Recruitment strategies to promote uptake of cervical cancer screening in West Cameroon

Marie-Anne Pham (hienanh.marieanne.pham@gmail.com)
University of Geneva

Khadidja Benkortbi
University of Geneva

Bruno Kenfack
University of Dschang

Evelyn Tincho
University Center Hospital of Yaoundé

Jessica Sormani
University Hospital of Geneva

Ania Wisniak
University Hospital of Geneva

Sophie Lemoupa
District Hospital of Dschang

Engelbert Manga
Help and Reintegration Center for Disabled Youth, Obala

Pierre Vassilakos
University Hospital of Geneva

Patrick Petignat
University Hospital of Geneva

Research Article

Keywords: cervical cancer screening, recruitment strategies, community health workers, cost-effectiveness

DOI: https://doi.org/10.21203/rs.3.rs-525066/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Objectives

World Health Organization’s (WHO) global strategy for cervical cancer elimination has set for 2030 that all countries reach the target of 70% coverage screening rate. Communities’ sensitization through media is often used but community health workers’ (CHW) involvement may contribute to improve screening coverage. We aimed to assess effectiveness and costs of two cervical cancer screening recruitment strategies conducted in a low resource setting.

Methods

The study was conducted in West region of Cameroon precisely in Dschang Health District, a community of 300’000 people. From September 2018 to February 2020, we recruited and screened women in a cervical cancer single-visit prevention campaign at Dschang District Hospital. For the first nine months, recruitment was only based on Community Information Channels (CIC) (i.e. street banners). Since the tenth month, participation of CHW was added for recruitment in the community after training for cervical cancer counselling. Population recruitment was compared between the two strategies by assessing the number of recruited women, and direct costs (CHW costs include recruitment, teaching, certification, identification badge, flyers, transport, and salary). Interventions’ cost-effectiveness is expressed using an incremental cost-effectiveness ratio (ICER).

Results and discussion

During the period under study, 1940 women were recruited, HPV positive rate was 18.6% (n = 361) and 39 cervical intraepithelial neoplasia grade 2 or worse (CIN2+) (10.8% of HPV-positive women) were diagnosed. Among participants, 69.9% (n = 1356) of women were recruited through CIC as compared to 30.1% (n = 584) by CHW. The cost per screened woman and CIN2+ diagnosed was higher in the CHW group as compared to the CIC group. The ICER was 6.45 USD or 16.61 2021Int'l$ per screened woman recruited by CHW. In rural areas, recruitment increased from 12.1–61.4% between CIC-led and CHW-led intervention. These outcomes highlight the importance of training, preparing, and deploying CHWs to screen hard-to-reach women, considering that up to 45% of the Cameroon population lives in a rural area.

Conclusion

CHW offer an important complement to CIC for expanding coverage in a rural sub-Saharan Africa setting like West Cameroon. CHW have a central role in building awareness and motivation for improving cervical cancer screening participation.

Background

Nearly 90% of cervical cancer (CC) deaths worldwide occur in low- and middle-income countries with a mortality rate almost three times higher than in more economically developed countries. (1) Among countries with the highest CC burden, 19 of the top 20 are located in Sub-Saharan Africa. (2) A key reason for persistent high morbidity and mortality is the lack of sufficient screening coverage. (3) The main challenges of introducing an efficient screening program in Sub-Saharan countries are limited resources and health infrastructure, shortage of caregivers, a low level of awareness, and insufficient attention to women's health, especially in rural populations. (4, 5) The result is that the vast majority of women cannot access screening and treatment.

In response to this growing problem, the World Health Organization (WHO) has launched the 90-70-90 targets for 2030 with the aim to eliminate cervical cancer. (6) These targets include (i) a coverage of 90% of girls vaccinated, (ii) 70% of women screened, and (iii) treatment of 90% of women identified with cervical disease. To reach the second and third WHO target, the recommendation is to use high performance HPV tests and associate screening and immediate treatment if needed (“screen-and-treat” approach). (7, 8)

Dschang Health District (West Cameroon) is rural, urban and semi-urban community of over 300’000 inhabitant. (9) In September 2018, we implemented a screening and treatment program in Dschang District Hospital, based on a single visit approach called 3T (for Test, Triage and Treat). The program is scheduled for a five-year period (2018–2023) and follows the WHO’s recommendations to screen women between the ages 30–49 years at least once every five years. According to the national census, we estimated that about 18’000 women should be screened in Dschang Health District to reach the 70% coverage following WHO’s “90-70-90 targets” by 2030. (6) Therefore, an annual recruitment of 3’600 women should be obtained to reach the second WHO target.
The strategy includes self-sampling for primary screening with rapid HPV testing (Self-HPV), followed by VIA and Lugol's iodine (VIA/VILI) for triage of HPV-positive women and treatment with thermal ablation or large loop excision of the transitional zone (LLETZ) if required. (10, 11)

Performance of the program and ultimately its impact on cervical cancer prevention highly depends on the population screening coverage and on reaching the targeted population which may be substantially enhanced by raising awareness with educational interventions. Outreach strategies to encourage participation in prevention program may be viewed as low priority activities and may suffer from a lack of resources by competing with other healthcare issues such as infectious diseases. (12, 13) Several challenges are raised regarding the optimal recruitment strategies to reach women about screening information and motivate them to participate. Screening intervention should also consider the large geographic expense and the dispersed population living in these areas and adapted to population needs.

Methods for improving awareness among the community for Community Information Channels (CIC) (advertising, radio, and television) are traditional choices for cervical cancer awareness having the potential to reach a large number of people within a short period of time. However, implication of community health workers’ (CHW) living in the community may have contribute for education and motivation improvement in screening coverage. Community health workers' definition varies according to different cultures and healthcare systems. In Cameroon, they are trusted community members, integrated into the community health system without any formal professional or paraprofessional medical training. (14–19) The purpose of this study was to analyze and compare the recruitment rate and costs of the two different recruitment strategies.

