

## Review Article

# Cervical Cancer Screening in Kazakhstan: Progress, Gaps, and the Promise of HPV Self-Sampling

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## ABSTRACT

Cervical cancer remains a major public health concern in Kazakhstan despite ongoing prevention efforts. Although incidence has declined in many high-income countries due to effective screening and human papillomavirus vaccination programs, Kazakhstan continues to report relatively high incidence and still considerable mortality rates compared with many developed regions. This narrative review summarizes the current epidemiological trends, screening practices, and prevention strategies for cervical cancer in Kazakhstan. National screening programs based on cytology have been implemented since 2008 and have improved early detection; however, screening coverage remains below the World Health Organization target of 70%, with participation particularly low in rural areas due to limited awareness, access barriers, and logistical challenges. The prevalence of human papillomavirus infection among women in Kazakhstan is relatively high, with high-risk types contributing significantly to disease burden. The reintroduction of the national HPV vaccination program targeting adolescents represents an important step toward long-term cervical cancer prevention. In addition, emerging screening approaches such as HPV self-sampling offer promising opportunities to increase screening uptake, especially among under-screened populations. Integrating vaccination programs with innovative and accessible screening strategies, alongside improved awareness, follow-up systems, and health system support, could significantly enhance cervical cancer prevention efforts. Strengthening these interventions will be essential for Kazakhstan to reduce cervical cancer burden and move toward achieving the World Health Organization goal of cervical cancer elimination.

**Keywords:** Uterine Cervical Neoplasms; Papillomavirus Infections; Mass Screening; Papillomavirus Vaccines; Papanicolaou Test

## Introduction

Cervical cancer (CC) remains a major public health challenge and is one of the leading causes of cancer-related morbidity and mortality among women worldwide (1). In 2022, approximately 660,000 new cases of the disease were reported, resulting in 350,000 deaths, thereby making cervical cancer the fourth leading cause of cancer-related death among women (1, 2). Although cervical cancer is largely preventable through HPV vaccination and effective screening, disease continues to disproportionately affect women in low- and middle-income countries, where around 90% of deaths happen (3, 4). Projections indicate that by 2030 the global burden will continue to rise, reaching more than 840,000 new cases, with an estimated 470,000 deaths (5). These patterns underscore ongoing disparities that affect people's ability to access preventive services which include vaccination and early detection and timely treatment (6, 7).

Cervical cancer also remains a major public health concern in Kazakhstan despite the implementation of national screening programs (8, 9). Participation rates remain below WHO targets, especially in rural and underserved communities, who face geographic, organizational, and awareness-related

barriers to accessing screening services (10). Addressing these gaps requires new solutions which could increase both public participation and availability of screening services.

One promising approach that could help to overcome these barriers is HPV self-sampling, which allows women to collect their own samples, which provides results comparable in accuracy to samples collected by trained professionals, while introducing better access options and maintaining testing privacy and user comfort (11, 12). A pilot study conducted among Kazakhstani women showed that self-sampling is both feasible and acceptable, highlighting its potential as a complementary approach to current screening programs (13).

This narrative review aims to examine cervical cancer prevention in Kazakhstan by summarizing the country's HPV prevalence, cervical cancer burden, and the progress of vaccination and screening programs. It also discusses the gaps in screening that already exist and how HPV self-sampling could help get more people involved and make screening easier and more effective across the whole healthcare system.

## Materials and Methods

This is a narrative review; PRISMA flowchart is provided for transparency of the search process rather than systematic review methodology. Peer-reviewed articles published in English between January 2016, and February 2026 were included. Major electronic databases—PubMed/MEDLINE, Google Scholar, and the Kazakh Journal of Oncology—were searched for studies on cervical cancer, human papillomavirus (HPV), screening, and vaccination in Kazakhstan. Medical Subject Headings (MeSH) were applied wherever they were suitable which included Uterine Cervical Neoplasms (D002583), Papillomavirus Infections (D030361), Mass Screening (D008403), Early Detection of Cancer (D055088), Papanicolaou Test (D065006), and Papillomavirus Vaccines (D053918) (Supplementary Table S1).

Studies were eligible if they addressed cervical cancer, HPV infection, screening, or vaccination in the context of Kazakhstan. Titles and abstracts were screened for relevance, and the full texts of potentially eligible studies were reviewed (Figure 1). Due to heterogeneity in study designs and outcomes, study results were presented as a narrative review.

