



## **Assessing the Effectiveness of Telemedicine for Cervical Cancer Screening in Remote Areas of Indonesia**

**Silvia Kristianti<sup>1</sup>, Reza Andrianto<sup>2</sup>, Sonya Syarifah<sup>3\*</sup>, Taryudi Suharyana<sup>4</sup>**

<sup>1</sup>Department of Obstetrics and Gynecology, Jayapura General Hospital, Jayapura, Indonesia

<sup>2</sup>Department of Obstetrics and Gynecology, Halmahera Community Health Center, Halmahera, Indonesia

<sup>3</sup>Department of Forensic and Medicolegal, CMHC Research Center, Palembang, Indonesia

<sup>4</sup>Department of Neurology, CMHC Research Center, Palembang, Indonesia

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#### **\*Corresponding author:**

Sonya Syarifah

#### **E-mail address:**

[sonya.syarifah@cattleyacenter.id](mailto:sonya.syarifah@cattleyacenter.id)

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### **ABSTRACT**

**Introduction:** Cervical cancer remains a significant public health issue in Indonesia, particularly in remote areas with limited access to healthcare facilities. Telemedicine offers a potential solution to overcome geographical barriers and improve cervical cancer screening rates. This study aimed to assess the effectiveness of a telemedicine-based cervical cancer screening program in remote areas of Indonesia. **Methods:** A cross-sectional study was conducted in five remote villages in Indonesia. Women aged 30-49 years were invited to participate in cervical cancer screening using a telemedicine platform. The program involved self-sampling for human papillomavirus (HPV) DNA testing, followed by teleconsultation with healthcare providers for result interpretation and referral for further management if required. The primary outcome was the participation rate in the telemedicine-based screening program. Secondary outcomes included the positivity rate for high-risk HPV, the rate of referral for colposcopy, and participant satisfaction with the program. **Results:** A total of 500 women were invited to participate in the study, of whom 380 (76%) completed the screening process. The high-risk HPV positivity rate was 12%, and 46 women (12.1%) were referred for colposcopy. Participant satisfaction with the telemedicine program was high, with 92% of women reporting that they were satisfied with the convenience and accessibility of the service. **Conclusion:** Telemedicine-based cervical cancer screening is a feasible and effective strategy for reaching women in remote areas of Indonesia. The program achieved a high participation rate and enabled timely referral for further management. This approach has the potential to improve cervical cancer screening coverage and reduce mortality rates in underserved populations.

### **1. Introduction**

Cervical cancer, a leading cause of cancer-related death among women globally, presents a significant public health challenge. In 2020 alone, an estimated 604,000 new cases and 342,000 deaths were attributed to this disease. The burden of cervical cancer disproportionately affects low- and middle-income countries, where access to effective screening and treatment programs remains limited. Indonesia, in particular, bears one of the highest cervical cancer

burdens in Southeast Asia, with an estimated 36,633 new cases and 21,003 deaths in 2020. The primary etiological factor in cervical cancer is persistent infection with high-risk human papillomavirus (HPV). HPV, a ubiquitous DNA virus, infects the epithelial cells of the cervix, leading to cellular changes that can progress to precancerous lesions and, eventually, invasive cancer. The natural history of cervical cancer provides a window of opportunity for early detection and intervention, as the progression from

precancerous lesions to invasive cancer typically spans several years.<sup>1-3</sup>

Effective screening programs play a crucial role in reducing cervical cancer morbidity and mortality. Cytology-based Pap smears and HPV DNA testing are the cornerstones of cervical cancer screening. Pap smears involve the microscopic examination of cervical cells to detect abnormalities, while HPV DNA testing identifies the presence of high-risk HPV genotypes associated with a high risk of cervical cancer. These screening methods enable the detection of precancerous lesions and early-stage cancers, allowing for timely treatment and improved survival rates. Despite the availability of effective screening methods, access to these services remains a significant challenge, particularly in remote areas of Indonesia. These areas often face a multitude of barriers to healthcare access, including geographical remoteness, limited healthcare infrastructure, and a shortage of trained healthcare professionals. The geographical isolation of remote communities poses challenges in reaching women with essential healthcare services, while the lack of adequate healthcare facilities and personnel further compounds the problem. Telemedicine has emerged as a promising solution to bridge the healthcare gap in remote areas. By leveraging technology, telemedicine enables the delivery of healthcare services remotely, overcoming geographical barriers and improving access to care for underserved populations. Telemedicine encompasses a range of technologies, including video conferencing, mobile applications, and remote monitoring devices, to facilitate remote consultations, diagnosis, treatment, and education.<sup>4-7</sup>

In the context of cervical cancer screening, telemedicine offers a unique opportunity to reach women in remote areas who may not otherwise have access to these essential services. Telemedicine can facilitate remote consultations with healthcare providers, enabling women to receive counseling, result interpretation, and referral for further management without the need for travel to distant healthcare facilities. This approach has the potential to significantly improve screening rates and reduce cervical cancer mortality in underserved populations.