Methods

Setting - Dschang Health District is divided into 22 health areas, which we separated into 4 zones based on accessibility to the district hospital (e.g. distances, roads, weather, and transportation means available). Zone 1 was defined as the most accessible area (urban) and Zone 4 the least accessible area (rural).

CIC recruitment - From September 2018 to May 2019, recruitment was entirely based on announcements made in women's associations, churches, and integrated health centers (chief nurses of each center were informed of this project). Local Radio broadcasting was made twice a week for one month. Large street banners were hung at the entrance and exit of the district of Dschang for a few months. In Dschang District Hospital, the project was presented daily to women waiting for their gynecologist’s consultation. Upon arrival to the screening unit, a one-hour health education was given by trained midwives. General information on sexual health, as well as precise explanations on HPV and CC, were given. We expected participants to spread information about this campaign to their relatives. The combination of these methods of recruitment is summarized as community information channels (CIC).

CHW recruitment – From June 2019 to February 2020, CHW recruitment strategy was added to CIC intervention. At district level, district health managers were informed about the campaign and invited to participate by recruiting CHW. Selection is based on volunteer application without any prerequisites. CHWs work in their village. They usually have a main job and act as CHW when called during public health activities. An incentive of 600 CFA (1 USD or 2.6 2021Int'l $) per woman recruited from June to September 2019 was given, which was then increased to 1000 CFA (1.68 USD or 4.3 2021Int'l $) since October 2019 to adequately cover cellphone and transportation fees. CHW were enrolled in a two-day multi-modal training based on the “WHO Toolkit for improving CWH Program and Service” (20, 21) and adapted to local barriers by regional caregivers. To differentiate CHW recruitment from CIC, CHW were given invitation vouchers to distribute to each woman they approached. CHW's received their incentive according to their respective number of vouchers returned by participants attending screening.

Data collection – Before completing their HPV test, participants filled a sociodemographic questionnaire distributed by midwives.

Inclusion - We included for this analysis all women aged 30 to 49 years old living within Dschang’s Health District or its surroundings who completed an HPV test and signed our consent form, from September 2018 to February 2020. Exclusion criteria for HPV screening were pregnancy, hysterectomy, and vaginal bleeding. To include women in the CHW recruitment group, they had to present a CHW invitation voucher.

Outcome measures - (i) A comparison of sociodemographic characteristics of women recruited by each method was performed with in-depth analysis for each zone of origin. (ii) The number of participants screened was assessed and costs for the implementation of CHW and CIC interventions compared and (iii) To assess the cost-effectiveness of CHW, the costs and screening recruitment outcomes associated with each intervention were compared to generate an incremental cost-effectiveness ratio (ICER). Costs of recruitment by CHW include workers recruitment, training supplies, certification, identification badges, vouchers, transportation, meals, accommodation, incentives, per diem, and miscellaneous materials. CIC costs include radio broadcasting, banners, and flyers. Both groups include financial aid for women's transportation to the screening center according to hospital accessibility from each health area. To highlight the actual field situation and its
margin of error, we decided to compare the real-life cost-effectiveness (actual expenses, including incorrect patient transport financial aid), and the theoretical cost-effectiveness (expected expenses) generated by the CHW intervention to the cost-effectiveness of the CIC intervention. Costs are expressed in USD according to the exchange rate on March 1st, 2020 and, in international dollars to consider purchasing power parity.

**Statistical analysis** - Quantitative data were stored and analyzed using Stata Statistical Software Release 16 (StataCorp LP, College Station, TX, USA). A descriptive analysis was conducted; categorical variables were summarized with frequencies and percentages, and continuous variables were summarized with means and standard deviations (SD). P-values were estimated using Pearson's chi-squared test, Student's t-test, and ANOVA test as appropriate. All analyses were 2-sided and p-values < 0.05 were considered statistically significant. Women's socio-demographic and medical data were collected, stored, and managed by the secuTrial® online database. The calculated incremental cost-effectiveness ratio (ICER) is determined as the additional cost per screened woman by CHW, calculated as the difference between CHW costs and CIC costs divided by the difference of the number of screened women between CHWs and CIC.

**Ethical considerations** – The study obtained approval from the Cantonal Ethics Board of Geneva, Switzerland (Commission cantonale d'éthique de la recherche [CCER], No. 2017 – 0110) and the Cameroonian National Ethics Committee for Human Health Research (No. 2018/07/1083/CE/CNERSH/SP).

**Results**

**Population** - A total of 1940 women were included during the study period, with an HPV positive rate of 18.6% (n = 361), and 39 CIN2+ (2.0%) lesions were diagnosed. In the CIC group, 1356 women (69.9%) were recruited and 28 CIN2+ (2.1%) lesions were detected. In the CHW 584 women (30.1%) were recruited and 11 CIN2+ (1.8%) lesions identified. Two hundred sixteen participants living outside the Dschang health district were recruited in the CIC group, and nineteen patients in the CHW group. Among the 68 CHW trained, eight did not recruit any participant. The recruitment progress is depicted in Fig. 1 showing reuptake of recruitment trend when introducing CHW and an annual closing of the Dschang Screening Unit for the winter holiday and equipment shortage in December. Figure 2A-B includes participants living in the health district. The CIC method recruited 87.89% women in zone 1 (n = 1002), 7.72% in zone 2 (n = 88), 2.81% in zone 3 (n = 32) and 1.58% in zone 4 (n = 18). The CHW method recruited 38.58% women in zone 1 (n = 218); 29.03% in zone 2 (n = 164); 13.81% in zone 3 (n = 78); 18.58% in zone 4 (n = 105).
## Table 1
Baseline sociodemographic, reproductive health, and clinical characteristics according to CHW and CIC groups

