% participants) for not attending previous screening appointments were embarrassment at being seen by a male physician (55.6%), lack of symptoms (38.9%), belief that the test was not necessary (27.5%), long clinic wait times (22.5%), belief that the screening would be painful (27.1%), fear that treatment would be needed (20.5%), belief that test results would not be kept confidential (20.1%), and fear that the person might lose part of the uterus during treatment (22.9%) (Table 4). The vast majority of women that accepted self-sampling expressed willingness to perform the procedure again (98.6%), and most agreed with statements highlighting positive aspects of the test (e.g., it is easy to perform, it can be performed at home, it is more comfortable to do the exam oneself). About half (50.2%) expressed unwillingness to be seen by a male physician, and a smaller number mentioned dislike of having a pelvic exam (19.9%) and distrust of local doctors (9.5%) as factors in their decision to accept the self-sampling test (Table 5). Overall satisfaction with the experience was high, with five assessment items averaging between 4.2 and 4.6 on a 5-point scale (Table 6).

4. Discussion

Self-sampling and HPV testing was highly acceptable to women in El Salvador who had previously failed to attend clinic-based appointments through various public cervical cancer prevention programs. Moreover, the method was viewed favorably by most women. These results demonstrate the feasibility of at-home self-sampling as a strategy to reach under-screened and never-screened women in an LMIC.

Although this study targeted non-attenders of public screening programs, HPV positivity rates and CIN2+ diagnoses were within the ranges found in the general population of the same regional departments (Cremer et al., 2016; Cremer et al., 2017). The overwhelming

Table 1
Sociodemographic characteristics of women by self-sampling result in El Salvador, 2016–2017.

Variable	Overall	Self-sampling		p-Value[a]
		Positive	Negative	
Age in years, n(%)				
30 to 40	756 (40.5)	116 (52.5)	640 (38.9)	< 0.001
Older than 40	1111 (59.5)	105 (47.5)	1006 (61.1)	
Education, n(%)				
None/elementary	1336 (71.6)	143 (64.7)	1193 (72.5)	0.02
Middle/high	531 (28.4)	78 (35.3)	453 (27.5)	
Marital status, n(%)				
Married/widowed/ partnered	1315 (70.4)	1193 (72.5)	122 (55.2)	< 0.001
Divorced/separated/ single	552 (29.6)	453 (27.5)	99 (44.8)	
Number of alive children, n(%)				
0–2	665 (35.6)	107 (48.4)	558 (33.9)	< 0.001
3–4	660 (35.4)	64 (29.0)	596 (36.2)	
≥5	541 (29.0)	50 (22.6)	491 (29.9)	
People living in the house, n(%)				
1–4	1235 (66.2)	146 (66.1)	1089 (66.2)	0.96
≥5	632 (33.9)	75 (33.9)	557 (33.8)	
Smoking status, n(%)				
Never smoker	1715 (91.9)	197 (89.1)	1518 (92.2)	0.14
Less than 100 cigarettes in lifetime	40 (2.1)	4 (1.8)	36 (2.2)	
More than 100 cigarettes in lifetime	112 (6.0)	20 (9.1)	92 (5.6)	
Age at first sexual intercourse				
Younger than 16	476 (26.7)	66 (30.6)	410 (26.2)	0.15[b]
16–19	819 (45.9)	86 (39.8)	733 (46.8)	
Older than 19	489 (27.4)	64 (29.6)	425 (27.1)	
Lifetime number of sexual partners				
1	846 (46.8)	69 (32.1)	777 (48.8)	< 0.001[b]
2–3	784 (43.4)	113 (52.6)	671 (42.2)	
> 3	176 (9.8)	33 (15.4)	143 (9.0)	
Working out of home, n (%)	516 (27.6)	77 (34.8)	439 (26.7)	0.01

Among women who accepted to perform self-sampling.
Numbers may not add 100% due to rounding error.
[a] Estimated using chi-squared or Fisher exact as appropriate.
[b] Not sure/unsure women were excluded from the calculation.

Table 2
Worst histopathology result of biopsy, endocervical curettage (ECC) or loop electrical excisional procedure (LEEP) among 202 women testing HPV positive and attending colposcopy in El Salvador, 2016–2017.