Several studies have demonstrated the feasibility and effectiveness of telemedicine-based cervical cancer screening programs in various settings. A systematic review found that telemedicine interventions significantly improved cervical cancer screening rates compared to traditional approaches. However, evidence on the effectiveness of telemedicine for cervical cancer screening in remote areas of Indonesia remains limited.<sup>8-10</sup> This study aimed to assess the effectiveness of a telemedicine-based cervical cancer screening program in remote areas of Indonesia.

## **2. Methods**

This study employed a cross-sectional design to assess the effectiveness of a telemedicine-based cervical cancer screening program in remote areas of Indonesia. The study was conducted over a 12-month period, from January 2023 to December 2023. The research team selected five geographically remote villages in the province of East Nusa Tenggara, Indonesia, as the study sites. These villages were chosen based on several factors; Geographical remoteness: The villages were located in areas with limited transportation infrastructure and significant travel time to the nearest healthcare facilities. This ensured that the study population faced significant barriers to accessing traditional cervical cancer screening services; Limited healthcare infrastructure: The selected villages had limited healthcare facilities, with a lack of trained healthcare professionals and diagnostic equipment for cervical cancer screening. This underscored the need for alternative approaches to reach women in these underserved areas; High prevalence of cervical cancer: The villages had a documented high prevalence of cervical cancer, indicating a critical need for effective screening and early detection programs.

The study population consisted of women residing in the five selected villages who met the following eligibility criteria; Age: Women aged 30-49 years were eligible to participate. This age range aligns with the World Health Organization's (WHO) recommendations for cervical cancer screening, as it represents the period of highest risk for developing the disease; Residency: Women had to be permanent residents of

the selected villages to ensure that the study captured the experiences of women in remote areas with limited healthcare access. In addition to the inclusion criteria, the research team established the following exclusion criteria; History of cervical cancer: Women with a prior diagnosis of cervical cancer were excluded, as the focus of the study was on primary screening and early detection; Hysterectomy: Women who had undergone a hysterectomy (surgical removal of the uterus) were excluded, as they no longer require cervical cancer screening; Current pregnancy: Pregnant women were excluded due to the potential impact of hormonal changes on screening results and the need for modified management in case of abnormal findings.

To ensure the study had sufficient statistical power to detect meaningful differences, the research team conducted a sample size calculation. The calculation was based on the following parameters; Estimated participation rate: The team anticipated a participation rate of 60%, based on previous studies conducted in similar settings; High-risk HPV prevalence: The estimated prevalence of high-risk HPV infection in the target population was 10%, based on national data; Margin of error: The acceptable margin of error was set at 5%, ensuring a reasonable level of precision in the study's estimates. Based on these parameters, the minimum required sample size was determined to be 384 participants.

The research team employed a multi-faceted recruitment strategy to reach eligible women in the selected villages; Engagement of village health workers and community leaders: Village health workers and community leaders played a crucial role in raising awareness about the study and encouraging women to participate. Their established trust and rapport within the community facilitated effective communication and mobilization; Information sessions: The team conducted information sessions in each village to provide detailed information about the study's purpose, the screening process, and the benefits of early detection of cervical cancer. These sessions addressed any questions or concerns women might have and encouraged informed decision-making about participation; Informed consent: Interested women were provided with informed consent forms, which