| Variable                                      | CIC, n (%) | CHW, n (%) | Total, n (%) | P-value* |
|-----------------------------------------------|------------|------------|--------------|----------|
| Participants recruited                        | 1356 (69.9%) | 584 (30.1%) | 1940 (100%) | < 0.001  |
| Age (years), mean ± SD                        | 39.4 (± 5.9) | 41.9 (± 5.6) | 40.2 (± 5.9) | < 0.001  |
| Marital status                                |             |            |              | < 0.001  |
| Single                                       | 121 (8.9%)  | 25 (4.3%)  | 146 (7.5%)   |          |
| Married/In a relationship                     | 1155 (85.2%) | 494 (84.6%) | 1649 (85%)   |          |
| Divorced/widowed.                             | 78 (5.8%)   | 64 (11.0%) | 142 (7.3%)   |          |
| Education                                    |             |            |              | < 0.001  |
| Unschooled                                   | 5 (0.4%)    | 9 (1.5%)   | 14 (0.7%)    |          |
| Primary education                             | 275 (20.3%) | 274 (46.9%) | 549 (28.3%)  |          |
| Secondary education                           | 759 (56.0%) | 274 (46.9%) | 1033 (53.3%) |          |
| Tertiary education                            | 315 (23.2%) | 24 (4.1%)  | 339 (17.5%)  |          |
| Employment status                             |             |            |              | < 0.001  |
| Employed                                     | 480 (35.4%) | 62 (10.6%)  | 542 (27.9%)  |          |
| Independent                                   | 412 (30.4%) | 121 (20.7%) | 533 (27.5%)  |          |
| Farmer                                       | 130 (10.0%) | 249 (42.6%) | 379 (19.5%)  |          |
| Housewife                                     | 274 (20.2%) | 147 (25.2%) | 421 (21.7%)  |          |
| Student                                       | 50 (3.7%)   | 4 (0.7%)    | 54 (2.8%)    |          |
| Unemployed                                    | 8 (0.6%)    | 0           | 8 (0.4%)     |          |
| Age at menarche (years), mean ± SD           | 14.6 (1.8)  | 14.9 (1.7)  | 14.7 (1.8)   | < 0.001  |
| Age at first intercourse, mean ± SD           | 18.0 (2.9)  | 17.48 (2.4) | 17.9 (2.8)   | < 0.001  |
| Number of sexual partners, median (IQR)      | 3 (2–5)     | 3 (2–4)     | 3 (2–5)      |          |
| Age at first delivery (years), mean ± SD      | 21.3 (5.8)  | 19.8 (4.3)  | 20.9 (5.4)   | 00.000    |
| Parity                                       |             |            |              | < 0.001  |
| Nulliparous                                   | 65 (4.8%)   | 13 (2.2%)   | 78 (4.0%)    |          |
| 1–4                                          | 662 (48.8%) | 166 (28.4%) | 828 (42.9%)  |          |
| >4                                           | 627 (46.2%) | 404 (69.2%) | 1031 (53.1%) |          |
| Tabaco consumption                            |             |            |              | < 0.001  |
| Yes                                          | 7 (0.5%)    | 27 (4.6%)   | 34 (1.8%)    |          |
| None                                         | 1347 (99.3%)| 555 (95.0%) | 1902 (98.0%) |          |
| Contraception                                 |             |            |              | < 0.001  |