	Number of women with result	Proportion (95% CI)
Normal	159	78.7 (72.5, 83.9)
CIN 1	12	5.9 (3.4, 10.2)
CIN 2	9	4.5 (2.3, 8.4)
CIN 3	21	10.4 (6.9, 15.5)
Adenocarcinoma	1	0.5 (0.1, 3.5)
Total	202	100%

majority of women accepted HPV self-sampling. However, attitudinal and educational variables may have an impact in women's lack of participation in screening programs. While some logistic challenges were selected as reasons for previous lack of attendance (e.g., long clinic wait times, inconvenient appointment times), these were not cited as frequently as beliefs and fears. For example, in a randomly chosen sub-sample of women who participated in CAPE Phase 1 (Rosenbaum et al., 2014), only a third of women cited embarrassment and privacy as reasons to prefer self-sampling. By contrast, more than half of women in this group indicated embarrassment or concern at being examined by a male physician as factors in their acceptance of self-sampling. A fifth expressed distrust of physicians or doubted that the confidentiality of results would be maintained if the test was performed in a clinical setting. Since health promoters and clinic staff who took part in the study were local residents and well-known to participants, some women feared their HPV status could be divulged in their communities.

Table 3
Knowledge, risk perception and screening history by self-sampling result.

Variable	Overall	Self-sampling		p-Value[a]
		Positive	Negative	
Heard of HPV-infection before, n(%)	817 (43.8)	108 (48.9)	709 (43.1)	0.10
Prior history of HPV-infection, n(%)				
Yes	62 (3.3)	7 (3.2)	55 (3.3)	0.98
No	1122 (60.1)	134 (60.6)	988 (60.0)	
Not sure	683 (36.6)	80 (36.2)	603 (36.6)	
Could have an HPV-infection in the future? n(%)				
Yes	252 (13.5)	38 (17.2)	214 (13.0)	0.19
No	829 (44.4)	90 (40.7)	739 (44.9)	
Not sure	786 (42.1)	93 (42.1)	693 (42.1)	
How severe do you think is the HPV-infection? n(%)				
Not severe/somewhat severe	25 (1.3)	2 (0.9)	23 (1.4)	0.81
Severe	1063 (56.9)	121 (54.8)	942 (57.2)	
Extremely severe	641 (34.3)	83 (37.6)	558 (33.9)	
Don't know/unsure	138 (7.4)	15 (6.8)	123 (7.5)	
How severe do you think is cervical cancer? n(%)				
Not severe/somewhat severe	9 (0.5)	1 (0.5)	8 (0.5)	0.70
Severe	870 (46.6)	97 (43.9)	773 (47.0)	
Extremely severe	924 (49.5)	113 (51.1)	811 (49.3)	
Don't know/unsure	64 (3.4)	10 (4.5)	54 (3.3)	
Last screen for cervical cancer, n(%)				
3–5 years	1138 (61.0)	119 (53.9)	1019 (61.9)	0.06
> 5	608 (32.6)	84 (38.0)	524 (31.8)	0.04[b]
Never	114 (6.1)	17 (7.7)	97 (5.9)	
Don't know/unsure	7 (0.4)	1 (0.5)	6 (0.4)	
Previous screen was part of which of the following?				
Regular check-up	1653 (94.3)	191 (93.6)	1462 (94.4)	0.84
To check specific problem	99 (5.7)	13 (6.4)	86 (5.6)	
Don't know/unsure	1 (0.1)	0	1 (0.1)	

Among women who accepted to perform self-sampling.
Numbers may not add 100% due to rounding error.
[a] Estimated using chi-squared or Fisher exact as appropriate.
[b] Comparing only women with last screen at 3–5 years vs. > 5 years.

Thus, among this under-screened population, some degree of mistrust in the healthcare system may explain why women failed to attend previous screenings. This may also contribute to why women agreed that the test made them feel empowered and to their confidence in their own ability to perform the self-sampling accurately. These findings stand in contrast to other studies in LMICs where women's acceptability of self-sampling is tempered by insecurity at completing the test correctly or a belief that provider-collection is more accurate (Ogilvie et al., 2013; Tisci et al., 2003). Despite positive attitudes toward self-sampling, women also reported low knowledge levels and numerous misconceptions regarding HPV and cervical cancer.

The obstacles to achieving high screening coverage with conventional cytology followed by colposcopy management programs in LMICs may stem from infrastructural inadequacies (i.e., lack of trained colposcopists, few clinics), but also from women's unfavorable interactions with public health systems and lack of education. For non-attending women in El Salvador, the convenience and comfort of at-home

Table 4
Reasons for not attending previous screening appointments by self-sampling result (multiple responses allowed).