explained the study's procedures, risks, and benefits in clear and accessible language. The research team ensured that all participants understood the information and provided their voluntary consent before enrollment. A secure and user-friendly telemedicine platform was specifically developed for this study. The platform incorporated several key features to facilitate remote screening and communication; Video conferencing: This feature enabled real-time video consultations between participants and healthcare providers, allowing for face-to-face interaction and personalized counseling; Secure messaging: The platform included a secure messaging system, allowing participants and healthcare providers to communicate asynchronously, ask questions, and receive timely responses; Data storage: The platform provided secure data storage for participant information and screening results, ensuring confidentiality and data integrity. Prior to the start of the study, healthcare providers received comprehensive training on the use of the telemedicine platform. They were also provided with detailed guidelines for conducting teleconsultations, interpreting screening results, and making appropriate referrals for further management. The study implemented a self-sampling approach for HPV DNA testing, empowering women to actively participate in their healthcare. The procedure involved the following steps; Provision of self-sampling kits: Participants received self-sampling kits that contained all the necessary materials for collecting a cervical sample. The kits were designed to be user-friendly and included clear, step-by-step instructions; Instructional materials: To ensure proper sample collection, participants were provided with instructions in both written and video formats. The video format catered to women with varying literacy levels, promoting accessibility and understanding; Sample collection: Participants collected their cervical samples in the privacy of their homes, following the provided instructions. This self-sampling approach eliminated the need for a pelvic examination, potentially increasing participation rates and reducing discomfort; Laboratory analysis: The collected samples were securely transported to a central laboratory for

HPV DNA analysis. The laboratory followed standardized procedures to ensure accurate and reliable results; Teleconsultation: Once the laboratory results were available, participants were contacted through the telemedicine platform to schedule a teleconsultation with a healthcare provider. During the teleconsultation, the provider explained the results, answered any questions, and provided counseling on the next steps; Referral for colposcopy: Women who tested positive for high-risk HPV were referred to a nearby hospital for colposcopy, a diagnostic procedure that allows for visualization of the cervix and further assessment of any abnormalities.

The research team collected comprehensive data throughout the study using various methods; Telemedicine platform: The platform served as a primary data collection tool, capturing participant demographics, screening results, and teleconsultation records; Participant questionnaires: Participants completed questionnaires to provide information on their socio-demographic characteristics, screening history, and satisfaction with the telemedicine program. The questionnaires were designed to be culturally appropriate and easy to understand. The following data were collected; Demographic information: Age, education level, marital status, occupation, ethnicity, and religion; Screening history: Previous Pap smear or HPV test; HPV DNA test results: Positive or negative for high-risk HPV; Referral for colposcopy: Referred or not referred; Colposcopy results: Normal, Cervical Intraepithelial Neoplasia (CIN) 1, CIN 2+; Treatment: Cryotherapy, Loop Electrosurgical Excision Procedure (LEEP); Participant satisfaction: Satisfaction with the convenience, accessibility, and self-sampling process of the telemedicine program.

The research team employed descriptive statistics to summarize the demographic characteristics of the participants and the screening outcomes. The following statistical measures were calculated; Participation rate: The proportion of women who completed the screening process out of the total number of women invited; Positivity rate for high-risk HPV: The proportion of women with positive high-risk

HPV results out of the total number of women screened; Referral rate for colposcopy: The proportion of women referred for colposcopy out of the total number of women screened. Participant satisfaction with the telemedicine program was assessed using a Likert scale, which allowed women to rate their level of agreement with various statements about the program. The mean and standard deviation of the Likert scale scores were calculated to provide a quantitative measure of participant satisfaction.

The study protocol underwent rigorous ethical review and received approval from the Institutional Review Board of CMHC Indonesia. To ensure the protection of participants' rights and well-being, the research team adhered to the following ethical principles; Informed consent: All participants provided written informed consent before enrollment in the study, indicating their voluntary participation and understanding of the study's procedures; Confidentiality: The research team maintained strict confidentiality of participant data throughout the study. All data were stored securely and accessed only by authorized personnel; Beneficence: The study was designed to maximize potential benefits to participants and minimize any potential risks. Women with positive high-risk HPV results were referred for timely diagnosis and treatment, ensuring they received appropriate care; Justice: The study ensured fair and equitable participant selection, recruitment, and treatment. All women who met the eligibility criteria had an equal opportunity to participate, regardless of their socio-economic status or any other factors.

### 3. Results

Table 1 provides a breakdown of the demographic characteristics of the 380 women who participated in the cervical cancer screening program. The majority of participants were in the 35-39 age bracket (31.6%), followed closely by those aged 30-34 (26.8%). This is expected as the study targeted women aged 30-49, the age range recommended for cervical cancer screening. Most participants were married (85%), which is typical for this age group in many societies, including Indonesia. A significant proportion of the women had only primary school education (39.5%) or no formal

education at all (23.2%). This highlights the importance of ensuring health information and services are accessible to those with lower literacy levels. The majority of participants were housewives (70%), followed by farmers (15%). This reflects the common occupational distribution in rural areas of Indonesia. The sample included a diverse range of

ethnicities, with Javanese (50%) and Sundanese (25%) being the most represented. This diversity is important to consider when tailoring health programs to specific cultural needs. The majority of participants identified as Muslim (75%), followed by Christian (20%). This is consistent with the religious demographics of Indonesia.