*p-values were estimated using chi-squared test, t-test.. as appropriate

Abbreviations: CHW = Community Health Workers, CIC = Community Information Channels, SD = Standard Deviation; IQR = Interquartile range; HIV = human immunodeficiency virus; HPV = Human papillomavirus; n = number
CIC versus CHW recruitment - As shown in Table 1, the mean participant age was 40.2 years old (SD ± 5.9). The two groups differ significantly on all socio-demographic variables (p = < 0.001) except for their HPV test results, HIV self-reported status, and histology among HPV-positive women. Some variables were missing as a few participants did not answer all questions. Populations recruited by CHW compared to CIC, accounted for more divorced and widowed women (11% vs 5.8%) and less single women (4.3% vs 8.9%). Predominant education level in the CIC group was secondary level with 56.0% of women and tertiary level with 23.25% of women, while predominant education levels in the CHW group were primary and secondary school with 46.9% in each sub-category. Employed and independent working women were the most represented in CIC-led intervention at 35.4% and 30.4% whereas in CHW-led recruitment, women were mostly farmers 42.6% and housewives 25.2%. The unemployment rate in our sample was 0.4%. Women recruited by CHW often had more than 4 children (69.2%) compared to CIC-recruited women, among which 48.8% had between 1–4 children and 46.2% had more than 4 children. Tobacco consumption was higher among women in the CHW group (4.6% vs 0.5%). Most women (69.8%) did not use any form of contraceptive. Condom usage was reported by 13.9% (n = 189) in the CIC group compared to 3.6% in the CHW group. DIU/implant/injection was the contraceptive method for 14.7% of participants in the CIC recruitment and 20.0% of participants in the CHW group. Previous CC screening was reported by 24.3% in the CIC-led intervention and 3.9% in the CHW-led intervention.
| Variable | CIC (1140/1356), n (%) | P-Value | CHW (565/584), n (%) | P-Value |
|----------|-----------------------|---------|----------------------|---------|
|          | Zone 1                | Zone 2  | Zone 3              | Zone 4  | Zone 1 | Zone 2  | Zone 3 | Zone 4  |
| Participants recruited n (%) | 1002 (87.9%) | 88 (7.7%) | 32 (2.8%) | 18 (1.6%) | 218 (38.6%) | 164 (29.0%) | 78 (13.8%) | 105 (18.6%) |
| Age (years), mean ± SD | 39.1 (±5.9) | 41.4 (±5.6) | 41.5 (±5.4) | 42.3 (±4.3) | < 0.001 | 40.9 (±5.7) | 43.1 (±5.4) | 43 (±5.5) | 41.9 (±5.3) | < 0.001 |
| Marital status | < 0.001 | < 0.023 |
| Single | 81 (8.1%) | 3 (3.4%) | 3 (9.4%) | 0 | 15 (6.9%) | 6 (3.7%) | 2 (2.6%) | 0 |
| Married/In a relationship | 870 (86.8%) | 76 (86.4%) | 25 (78.1%) | 13 (72.2%) | 189 (86.7%) | 133 (81.1%) | 65 (83.3%) | 91 (86.7%) |
| Divorced/widowed | 50 (5.0%) | 9 (10.2%) | 4 (12.5%) | 5 (27.8%) | 14 (6.4%) | 25 (15.2%) | 11 (14.1%) | 13 (12.4%) |
| Education | <0.001 | <0.001 |
| Unschooled | 3 (0.3%) | 2 (2.3%) | 0 | 0 | 1 (0.5%) | 6 (3.7%) | 1 (1.3%) | 1 (1.0%) |
| Primary education | 174 (17.4%) | 25 (28.4%) | 12 (37.5%) | 11 (61.1%) | 86 (39.5%) | 85 (51.8%) | 47 (60.3%) | 51 (48.6%) |
| Secondary education and higher | 824 (82.2%) | 61 (69.3%) | 20 (62.5%) | 7 (38.9%) | 131 (60.1%) | 72 (43.9%) | 30 (38.5%) | 52 (49.5%) |
| Employment status | <0.001 | <0.001 |
| Employed | 382 (38.1%) | 16 (18.2%) | 8 (25%) | 3 (16.7%) | 36 (16.5%) | 11 (6.7%) | 10 (12.8%) | 3 (2.9%) |
| Independent | 332 (33.1%) | 14 (15.9%) | 2 (6.3%) | 2 (11.1%) | 76 (34.9%) | 30 (18.3%) | 6 (7.7%) | 6 (5.7%) |
| Farmer | 55 (5.5%) | 30 (34.1%) | 11 (34.4%) | 9 (50%) | 33 (15.1%) | 81 (49.4%) | 50 (92.3%) | 80 (76.2%) |
| Unemployed, Housewife and student | 232 (23.2%) | 28 (31.4%) | 11 (34.4%) | 4 (22.2%) | 73 (33.5%) | 42 (25.6%) | 12 (15.4%) | 15 (14.3%) |
| Age at menarche (years), mean ± SD | 14.6 (1.8) | 14.6 (1.8) | 15.1 (1.8) | 14.7 (1.6) | 0.389 | 15.0 (1.7) | 14.7 (1.6) | 14.9 (1.7) | 14.9 (1.8) | 0.583 |
| Age at first intercourse, mean ± SD | 18.1 (2.9) | 17.3 (1.9) | 17.9 (2.8) | 16.3 (1.5) | 0.004 | 17.9 (2.5) | 17.2 (2.0) | 17.4 (2.4) | 17.0 (2.5) | 0.012 |
| Number of sexual partners, median (IQR) | 3 (2-5) | 3 (2-5) | 3 (2-4) | 3 (2.8-4.3) | 3 (2-4) | 3 (2-4) | 2 (1-4) | 3 (2-5) |
| Parity | 0.001 | 0.001 |
| Nulliparous | 47 (4.7%) | 3 (3.4%) | 1 (3.1%) | 0 | 5 (2.3%) | 3 (1.8%) | 1 (1.3%) | 2 (1.9%) |
|          | 1–4       | >4        |
|----------|-----------|-----------|
|          | (49.7%)   | (45.5%)   |
|          | (30.7%)   | (65.9%)   |
|          | (34.4%)   | (20.2%)   |
|          | (22.2%)   | (77.8%)   |
|          | (33.0%)   | (64.7%)   |
|          | (28.1%)   | (70.1%)   |
|          | (24.4%)   | (74.4%)   |
|          | (16.2%)   | (81.0%)   |

| Contraception | 0.002 | 0.120 |
|---------------|-------|-------|
| None          | 659   | 61    |
| Condom        | 152   | 12    |
| Other         | 190   | 15    |

| Previous cervical cancer screening | 0.092 | 0.017 |
|-----------------------------------|-------|-------|
| None                              | 746   | 74    |
| Yes                               | 255   | 14    |

| HIV status (self-reported) | 0.004 | 0.596 |
|---------------------------|-------|-------|
| Negative                  | 949   | 82    |
| Positive                  | 39    | 5     |

| HPV testing results | 0.091 | 0.741 |
|---------------------|-------|-------|
| Negative            | 817   | 76    |
| Positive            | 185   | 12    |

Abbreviations: CHW = Community Health Workers, CIC = Community Information Channels, SD = Standard Deviation; IQR = Interquartile range; HIV = human immunodeficiency virus; HPV = Human papillomavirus; n = number

Recruitment breakdown by zone - Socio-demographic differences between women recruited by CIC and CHW in the four zones are described in Table 2. Mean participants’ age varied between urban and rural areas, with women in zone 1 tending to be younger than those in zone 4 (p = < 0.001). In zone 1, primary education only was attended by 17.4% of women in the CIC group contrasting with 39.5% of women recruited in CHW group. When comparing the two groups, secondary level and higher was reached by more participants, in CIC group than in CHW-led intervention except for zone 4, 38.9% in CIC and 49.5% in CHW group. Tertiary education was attended by 25.6% in zone 1 recruited by CIC compared to only 7.8% to zone 1 within CHW group. In the CIC-led intervention, women in zone 1 were more frequently employed (38.1%) and independent workers (33.1%), whereas in zone 2–4, women worked more as farmers (34.1%, 34.4% and 50% respectively). In the CHW-led intervention, most participants were independent workers in zone 1 (34.9%), and farmers in zones 2 (49.4%), 3 (92.3%) and 4 (76.2%). We also found that most unemployed women 0.7% lived in zone 1 and were recruited through CIC. Women coming from zone 1 and recruited through CIC had fewer children than in other zones. Indeed, 49.7% women in zone 1 had between 1–4 children and 45.51% had more than 4 children, while in other subgroups, between 62.5% and 80.95% of participants had more than 4 children. Within the CIC-recruited group, most women who used condoms were in zone 1 (15.2%) and zone 2 (13.6%). Participants who smoked the most were recruited by CHW and live in zone 2 (7.9%) and in zone 3 (12.8%). Variance in previous CC screening was also shown between women living in urban zones compared to those in rural zones and depending on the recruitment method. Recruited through CIC, 25.45% of women living in zone 1 had a history of previous HPV screening, 15.9% in zone 2, 9.4% in zone 3 and 5.6% in zone 4 (p = 0.092). Rates of previous screening were generally lower in women recruited by CHW, where 7.8% of women in zone 1 had a previous CC screening, 1.2% in zone 2, 2.6% in zone 3 and 1.9% in zone 4 (p = 0.017).
Screening rate - Figs. 2C shows recruitment method predominance is shown. Health areas in dark blue show that most screened women were recruited by CHW and in orange represent health areas where recruitment was predominantly done through CIC. White color indicates that half of the patients were recruited by CIC and half by CHW. In grey, two health areas were excluded (Mekouale and Lepoh) as no CHW participated. We observe a predominance for CHW recruitment in areas distant from the center.