Variable	Overall	Self-sampling result		*p*-Value[a]
		Positive	Negative	
Total, n(%)	1981	227	1662	
Practical reasons, n(%)				
The appointment was at an inconvenient time	178 (9.5)	17 (7.7)	161 (9.8)	0.32
You were not able to get time off work	275 (14.7)	41 (18.6)	234 (14.2)	0.09
You don't need to do the test	513 (27.5)	67 (30.3)	446 (27.1)	0.32
You could not pay for transportation	94 (5.0)	7 (3.2)	87 (5.3)	0.18
You did not have adequate transportation	99 (5.3)	11 (5.0)	88 (5.4)	0.82
You were not able to find adequate childcare	191 (10.2)	22 (10.0)	169 (10.3)	0.88
You don't know what the test is for	30 (1.6)	0	30 (1.8)	0.04
You forgot you had an appointment	147 (7.9)	14 (6.3)	133 (8.1)	0.37
Your spouse/family member would not let you go	14 (0.8)	0	14 (0.9)	0.40
You had to wait too long at the clinic	420 (22.5)	55 (24.9)	365 (22.2)	0.35
You were pregnant	17 (0.9)	3 (1.4)	14 (0.9)	0.44
Want to do the test in another time	359 (19.2)	50 (22.6)	309 (18.8)	0.16
Emotional, n(%)				
You are embarrassed about being seen by a male physician	1038 (55.6)	114 (51.6)	924 (56.1)	0.19
You think the screening will be painful	505 (27.1)	67 (30.3)	438 (26.6)	0.26
You had a bad experience with pelvic exams in the past	282 (15.1)	39 (17.7)	243 (14.8)	0.24
You are afraid of the test result	369 (19.8)	53 (24.0)	316 (19.2)	0.09
You are afraid you will need treatment	382 (20.5)	43 (19.5)	339 (20.5)	0.69
If you believe cancer can't but cured, why should you get test?	80 (4.3)	7 (3.2)	73 (4.4)	0.39
You are afraid to lose “part of your uterus” to surgery/biopsy	427 (22.9)	48 (21.7)	379 (23.0)	0.64
You are afraid of your spouse/partner reaction	105 (5.6)	16 (7.2)	89 (5.4)	0.27
Risk, n(%)				
You are not at risk for HPV	62 (3.3)	9 (4.1)	53 (3.2)	0.46
You don't have symptoms so you don't need to go to the clinic	727 (38.9)	90 (40.7)	637 (38.7)	0.58
You are not at risk for cervical cancer	88 (4.7)	12 (5.4)	76 (4.6)	0.57
You are not sexually active	365 (19.6)	37 (16.7)	328 (19.9)	0.27
Data and information safety, n(%)				
You are afraid of results being	375 (20.1)	49 (22.2)	326 (19.8)	0.42
Your results will not be safely kept	258 (13.8)	32 (14.5)	226 (13.7)	0.76
You do not trust the doctors	367 (19.7)	44 (19.9)	323 (19.6)	0.91

[a] Estimated using chi-squared or Fisher's exact.

Table 5
Reasons for accepting self-sampling (multiple responses allowed).

Reason	Accepted self-sampling	
	N	%
You don't trust doctors in your healthcare unit	178	9.5
You don't want a pelvic exam	373	19.9
You don't want to be examined by a male physician	937	50.2
You felt less embarrassed by doing the exam yourself	1746	93.5
You felt more comfortable doing the exam yourself	1811	97.0
You felt self-collection saves time	1839	98.5
Self-collecting made you feel empowered/in control	1824	97.7
Self-collection is an easy process	1810	96.9
You like that self-collection can be performed in your home	1835	98.3
Would you preform self-collection again?		
Yes	1841	98.6

Table 6
Overall satisfaction with the self-sampling process.

Possible scores from 0 to 5 (0 = least; 5 = most)	Accepted self-sampling			
	Mean	Mode	Median	Range
Satisfaction with the kit	4.2	4	4	1, 5
Satisfaction with the oral explanations	4.5	5	5	2, 5
Satisfaction with the material used in explanations	4.4	4	4	1, 5
Overall comfort with self-sampling	4.6	5	5	1, 5
Confidence that you completed the test accurately	4.2	4	4	1, 5

screening appear to be compounded by negative attitudes toward various aspects of clinic visits. However, it is essential to balance participants' concerns with a realistic assessment of available resources. A sustainable screening program must include the local healthcare providers who play a central role in recruiting and motivating women to attend screening. Strategies to assuage participants' concerns include highlighting the importance of confidentiality regulations during program staff training and to provide a fuller explanation of the steps taken to ensure confidentiality to those invited to take part in the study. Another possibility is to hold community workshops that dispel erroneous beliefs and inform women about the risks of HPV infection and the need for regular screening.