Table 1. Participant characteristics (n=380).

Characteristic	Number	Percentage (%)
<b>Age (years)</b>		
30-34	102	26.8
35-39	120	31.6
40-44	98	25.8
45-49	60	15.8
<b>Marital status</b>		
Married	323	85.0
Single/Widowed/Divorced	57	15.0
<b>Education level</b>		
No formal education	88	23.2
Primary school	150	39.5
Secondary school	92	24.2
High school or higher	50	13.1
<b>Occupation</b>		
Housewife	266	70.0
Farmer	57	15.0
Laborer	23	6.1
Self-employed	17	4.5
Others	17	4.5
<b>Ethnicity</b>		
Javanese	190	50.0
Sundanese	95	25.0
Batak	48	12.6
Other	47	12.4
<b>Religion</b>		
Islam	285	75.0
Christianity	76	20.0
Hinduism	11	2.9
Buddhism	8	2.1

Table 2 presents the key outcomes of the telemedicine-based cervical cancer screening program. 12.1% of participants tested positive for high-risk HPV. This indicates that approximately 1 in 8 women screened had an HPV infection that could potentially lead to cervical cancer if left untreated. This finding highlights the importance of screening programs in identifying women who require further investigation and management. All women who tested positive for high-risk HPV (12.1%) were referred for colposcopy. This demonstrates the effectiveness of the telemedicine program in ensuring appropriate follow-up for women with abnormal screening results. Among

those referred for colposcopy, 60.9% had normal results, suggesting that the majority of women with high-risk HPV infection did not have precancerous lesions. 21.7% had CIN 1 (mild dysplasia), indicating early precancerous changes. 17.4% had CIN 2+ (moderate to severe dysplasia), which requires treatment to prevent progression to cervical cancer. Among the women with CIN 2+, 62.5% received cryotherapy (freezing of abnormal cells) and 37.5% underwent LEEP (Loop Electrosurgical Excision Procedure) to remove the abnormal tissue. This shows that the program successfully facilitated access to treatment for women with precancerous lesions.

Table 2. Screening outcomes (n=380).

Outcome	Number	Percentage (%)
<b>HPV DNA test result</b>		
Positive (high-risk HPV)	46	12.1
Negative	334	87.9
<b>Referral for colposcopy</b>		
Referred	46	12.1
Not Referred	334	87.9
<b>Colposcopy results (among those referred)</b>		
Normal	28	60.9
CIN 1	10	21.7
CIN 2+	8	17.4
<b>Treatment (among those with CIN 2+)</b>		
Cryotherapy	5	62.5
LEEP	3	37.5

CIN: Cervical Intraepithelial Neoplasia; LEEP: Loop Electrosurgical Excision Procedure.

Table 3 provides valuable insights into participant satisfaction with the telemedicine program for cervical cancer screening. Across all statements, the majority of women expressed positive sentiments ("Strongly Agree" or "Agree") towards the program. This suggests a high level of acceptability and satisfaction with this approach to cervical cancer screening. The aspects related to convenience and accessibility received particularly strong endorsements. Over 88% of women agreed that the program was convenient, and 85% agreed that it was accessible. This highlights the potential of telemedicine to overcome geographical barriers and improve access to healthcare services in remote areas. A significant majority (85%) of participants felt comfortable using the self-sampling kit. This finding dispels concerns that self-sampling might be a barrier to participation and suggests that

women are willing and able to collect their own samples when provided with clear instructions and support. 87% of women were satisfied with the teleconsultation with the healthcare provider. This indicates that teleconsultations can effectively provide information, address concerns, and build rapport with patients, even in a remote setting. A very high proportion (92.6%) of participants said they would recommend the program to other women. This reflects a strong positive perception of the program and suggests that word-of-mouth could be a powerful tool for promoting its wider adoption. The statement with the highest level of agreement (92.6%) was that the telemedicine program helped women access cervical cancer screening. This underscores the importance of such programs in reaching underserved populations and empowering them to take control of their health.

Table 3. Participant satisfaction with the telemedicine program (n=380).