Table 3: Cost-analysis of recruitment

The incremental cost-effectiveness ratio (ICER) is determined as the additional cost per screened woman calculated as the difference between CHW costs and CIC costs divided by the additional of number of screened women due to CHW.

| Variable                | CIC (USD) | CHW (USD) |
|-------------------------|-----------|-----------|
| Recruited patients (n)  | 1,356     | 584       |
| Patients' transport reimbursement | 1345.74  | 1845.87   |
| Street Banners (n=2)    | 184.92    | N/A       |
| Radiobroadcast (n=4)    | 33.62     | N/A       |
| Flyers (n=1000)         | 42.03     | N/A       |
| CHW's training          | N/A       | 2657.86   |
| CHW wages               | N/A       | 870.40    |
| **Total costs**         | 1606.31   | 5374.13 (training included) 2716.27 (training excluded) |

**Costs per recruited woman**

| Variable                  | CIC (USD) | CHW (USD) |
|---------------------------|-----------|-----------|
| ACER                      | 1.18      | 9.20 (training included) 4.65 (training excluded) |
| Incremental additional cost | N/A     | 3767.82 (training included) 1109.06 (training excluded) |
| ICER in USD               | N/A       | 6.45 (training included) 1.90 (training excluded) |
| ICER in 2021Int'l$*       | N/A       | 16.61 (training included) 4.89 (training excluded) |

Abbreviations: CHW = Community Health Workers, CIC = Community Information Channels, Incremental cost-effectiveness ratios (ICER), ACER= average cost effectiveness ratio, n= number; N/A = not applicable.

Cost-effectiveness analysis of recruitment is presented in Table 3. Cost analysis - A detailed breakdown of CHWs training costs for each session is presented in the supplemental table. The June session costed a total cost of 694.98 USD (cost per trained CHW is 33.09 USD for 21 CHW). The October session total cost was 1962.88 USD (cost per trained CHW is 37.75 USD for 52CHW). CIC costs include 33.62 USD for four radio broadcasts, banners 184.92 USD for two street banners, 42.03 USD for a thousand flyers. Based on the onsite account book, the patients’ transport aid was 1411.30 USD without distinction between the two intervention groups. To compare the two groups, the theoretical patients’ transport aid is presented on Table 3. This was calculated based on the predefined amount allocated for each participant’s according to hospital accessibility from each health area health area 1845.87 USD for CHW-led intervention and 1345.74 USD for CIC-led intervention. The amount paid to CHW was calculated to be around 1141.57 USD (571.67 USD + theoretically calculated for missing receipt). Theoretical CHW incentive

$\text{based on the number of women recruited were 870.40 USD. The average cost per CIC-recruited woman is 1.18 USD compared to 9.20 USD per CHW-recruited woman. Based on theoretical costs, the ICER is 6.45 USD or 16.61 2021Int'l$ per screened woman recruited by CHW. The average cost per CIN2 + lesion diagnosed is 57.37 USD in the CIC group compared to 488.56 USD in the CHW group.}

Discussion
The global WHO strategy for cervical cancer elimination recommends that each country should meet by 2030 the 90-70-90 targets. (6) Achieving and sustaining the second target (70% of participation rate with a high-performance test) will be one of the most challenging issue for many LMCs countries. For example, in Cameroon, participation is very low, it is estimated that cervical cancer screening participation rate in a woman's lifetime is less than 10%. (22) This condition is one of the main reasons for the high cervical cancer incidence and death among middle-aged women in the country. (8) Our aim was to explore the effectiveness and costs of two different recruitment strategies in encouraging women to have a screening test.

Media-based information for public education about health-related issue are frequently used in many national campaigns in Cameroon. (23–25) However, according to the 2018 Demographic and Health Survey in Cameroon, within West Region, 38.1% of women were not exposed to any television, radio, or newspapers, 56.5% of women watch television and 22.4% listen to radio at least once a week. (22) This aspect is crucial for any decision making related to information spreading. Considering this data, radio broadcasting in our context is not the most efficient strategy compared to television-based intervention which also may be more expensive. Data is still limited about the impact of encouraging behavior changes in favor of effective health service and cost per person screened.

Efficiency results for screening coverage must consider that CIC and oral communication within the community co-existed with CHW-led intervention during the second period under study and that several women recruited by CHW could have been screened without mentioning the CHW referral, which would lead to their misclassification. Community spread communication co-existed with CHW-led intervention and has probably also increased our recruitment in each group, thus CHW’s impact could be greater than we assumed. At the screening center, warm welcome can lead to a positive experience and favor recruitment.