An additional consideration in planning future interventions in LMICs is the use of an HPV test that provides flexibility in storage and transportation. While the tests used in this study were stored at 4–8 °C to ensure stability for up to one month, they can be maintained for up to 14 days if stored at temperatures of 15–30 °C. This makes it a feasible alternative for use in a wide variety of conditions, from areas with unstable energy grids to field-based campaigns where refrigeration is not immediately possible.

4.1. Study limitations and strengths

High rates of gang-related violence prevented us from reaching women in some areas. By focusing on under-screened and never-screened women in safer municipalities, it is possible to miss important factors related to insecurity that impact screening acceptability. There are also limitations to the screening strategy presented here. Open-ended questions in our data collection instruments revealed that some women did not attend past screenings at their nearest health unit because they felt embarrassed and uncomfortable at being examined by

local staff members whom they knew well. Since colposcopies in the study were carried out by external providers (BHI staff), this may account for the high participation of HPV positive women in the follow-up visit. In addition, research assistants had regular means of transportation, which may not always be available or economically feasible in LMICs. Despite these constraints, this approach incorporated and relied on existing resources of the MOH, including the support of community health promoters and clinics where the research team could house colposcopy equipment and bring trained staff for examinations. This provides a more accurate reflection of the program's sustainability and can serve as an initial blueprint for similar initiatives in other LMICs where public resources can be combined with other initiatives to reach under-screened populations.

5. Conclusions

HPV testing via self-sampling performed at home was overwhelmingly acceptable to under-screened and never-screened women in El Salvador who had been unsuccessfully targeted by previous screening programs. Women reported high levels of satisfaction with the experience and almost universally expressed a willingness to perform the test in the future. Participants cited embarrassment at being examined by a male physician, distrust of the healthcare system, and various types of misinformation surrounding screening as factors impacting their previous lack of participation in clinic-based screening and their acceptance of the self-sampling test. Despite low education levels and widely-held misconceptions, the high acceptability of a self-sampled HPV test in this study indicates that the method can be effective at overcoming barriers to conventional cervical cancer screening. These findings will facilitate the El Salvador MOH's endorsement and inclusion into local guidelines of HPV testing via self-sampling as an option to reach under-screened women.

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References

Alfaro, K.M., Gage, J.C., Rosenbaum, A.J., et al., 2015. Factors affecting attendance to cervical cancer screening among women in the Paracentral Region of El Salvador: a nested study within the CAPE HPV screening program. BMC Public Health 15 (1), 1058.

Arriba, L.N., Enerson, C.L., Belinson, S., et al., 2010. Mexican Cervical Cancer Screening Study II: acceptability of human papillomavirus self-sampler. Int. J. Gynecol. Cancer 20 (8), 1415–1423.

Arrossi, S., Thouyaret, L., Herrero, R., et al., 2015. Effect of self-collection of HPV DNA offered by community health workers at home visits on uptake of screening for cervical cancer (the EMA study): a population-based cluster-randomised trial. Lancet Glob. Health 3 (2), e85-e94.

Berner, A., Hassel, S.B., Tebeu, P.M., et al., 2013. Human papillomavirus self-sampling in Cameroon: women's uncertainties over the reliability of the method are barriers to acceptance. J. Low. Genit. Tract Dis. 17 (3), 235–241.

Broberg, G., Gyrd-Hansen, D., Miao Jonasson, J., et al., 2014. Increasing participation in cervical cancer screening: offering a HPV self-test to long-term non-attendees as part of RACOMIP, a Swedish randomized controlled trial. Int. J. Cancer 134 (9), 2223–2230.

Cremer, M.L., Maza, M., Alfaro, K.M., et al., 2016. Introducing a high-risk HPV DNA test into a public sector screening program in El Salvador. J. Low. Genit. Tract Dis. 20 (2), 145–150.

Cremer, M., Maza, M., Alfaro, K., et al., 2017. Scale-up of an human papillomavirus testing implementation program in El Salvador. J. Low. Genit. Tract Dis. 21 (1), 26–32.

Darlin, L., Borgfeldt, C., Forslund, O., et al., 2013. Comparison of use of vaginal self-sampling and HPV testing and offering flexible appointments as strategies to reach long-term non-attending women in organized cervical screening. J. Clin. Virol. 58 (1), 155–160.

Ferlay, Soerjomataram, I., Dikshit, R., et al., 2014. GLOBOCAN 2012 v1.1, cancer incidence and mortality worldwide. Available from: http://globocan.iarc.fr/, Accessed date: 1 December 2017.

Gök, M., Heideman, D.A., van Kemenade, F.J., et al., 2010. HPV testing on self collected cervicovaginal lavage specimens as screening method for women who do not attend cervical screening: cohort study. BMJ 340, c1040.