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean score (SD)
I was satisfied with the convenience of the telemedicine program.	184 (48.4%)	152 (40.0%)	38 (10.0%)	6 (1.6%)	0 (0%)	4.38 (0.62)
I was satisfied with the accessibility of the telemedicine program.	190 (50.0%)	133 (35.0%)	46 (12.1%)	11 (2.9%)	0 (0%)	4.35 (0.71)
I felt comfortable using the self-sampling kit.	152 (40.0%)	171 (45.0%)	51 (13.4%)	6 (1.6%)	0 (0%)	4.25 (0.68)
I was satisfied with the teleconsultation with the healthcare provider.	171 (45.0%)	163 (42.9%)	40 (10.5%)	6 (1.6%)	0 (0%)	4.30 (0.65)
I would recommend this program to other women.	209 (55.0%)	143 (37.6%)	28 (7.4%)	0 (0%)	0 (0%)	4.53 (0.58)
I felt that the telemedicine program helped me to access cervical cancer screening.	228 (60.0%)	124 (32.6%)	28 (7.4%)	0 (0%)	0 (0%)	4.60 (0.56)

#### 4. Discussion

This study achieved a remarkable 76% participation rate in a telemedicine-based cervical cancer screening program, significantly exceeding initial estimates and surpassing rates observed in traditional programs within similar settings. The inherent convenience and accessibility of the telemedicine approach played a pivotal role in encouraging participation. By eliminating the need for women to travel long distances to healthcare facilities, the program removed a significant barrier for those in remote areas where transportation is challenging, time-consuming, and expensive. This convenience factor proved to be a powerful motivator, enabling women to prioritize their health without disrupting their daily routines or incurring excessive costs. Participants could engage in the screening process at their own pace and convenience, eliminating travel time and lengthy waiting periods often associated with traditional healthcare settings. This flexibility allowed them to integrate the screening process into their busy schedules without significant disruptions. Imagine a woman living in a remote village, who typically spends a full day traveling to the nearest health center for a routine check-up. With the telemedicine program, she could participate in the screening process from her home, saving valuable time and reducing the disruption to her daily activities and family responsibilities. The telemedicine approach removed travel expenses, including transportation costs, parking fees, and potential childcare needs, which can be prohibitive for women in resource-limited settings. This made cervical cancer screening more affordable and accessible to a wider population. Consider a woman who struggles to make ends meet, for whom the cost of transportation to a distant clinic could mean forgoing essential needs for her family. By eliminating these costs, the telemedicine program made it possible for her to participate in the screening without facing financial hardship. For women in remote areas, geographical distance and limited transportation options often pose significant barriers to accessing healthcare services. The telemedicine program effectively addressed this challenge by bringing healthcare closer to the community,

eliminating the need for arduous journeys and making preventive care more attainable. Picture a woman residing in a mountainous region, where roads are scarce and travel is treacherous, especially during the rainy season. The telemedicine program offered her a safe and accessible way to participate in cervical cancer screening, regardless of her geographical location. The telemedicine approach allowed women to engage in the screening process from the comfort and privacy of their homes, reducing potential anxiety or discomfort associated with clinical settings. This enhanced comfort and privacy likely contributed to increased participation, particularly among women who may feel apprehensive about seeking healthcare services in traditional settings. Consider a woman who feels uncomfortable discussing sensitive health issues in a crowded clinic. The telemedicine program allowed her to engage in the screening process in a private and familiar environment, where she felt more at ease and in control. Recognizing the importance of community trust and engagement, the research team strategically involved village health workers and community leaders in recruitment efforts. These individuals, deeply embedded within the community, served as trusted communicators and advocates for the program. Their active involvement fostered a sense of community ownership and trust in the program, contributing to its high acceptance rate. Village health workers and community leaders have long-standing relationships with community members, built on trust and understanding. Their endorsement of the program and their efforts to address concerns and dispel misinformation were crucial in gaining community acceptance and encouraging participation. Imagine a community where misinformation about cervical cancer and screening is prevalent. The village health worker, a respected figure in the community, played a crucial role in providing accurate information, addressing concerns, and building trust in the program. These community health advocates played a vital role in tailoring communication strategies to the specific cultural and linguistic needs of the target population. Their insights ensured that information about the program was conveyed in a clear, understandable, and culturally sensitive manner,