Involvement of CHW for health education and promotion around cervical cancer in the community constitute an important step to increase participation in program. CHW intervention contribute to optimize the participation as they use their cultural knowledge and ensure that message are delivered in a culturally appropriate fashion according to women's preferences and needs in rural areas who are rarely or never screened, which differ from those of women living closer to the city. (16, 26) As shown in Tables 1 and 2, women recruited by CHW tended to be less educated, have more children, use fewer condoms, and consume more tobacco. Participant knowledge about cervical cancer may not be the same as women living closer to the hospital. Studies have suggested that higher cervical cancer awareness is found among women within an urban environment due to internet and media access. (27) It has been established that a lack of information and awareness about screening centers’ location, costs, available time, and geographical condition are the main barriers to CC screening. (28–31)

In our study, CIC were used to convey an invitation to get screened. However, other studies have utilized media as an educational tool that appeared as effective as CHW intervention to recognize the importance of CC screening, although lay health workers were more effective to change screening behaviors through encouragement and logistical support. (32, 33)

CIC appear to be most suitable for women living close to the city center, while CHW improve recruitment coverage in rural areas. CHW not only enhanced recruitment outside urban areas, but they were also able to engage with and invite more women from a different socio-demographic population to be screened, including in zone 1. To avoid a Bottleneck effect due to limited capacities at the screening center, one strategy could be to start by using CIC, before gradually implementing CHW intervention.

A probable reason for a higher history of previous cervical cancer screening among participants from zone 1 in the CIC group is an increase of awareness and a built trust throughout a previous screening campaign in Dschang, in addition to the twenty years of collaboration of our research team in Cameroon. (11)

Transportation and childcare were previously reported as screening barriers. (26) Our screening recruitment heavily depended on rain seasons as roads were impracticable. Moreover, financial transport aid was an essential aspect of our strategy as women living in rural areas had to travel for many hours. CHW intervention helped to decrease these barriers as they recruited hard-to-reach women with multiple children and informed them about the financial subsidies for transportation.

The cost per screened women and CIN2+ diagnosed was higher in the CHW group. However, the media campaign was most efficient in zone 1. The higher recruitment of women in rural areas by CHW highlights the importance of training, preparing, and deploying CHWs to screen hard-to-reach women, especially considering that almost 45% of the Cameroon population lives in a rural area. (34) Undetected cervical lesions potentially leading to cervical cancer also increase overall costs not only for the healthcare system but can cause direct and indirect costs for the woman and her family such as cancer management cost, or loss of income due to disease, disability or even death.

In Uganda, if the population screening coverage was increased, then a self-HPV community campaign was found more cost-effective than provider collection. (35) When possible, CHW selection should be based on abilities and long term motivation, and their work should be adequately compensated to avoid having inactive workers that need to be replaced by newly trained personnel, which increases the
screening cost. (15, 36) Training in October 2019 was more expensive in total than the first session in June 2019; however, the investment is similar if we consider the expense per CHW trained. Improving CHW knowledge is a key factor to a successful recruitment intervention, (18) as was shown with the October session based on a multi-modal training, which was followed by an increase of screened women.

Strategies with multiple visits to get screened, treated, and follow-up can decrease screening effectiveness and can increase the overall cost of cancer prevention per woman due to loss to follow-up (14, 37). In our setting, the 3T strategy led only to a 1.1% loss to follow-up and will probably increase program effectiveness as barriers for Cameroonian women include “low health literacy, poverty, lack of resources, and geographical conditions”. (10) However, additional after-treatment visits may increase the need for CHW, as studies have shown that in-person follow-up could be a cost-effective approach to keep women in the screening process. (14) In this study, we only focused on the cost of screening recruitment; however, further studies will be needed to assess the full financial and social burden and cost-benefit analysis of an HPV “screen and treat” program in Dschang. In Sub-Saharan Africa, most women dying from cervical cancer are around fifty years old and DALYs caused by CC were estimated as 641 years per 100,000 women. (11, 38)

The large sample size and heterogeneity of the population regarding social and demographic characteristics are the major strengths of this study. Real-world conditions and thus the amount paid for equipment, supplies, and labor do not reflect theoretical costs. Health area attribution discordances and village overlap between two health areas/zones could have led to misclassification and inexact cost and recruitment rate estimates, in addition to some miscommunication that led to incorrect patient reimbursement cost. Moreover, measuring the success rate of CHW intervention could have allowed a more detailed analysis of the cost of CHW service. Indeed, the ratio of CHW-approached to screened women is currently unknown. Since recruitment strategies were not led simultaneously, CHW intervention might have enroll less participants as some women had already been informed through CIC. Another limitation is that some women recruited by CHW might have eventually attended screening without CHW intervention, at least we advanced their screening participation.

**Conclusion**

Combining both approaches appear as the most efficient strategy for improving recruitment among the target population according to regional context. CHW have a central role in building awareness and motivation for improving cervical cancer screening participation. Further studies are needed to explore innovative community-based intervention on effective way to improve recruitment of the target population.

**List Of Abbreviations**

| Abbreviation | Full Form |
|--------------|-----------|
| WHO          | World Health Organization's |
| HPV          | Human papillomavirus |
| CHW          | community health workers |
| CIC          | Community Information Channels |
| ICER         | Incremental Cost-Effectiveness Ratio |
| CC           | Cervical Cancer |
| SD           | Standard Deviation |
| IQR          | Interquartile range |
| HIV          | human immunodeficiency virus |
| N            | number |

**Declarations**

The study obtained approval from the Cantonal Ethics Board of Geneva, Switzerland (Commission cantonale d'éthique de la recherche [CCER], No. 2017-0110) and the Cameroonian National Ethics Committee for Human Health Research (No. 2018/07/1083/CE/CNERSH/SP).
Availability of data and materials

Data availability statement Data are available upon reasonable request. In accordance with the journal's guidelines, we will provide our data for the reproducibility of this study in other centers if such is requested.

Competing interests

The authors declare no competing interests.