Jeronimo, J., Bansil, P., Lim, J., et al., 2014. A multicountry evaluation of careHPV testing, visual inspection with acetic acid, and papanicolaou testing for the detection of cervical cancer. Int. J. Gynecol. Cancer 24 (3), 576.

Labani, S., Asthana, S., Sodhani, P., et al., 2014. CareHPV cervical cancer screening demonstration in a rural population of north India. Eur. J. Obstet. Gynecol. Reprod. Biol. 176, 75–79.

Laskow, B., Figueroa, R., Alfaro, K.M., et al., 2017. A pilot study of community-based self-sampling for HPV testing among non-attenders of cervical cancer screening programs in El Salvador. Int. J. Gynecol. Obstet. 138 (2), 194–200.

Mayrand, M.H., Duarte-Franco, E., Rodrigues, I., et al., 2007. Human papillomavirus DNA versus Papanicolaou screening tests for cervical cancer. N. Engl. J. Med. 357 (16), 1579–1588.

Ministerio de Salud, Viceministerio de Politicas de Salud, 2015. Lineamientos técnicos para la prevención y control del cáncer cérvico uterino y de mama [Internet]. 1o Edición. Diseñarte SA de CV, San Salvador, El Salvadorhttp://asp.salud.gob.sv/regulacion/pdf/lineamientos/lineamientos_prevencion_cancer_cervico_uterino_y_de_mama_v3.pdf, Accessed date: 30 January 2018.

Ogilvie, G.S., Mitchell, S., Sekikubo, M., et al., 2013. Results of a community-based cervical cancer screening pilot project using human papillomavirus self-sampling in Kampala, Uganda. Int. J. Gynecol. Obstet. 122 (2), 118–123.

Oranratanaphan, S., Termrungruanglert, W., Khemapech, N., 2014. Acceptability of self-sampling HPV testing among Thai women for cervical cancer screening. Asian Pac. J. Cancer Prev. 15 (17), 7437–7441.

Qiao, Y.L., Sellors, J.W., Eder, P.S., et al., 2008. A new HPV-DNA test for cervical-cancer screening in developing regions: a cross-sectional study of clinical accuracy in rural China. Lancet Oncol. 9 (10), 929–936.

Ronco, G., Giorgi-Rossi, P., Carozzi, F., et al., 2010. Efficacy of human papillomavirus testing for the detection of invasive cervical cancers and cervical intraepithelial neoplasia: a randomised controlled trial. Lancet Oncol. 11 (3), 249–257.

Rosenbaum, A.J., Gage, J.C., Alfaro, K.M., et al., 2014. Acceptability of self-collected versus provider-collected sampling for HPV DNA testing among women in rural El Salvador. Int. J. Gynecol. Obstet. 126 (2), 156–160.

Rositch, A.F., Gatuguta, A., Choi, R.Y., et al., 2012. Knowledge and acceptability of pap smears, self-sampling and HPV vaccination among adult women in Kenya. PLoS One 7 (7), e40766.

Sancho-Garnier, H., Tamalet, C., Halfon, P., et al., 2013. HPV self-sampling or the Pap-smear: a randomized study among cervical screening nonattenders from lower socioeconomic groups in France. Int. J. Cancer 133 (11), 2681–2687.

Snijders, P.J., Verhoef, V.M., Arbyn, M., et al., 2013. High-risk HPV testing on self-sampled versus clinician-collected specimens: a review on the clinical accuracy and impact on population attendance in cervical cancer screening. Int. J. Cancer 132 (10), 2223–2236.

Szarewski, A., Cadman, L., Mesher, D., et al., 2011. Self-sampling and HPV testing as an alternative strategy in non-attenders for cervical screening–a randomised controlled trial. Br. J. Cancer 104 (6), 915–920.

Tisci, S., Shen, Y.H., Fife, D., et al., 2003. Patient acceptance of self-sampling for human papillomavirus in rural China. J. Low. Genit. Tract Dis. 7 (2), 107–116.

Trope, L.A., Chumworathayi, B., Blumenthal, P.D., 2013. Feasibility of community-based careHPV for cervical cancer prevention in rural Thailand. J. Low. Genit. Tract Dis. 17 (3), 315–319.

Vaccarella, S., Lortet-Tieulent, J., Plummer, M., et al., 2013. Worldwide trends in cervical cancer incidence: impact of screening against changes in disease risk factors. Eur. J. Cancer 49 (15), 3262–3273.

WHO, 2013. Guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. World Health Organizationhttp://apps.who.int/iris/bitstream/10665/94830/1/9789241548694_eng.pdf?ua=1, Accessed date: 29 January 2018.