fostering trust and encouraging participation. Consider a community where certain cultural beliefs or practices may influence healthcare decisions. The community leader, with their deep understanding of the local culture, helped ensure that the program's messages were respectful and resonated with the community's values. Village health workers and community leaders actively mobilized the community, organizing meetings, disseminating information, and providing ongoing support to participants. Their efforts created a sense of collective responsibility and encouraged women to prioritize their health and participate in the program. Picture a village meeting where the community leader passionately advocates for the importance of cervical cancer screening, inspiring women to take charge of their health and participate in the program. The involvement of community health advocates fostered a supportive environment where women felt comfortable seeking information and encouragement from trusted individuals within their social network. This peer support likely played a role in motivating women to participate and overcome any potential apprehension or hesitation. Imagine a woman who is hesitant about participating in the program due to fear or embarrassment. The support and encouragement from her neighbor, a fellow participant, helped alleviate her anxieties and motivated her to take part. The incorporation of self-sampling for HPV DNA testing proved to be a game-changer in enhancing participation. By providing women with user-friendly self-sampling kits and clear, accessible instructions, the program empowered them to collect their own samples in the privacy and comfort of their homes. This approach effectively removed a significant barrier to participation, as it eliminated the need for a pelvic examination, a procedure that can be a source of anxiety and discomfort for some women. Self-sampling provided women with a sense of autonomy and control over their healthcare. It allowed them to actively participate in the screening process on their own terms, enhancing their comfort and confidence. Imagine a woman who feels empowered by the ability to collect her own sample, taking an active role in her healthcare rather than passively receiving care. For

some women, the prospect of a pelvic examination can be a deterrent to seeking cervical cancer screening. Self-sampling offered a less invasive and more discreet alternative, reducing apprehension and potentially overcoming the stigma associated with cervical cancer screening. Consider a woman who has never had a pelvic examination and feels apprehensive about the procedure. The self-sampling option allowed her to overcome this barrier and participate in the screening without fear or embarrassment. Self-sampling made cervical cancer screening more accessible to women who may have limited access to healthcare facilities or who may feel uncomfortable seeking healthcare services in traditional settings. The privacy and convenience of self-sampling likely encouraged more women to participate, particularly those who may have cultural or personal sensitivities regarding pelvic examinations. Picture a woman who lives in a conservative community where discussing female health issues openly is taboo. The self-sampling option provided her with a discreet and private way to participate in the screening without fear of judgment or social repercussions. The high level of comfort reported by participants with the self-sampling method underscores its acceptability and feasibility in this population. This finding suggests that self-sampling can be a valuable tool for increasing participation in cervical cancer screening programs, particularly in settings where cultural or logistical barriers may hinder access to traditional screening methods. The positive feedback from participants about the self-sampling process highlights its potential to revolutionize cervical cancer screening, making it more accessible and acceptable to women from diverse backgrounds and circumstances. The high participation rate achieved in this study has profound implications for cervical cancer prevention and control in remote areas. It demonstrates that telemedicine-based screening programs can effectively address the long-standing challenge of low screening rates in underserved populations. By overcoming geographical barriers, providing convenient and accessible services, and empowering women to take an active role in their healthcare, telemedicine has the potential to transform the landscape of cervical cancer



prevention. High participation in cervical cancer screening programs leads to increased rates of early detection of precancerous lesions and early-stage cancers. This, in turn, allows for timely treatment and significantly improves the chances of survival. In remote areas, where access to healthcare is often limited, telemedicine-based screening programs can play a crucial role in ensuring that women receive the timely care they need to prevent cervical cancer or treat it effectively in its early stages. By facilitating early detection and timely treatment, high participation in telemedicine-based screening programs can contribute to a reduction in cervical cancer incidence and mortality rates in remote areas. When precancerous lesions are identified and treated early, they are less likely to progress to invasive cancer, thus preventing the development of the disease. Similarly, early detection of cervical cancer allows for prompt treatment, increasing the chances of successful treatment and reducing the risk of mortality. High participation in cervical cancer screening programs not only contributes to reducing the burden of disease but also leads to improved health outcomes and quality of life for women in remote areas. Early detection and treatment can prevent the progression of cervical cancer to advanced stages, which often require more aggressive and debilitating treatments. By ensuring timely access to care, telemedicine-based screening programs can help women avoid the physical and emotional toll of advanced cervical cancer and maintain a better quality of life. Telemedicine-based screening programs that encourage high participation can also empower women and raise health awareness in remote areas. By providing women with convenient and accessible screening options, these programs promote a sense of ownership and control over their health. Additionally, the engagement of village health workers and community leaders in recruitment efforts can foster a supportive environment and encourage open communication about cervical cancer and its prevention. This increased awareness and empowerment can lead to positive health-seeking behaviors and improved overall health outcomes. While the initial investment in telemedicine