Funding

This study was funded by ESTHER Switzerland 17G1, Service de Solidarité Internationale (Canton of Geneva), the University Hospital of Geneva (HUG) (Switzerland) the Fondation Privée de (HUG), the Commission des Affaires Humanitaires (CAH) of HUG, the Groupement Romand de la Société Suisse de Gynécologie et Obstétrique (GRSSGO), and the University of Dschang (Cameroon).

Authors' contributions

PP, BK, and PV designed the study protocol, implemented the study. PP, BK, PV, AW, and JS oversaw the data collection and interpreted the data. MP and KB drafted the paper. MP and AW conducted data analysis. AW, JS and ET supported the data collection. KB, BK, ET and JS trained the study staff and assumed quality control. JS assumed project administration and funding acquisition. All authors interpreted the analyses and approved the final manuscript.

Acknowledgements

The authors would like to thank the entire project team in Dschang and Geneva for their valuable contribution, and all the women who participated in the study in Cameroon. We would also like to thank all our funders for the economic support.

References

1. International Agency for Research on Cancer, World Health Organization N. Global Cancer Observatory. Estimated cancer incidence, mortality and prevalence worldwide in 2018: cervical cancer [Internet]. [cited 2021 Feb 17]. Available from: https://gco.iarc.fr/today/data/factsheets/cancers/23-Cervix-uteri-fact-sheet.pdf
2. WHO_INFOgraphics_CervicalCancer [Internet]. [cited 2021 Feb 18]. Available from: https://www.afro.who.int/sites/default/files/health_topics_infographics/WHO_INFOgraphics_CervicalCancer.pdf
3. International Agency for Research on Cancer. IARC handbooks of cancer prevention: volume 10—cervix cancer screening. [Internet]. 2005 [cited 2021 Feb 17]. Available from: https://publications.iarc.fr/Book-And-Report-Series/Iarc-Handbooks-Of-Cancer-Prevention/Cervix-Cancer-Screening-2005
4. Denny L, Anorlu R. Cervical cancer in Africa. Cancer Epidemiol Biomark Prev Publ Am Assoc Cancer Res Cosponsored Am Soc Prev Oncol. 2012 Sep;21(9):1434–8.
5. Ochomo EO, Atieli H, Gumo S, Ouma C. Assessment of community health volunteers’ knowledge on cervical cancer in Kadibo Division, Kisumu County: a cross sectional survey. BMC Health Serv Res. 2017 Sep 25;17(1):675.
6. World Health Organization. Global strategy to accelerate the elimination of cervical cancer as a public health problem [Internet]. 2020 [cited 2021 Feb 17]. Available from: https://apps.who.int/iris/bitstream/handle/10665/336583/9789240014107-eng.pdf
7. World Health Organization, editor. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. Geneva: World Health Organization; 2013. 40 p.
8. World Health Organization, World Health Organization, Reproductive Health and Research. Comprehensive cervical cancer control: a guide to essential practice. [Internet]. 2014 [cited 2021 Mar 1]. Available from: http://apps.who.int/iris/bitstream/10665/144785/1/9789241548953_eng.pdf?ua=1
9. Bureau central des recensements et des études de population du Cameroun (BUCREP). Troisième recensement général de la population et de l’habitat (3e RGPH, 2005). 2010.
10. Kunckler M, Schumacher F, Kenfack B, Catarino R, Viviano M, Tincho E, et al. Cervical cancer screening in a low-resource setting: a pilot study on an HPV-based screen-and-treat approach. Cancer Med. 2017 Jun 4;6(7):1752–61.
11. Vassilikos P, Tebeu P-M, Halle-Ekane G, Sando Z, Kenfack B, Baumann F, et al. Vingt années de lutte contre le cancer du col utérin en Afrique subsaharienne - Collaboration médicale entre Genève et Yaoundé [Internet]. Vol. 15, Revue medicale suisse. Rev Med Suisse; 2019 [cited 2020 Nov 22]. Available from: https://pubmed.ncbi.nlm.nih.gov/30865394/
12. Busolo D, Woodgate R. Cancer prevention in Africa: A review of the Literature. Glob Health Promot. 2014 Jul 15;22.

13. Anaman-Torgbor J, Angmorterh SK, Dordouo D, Ofori EK. Cervical cancer screening behaviours and challenges: a sub-Saharan Africa perspective. Pan Afr Med J [Internet]. 2020 Jun 16 [cited 2021 Apr 12];36. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7392861/

14. Mezei AK, Armstrong HL, Pedersen HN, Campos NG, Mitchell SM, Sekikubo M, et al. Cost-effectiveness of cervical cancer screening methods in low- and middle-income countries: A systematic review. Int J Cancer. 2017 01;141(3):437–46.

15. O’Donovan J, O’Donovan C, Nagraj S. The role of community health workers in cervical screening in low-income and middle-income countries: a systematic scoping review of the literature. BMJ Glob Health. 2019 May 1;4(3):e001452.

16. Wong CL, So WKW, Chan DNS, Choi KC, Rana T. A community health worker-led multimedia intervention to increase cervical cancer screening uptake among South Asian women: study protocol for a cluster randomized wait-list controlled trial. Trials. 2019 May 14;20(1):270.

17. Vaughan K, Kok MC, Witter S, Dieleman M. Costs and cost-effectiveness of community health workers: evidence from a literature review. Hum Resour Health [Internet]. 2015 Sep 1 [cited 2021 Jan 10];13. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4557864/

18. Kien N, Bittencourt L, Pelloso SM, Consolaro MEL, Castle PE, Partridge EE, et al. Cervical Cancer Screening among Underscreened and Unscreened Brazilian Women: Training Community Health Workers to be Agents of Change. 2018;12(2018):10.

19. Lewin S, Munabi-Babigumira S, Glenton C, Daniels K, Bosch-Capblanch X, van Wyk BE, et al. Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases. Cochrane Database Syst Rev. 2010 Mar 17;(3):CD004015.

20. Crigler L, Hill K, Furth R, Bjørregaard D. Community Health Worker Assessment and Improvement Matrix (CHW AIM): A Toolkit for Improving CHW Programs and Services [Internet]. USAID Health Care Improvement Project. Bethesda, MD: University Research Co., LLC (URC);. 2013 [cited 2021 Mar 1]. Available from: https://www.who.int/workforcealliance/knowledge/toolkit/CHWAIMToolkit_Revision_Sep13.pdf

21. World Health Organization. Cervical cancer screening and management of cervical pre-cancers: training of community health workers [Internet]. World Health Organization. Regional Office for South-East Asia; 2017 [cited 2021 Mar 1]. Available from: https://apps.who.int/iris/handle/10665/279798

22. Institut National de la Statistique (INS), ICF. Enquête Démographique et de Santé du Cameroun 2018 [Internet]. Yaoundé, Cameroun et Rockville, Maryland, USA; 2020 [cited 2021 Apr 11]. Available from: https://www.minsante.cm/site/?q=fr/content/enqu%C3%A9t%d3%A9%20d%5C3%A9mographique-de-sant%C3%A9

23. Dzudie A, Djomou A, Ba H, Njume E, Ndom MS, Mfekeu LK, et al. MMM17-Cameroon, analysis and opportunities—Sub-Saharan Africa. Eur Heart J Suppl J Eur Soc Cardiol. 2019 Apr;21(Suppl D):D31–3.

24. Bowen HL. Impact of a mass media campaign on bed net use in Cameroon. Malar J. 2013 Jan 25;12(1):36.

25. Babalola S, Figueroa ME, Krenn S. Association of Mass Media Communication with Contraceptive Use in Sub-Saharan Africa: A Meta-Analyses of Demographic and Health Surveys. J Health Commun. 2017 Nov 10;22:1–11.

26. Elliott PF, Belinson SE, Ottoleghi E, Smyth K, Belinson JL. Community health workers, social support and cervical screening among high-risk groups in rural Mexico. J Health Care Poor Underserved. 2013 Nov;24(4):1448–59.

27. Nk fusai NC, Cumber SN, Anchong KJ, Nji KE, Shirinde J, Nota DA. Assessment of the current state of knowledge and risk factors of cervical cancer among women in the Buea Health District, Cameroon. Pan Afr Med J [Internet]. 2019 May 21 [cited 2021 Mar 1];33(38). Available from: https://www.panafrican-med-journal.com/content/article/33/38/full

28. Eze JN, Umeora OU, Obuna JA, Egwuatu VE, Ejikeme BN. Cervical cancer awareness and cervical screening uptake at the Mater Misericordiae Hospital, Afikpo, Southeast Nigeria. Ann Afr Med. 2012 Dec;11(4):238–43.

29. Abotchie PN, Shokar NK. Cervical cancer screening among college students in ghana: knowledge and health beliefs. Int J Gynecol Cancer Off J Int Gynecol Cancer Soc. 2009 Apr;19(3):412–6.

30. Lim JW, Ojo AA. Barriers to utilisation of cervical cancer screening in Sub Sahara Africa: a systematic review. Eur J Cancer Care (Engl). 2017 Jan;26(1).

31. Donatus L, Nina FK, Sama DJ, Nkfusai CN, Bede F, Shirinde J, et al. Assessing the uptake of cervical cancer screening among women aged 25–65 years in Kumbo West Health District, Cameroon. Pan Afr Med J [Internet]. 2019 Jun 12 [cited 2021 Mar 1];33(106). Available from: https://www.panafrican-med-journal.com/content/article/33/106/full

32. Lam TK, McPhee SJ, Mock J, Wong C, Doan HT, Nguyen T, et al. Encouraging Vietnamese-American Women to Obtain Pap Tests Through Lay Health Worker Outreach and Media Education. J Gen Intern Med. 2003 Jul;18(7):516–24.
33. Mock J, McPhee SJ, Nguyen T, Wong C, Doan H, Lai KQ, et al. Effective Lay Health Worker Outreach and Media-Based Education for Promoting Cervical Cancer Screening Among Vietnamese American Women. Am J Public Health. 2007 Sep;97(9):1693–700.

34. Rural population (% of total population) - Cameroon | Data [Internet]. [cited 2021 Feb 15]. Available from: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=CM&view=map

35. Campos NG, Tsu V, Jeronimo J, Njama-Meya D, Mvundura M, Kim JJ. Cost-effectiveness of an HPV self-collection campaign in Uganda: comparing models for delivery of cervical cancer screening in a low-income setting. Health Policy Plan. 2017 Sep 1;32(7):956–68.

36. Colón-López V, González D, Vélez C, Fernández-Espada N, Soler AF, Escobar KA, et al. Community-Academic Partnership to implement a Breast and Cervical Cancer screening education program in Puerto Rico. P R Health Sci J. 2017 Dec;36(4):191–7.

37. Goldhaber-Fiebert JD, Denny LE, De Souza M, Wright TC, Kuhn L, Goldie SJ. The costs of reducing loss to follow-up in South African cervical cancer screening. Cost Eff Resour Alloc. 2005 Nov 15;3(1):11.

38. Soerjomataram I, Lortet-Tieulent J, Parkin DM, Ferlay J, Mathers C, Forman D, et al. Global burden of cancer in 2008: a systematic analysis of disability-adjusted life-years in 12 world regions. The Lancet. 2012 Nov 24;380(9856):1840–50.

**Figures**

![Figure 1](image)

**Figure 1**

Recruitment evolution from September 2018 to February 2020
A. Dschang Health Area separated in 4 zones Zone 1 being the most accessible areas (urban) and Zone 4 the least accessible areas (rural) B. Screening distribution per zone according to recruitment method C. Recruitment method predominance. In white, half of the patients were recruited by CIC and half by CHW (In gray, Mekouale and Lepoh area excluded, since no CHW participate. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementalTable.docx