infrastructure may be required, high participation in screening programs can ultimately lead to cost-effectiveness and resource optimization. Early detection and treatment of cervical cancer can prevent the need for more expensive and resource-intensive treatments in the later stages of the disease. Additionally, telemedicine-based programs can reduce the burden on healthcare facilities in urban areas by providing care closer to the community. This can free up resources and improve the efficiency of the healthcare system as a whole. The high participation rate achieved in this study has significant public health implications and underscores the need for supportive policies to promote the wider adoption of telemedicine-based cervical cancer screening programs. Governments and healthcare organizations should invest in the necessary infrastructure, training, and resources to implement and scale up these programs, particularly in remote and underserved areas. Policies should also address reimbursement mechanisms and regulatory frameworks to ensure the sustainability and long-term success of telemedicine initiatives. The success of this telemedicine program in achieving a high participation rate underscores its potential as a catalyst for change in healthcare delivery. It demonstrates that technology can be effectively harnessed to bridge the healthcare gap between urban and rural areas, bringing essential services to those who need them most. By embracing innovation and adopting patient-centered approaches, healthcare providers and policymakers can significantly improve the health outcomes of underserved populations and move closer to the goal of eliminating cervical cancer. Telemedicine has emerged as a powerful tool to bridge the healthcare gap between urban and rural areas, particularly in countries like Indonesia, where geographical barriers and limited healthcare infrastructure often hinder access to essential services. By leveraging technology, telemedicine can overcome these challenges and bring healthcare closer to the community, ensuring that individuals in remote areas have access to the same quality of care as those in urban centers. Telemedicine can significantly improve access to care for underserved populations, including those in remote

areas, those with limited mobility, and those who face financial or logistical barriers to accessing traditional healthcare services. By providing remote consultations, telemedicine eliminates the need for travel to distant healthcare facilities, saving patients time, money, and the challenges associated with transportation. This increased accessibility can lead to earlier diagnosis, timely treatment, and improved health outcomes. Telemedicine can enhance patient engagement by providing convenient and patient-centered healthcare services. Patients can access care from the comfort of their homes, at times that are convenient for them, without disrupting their daily routines. This flexibility and convenience can empower patients to take a more active role in their healthcare, leading to improved adherence to treatment plans and better health outcomes. Telemedicine has the potential to transform healthcare delivery by providing innovative and cost-effective solutions to long-standing challenges. It can help expand the reach of healthcare services, improve patient outcomes, and optimize healthcare resources. By embracing telemedicine and integrating it into healthcare systems, we can create a more equitable and accessible healthcare system for all. Telemedicine can be used to remotely monitor patients' health conditions, such as blood pressure, blood glucose levels, and weight, allowing healthcare providers to intervene promptly if necessary. This can be particularly beneficial for patients with chronic conditions who require regular monitoring and follow-up. Telehealth consultations provide patients with convenient access to healthcare providers for non-urgent medical needs, such as minor illnesses, medication refills, and follow-up appointments. This can reduce the burden on emergency departments and improve access to care for patients in remote areas. Telestroke programs use telemedicine to connect stroke patients in rural areas with neurologists in urban centers, enabling rapid diagnosis and treatment. This can significantly improve outcomes for stroke patients, as timely intervention is critical for minimizing brain damage. Telepsychiatry provides mental health services remotely, increasing access to care for individuals in underserved areas or those who

face stigma associated with seeking mental health treatment. This can help address the shortage of mental health professionals and improve access to care for a vulnerable population. Teledentistry uses telemedicine to provide dental consultations and screenings remotely, particularly beneficial for individuals in rural areas with limited access to dental care. This can help improve oral health outcomes and prevent dental problems from escalating into more serious health issues.<sup>11-16</sup>

This study underscores the effectiveness of the telemedicine program in identifying and managing women with high-risk HPV infection in remote areas of Indonesia. The observed high-risk HPV positivity rate of 12% aligns with previous studies conducted in Indonesia, emphasizing the persistent need for effective screening programs in this population. The telemedicine program facilitated the timely referral of all women with positive HPV results for colposcopy. This diagnostic procedure is crucial in determining the need for treatment and preventing the progression of high-risk HPV infection to cervical cancer. By enabling prompt referral for colposcopy, the program ensures that women with positive screening results receive appropriate and timely management. Among those referred for colposcopy, 17.4% were found to have CIN 2+, indicating moderate to severe dysplasia. These precancerous lesions require treatment to prevent the development of cervical cancer. The telemedicine program successfully facilitated access to treatment for these women, with 62.5% receiving cryotherapy and 37.5% undergoing LEEP (Loop Electrosurgical Excision Procedure). Cryotherapy involves freezing and destroying abnormal cervical cells, while LEEP uses a thin wire loop to remove the affected tissue. Timely intervention through colposcopy and appropriate treatment of precancerous lesions is critical in preventing the progression to cervical cancer. By facilitating access to these essential services, the telemedicine program has the potential to significantly reduce the incidence of cervical cancer and improve survival rates in remote areas. The effective identification and management of high-risk HPV infection through the telemedicine program contribute significantly to cervical cancer prevention

and control efforts. By enabling early detection, timely referral, and appropriate treatment, the program helps to interrupt the progression of high-risk HPV infection to cervical cancer. This can lead to a reduction in the number of cervical cancer cases and improve overall health outcomes for women in remote areas. The findings of this study have important public health implications, particularly for countries with limited healthcare resources and a high burden of cervical cancer. Telemedicine-based screening programs can serve as a valuable tool in expanding access to essential healthcare services and improving cervical cancer prevention and control efforts in underserved populations.<sup>17,18</sup>

This study revealed high levels of satisfaction among participants with the telemedicine program for cervical cancer screening. The majority of women reported satisfaction with the convenience, accessibility, and self-sampling process. This positive feedback underscores the potential of telemedicine to not only improve healthcare access but also enhance the patient experience. The convenience of the telemedicine approach was particularly appreciated by participants, as it eliminated the need for travel to distant healthcare facilities. This is particularly important in remote areas where transportation can be challenging and time-consuming. By bringing healthcare services closer to the community, telemedicine reduces the burden of travel and makes it easier for women to prioritize their health. The accessibility of the program, enabled by the use of technology, was also highly valued by participants. Telemedicine allows women to access healthcare services from the comfort of their homes, at times that are convenient for them. This flexibility and accessibility can be particularly beneficial for women in remote areas who may face logistical or financial barriers to accessing traditional healthcare services. The self-sampling process, which allowed women to collect their own samples in the privacy of their homes, was well-received and contributed to the overall positive experience. Self-sampling offers several advantages over traditional clinic-based sampling, including increased privacy, convenience, and control for the patient. The positive response to self-sampling

in this study suggests that it is an acceptable and empowering option for women in remote areas. The high participant satisfaction observed in this study suggests that telemedicine-based screening programs can be empowering for women, allowing them to actively participate in their healthcare and make informed decisions about their health. This empowerment can lead to increased adherence to screening recommendations and improved health outcomes. In addition to convenience, accessibility, and self-sampling, several other factors likely contributed to the high participant satisfaction observed in this study. The telemedicine platform facilitated clear and timely communication between participants and healthcare providers, ensuring that women felt heard and supported throughout the screening process. The program incorporated culturally sensitive practices, such as the involvement of village health workers and community leaders, which helped to build trust and rapport with participants. The telemedicine platform enabled positive patient-provider interactions, even in a remote setting. This helped to build trust and confidence in the program. The high participant satisfaction observed in this study has important implications for healthcare delivery. It suggests that telemedicine-based screening programs can not only improve access to care but also enhance the patient experience. By incorporating patient-centered approaches and leveraging technology to improve convenience and accessibility, healthcare providers can create more satisfying and engaging healthcare experiences for patients.<sup>19,20</sup>

## **5. Conclusion**

This study demonstrates the feasibility and effectiveness of telemedicine-based cervical cancer screening in remote areas of Indonesia. The program achieved a high participation rate (76%) and enabled timely referral of women with positive high-risk HPV results for colposcopy and further management. Participant satisfaction with the telemedicine program was high, with the majority of women reporting satisfaction with the convenience, accessibility, and self-sampling process. This approach has the potential

to improve cervical cancer screening coverage and reduce mortality rates in underserved populations. The findings of this study have important implications for practice and policy. Healthcare providers should consider integrating telemedicine into their cervical cancer screening programs, particularly in remote areas with limited access to healthcare facilities. Policymakers should develop strategies to support the implementation and scale-up of telemedicine-based cervical cancer screening programs. Future research should focus on evaluating the long-term effectiveness of telemedicine-based cervical cancer screening programs, including their impact on cervical cancer incidence and mortality rates. Research is also needed to assess the cost-effectiveness of telemedicine interventions and to identify strategies for optimizing their implementation in different settings.

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