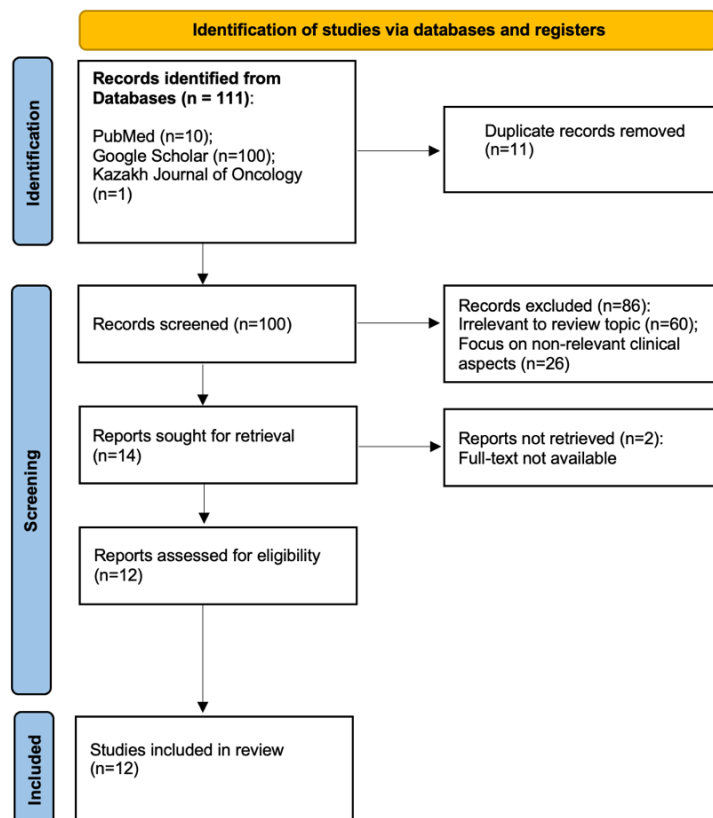


Figure 1. PRISMA flowchart of study selection for the review

## Results and Discussion

### Epidemiology in Kazakhstan and HPV Prevalence

Trends in many developed regions of the world show that cervical cancer rates are decreasing due to effective preventive measures, such as HPV vaccination and organized screening programs (14). Cervical cancer still remains the second most common cancer in women

in Kazakhstan after breast cancer, indicating persistent public health challenge (15).

Kazakhstan's age-standardized cervical cancer incidence (ASIR) is 15.7 per 100,000 women, and the age-standardized mortality rate (ASMR) is 7.2 per 100,000 women (Table 1) (16, 17).

**Table 1. Age-Standardized Cervical Cancer Incidence and Mortality Across Global Regions, 2022**

Region / Country	Cases (n)	ASIR (per 100,000)	Deaths (n)	ASMR (per 100,000)
<b>Kazakhstan</b>	1,777	15.7	834	7.2
<b>Central Asia</b>	153,944	15.1	95,962	9.5
<b>Asia (all)</b>	397,082	13.9	199,795	6.7
<b>Europe</b>	58,219	10.6	26,950	3.9
<b>Africa</b>	125,699	26.4	80,614	17.6
<b>Americas</b>	63,171	15.1	33,514	7.7
<b>Oceania</b>	2,476	9.6	1,309	4.5
<b>Global</b>	662,301	14.1	348,874	7.1

The observed rates exceed global averages (ASIR 14.1, ASMR 7.1) and exceed Western European rates more than two times (ASIR 6.6, ASMR 2.1), which shows that cervical cancer remains a significant public health problem in the country despite national screening programs (16, 17). Kazakhstan shows a slightly higher incidence of cervical cancer compared to the Central Asian region (ASIR 15.1, ASMR 9.5), while the country experiences a lower mortality rate, which indicates better access to early detection or treatment in Kazakhstan (16, 17). The worldwide distribution of cervical cancer burden demonstrates a significant variation which reaches its peak in African countries (ASIR 26.4, ASMR 17.6) (16, 17). The findings highlight the differences in access to effective screening, prevention strategies, and cancer treatment services across regions (18). Overall, these findings emphasize that Kazakhstan urgently needs to enhance screening, HPV vaccination, and follow-up care to achieve results comparable to regions with lower disease rates.

HPV infection is a critical driver of cervical cancer in Kazakhstan. The overall HPV prevalence among women in Kazakhstan is estimated at approximately 25% (19), but the number is remarkably higher for women attending gynecologists in clinics, where the prevalence ranges between 39% to 43% (20, 21). Additionally, women with abnormal cervical cytology demonstrate higher HPV prevalence, reaching 43–49% (19). These findings indicate substantial HPV

exposure and emphasize the need for comprehensive screening and effective follow-up care.

High-risk HPV types, particularly HPV-16 and HPV-18, are responsible for most of the cervical cancer cases, are the principal factors leading to the high incidence of cervical cancer in Kazakhstan (22). Among the various types, HPV-16 is found to be the one that poses the greatest threat as its presence is detected consistently through the various stages of precancerous lesions (20, 21). The link of HPV infection to the development of cervical cancer emphasizes the need for effective screening and preventive measures.

The government of Kazakhstan started a nationwide program for cervical cancer screening in 2008, providing the opportunity to have a cytology-based screening (23, 24). Even though the program was designed and offered at no cost, screening participation remains very low, where limited access to healthcare services, low awareness, and logistical barriers continue to restrict uptake. The reported screening rate is 48-50% (23, 24), which is still far behind the 70% target set by the WHO for effective cervical cancer prevention (21). In rural areas, lack of knowledge, fear, and geographical and logistical barriers to accessing screening services are some of the reasons that contribute to lower screening rates (21). The local researchers have indicated that rural women had less chance of participating in screening tests than urban

women, and the reasons given above were mainly responsible for that.

Cervical cancer rates are highly varied in the country based on different areas. The East Kazakhstan region, based on the records of the Kazakhstan Cancer Registry (KCR), has the highest incidence rates, while the South region has the lowest incidence rates (23). Different rates may be due to differences in the quality of health care, the availability of screening, and demographic factors such as population density and migration patterns. Age-standardized incidence rates indicate that the major occurrence of cervical cancer in Kazakhstan is among the 40-49-year-old age group, who represent a key working-age population (15). This age group is the backbone of Kazakhstan's labor force and also contributes significantly to the country's economic output. Consequently, the higher rates of cervical cancer, both in terms of incidence and mortality, among the given demographic are responsible for posing public health and financial concerns of large magnitude.

Moreover, the health-care system needs to ensure that women with a positive HPV test or those with precancerous lesions get immediate treatment as follow-up. The prompt action for cervical intraepithelial neoplasia can prevent the process of cancer and thereby, reduce mortality rates. The availability of methods like cryotherapy, loop electrosurgical excision procedures (LEEP) and surgery or radiation therapy for the very severe cases needs to be better especially in the rural areas (23) (19).

#### **HPV vaccination in Kazakhstan**

A major strategy in reducing cervical cancer in Kazakhstan is the combined implementation of HPV vaccination and screening programs. The combined method has proven successful for countries which have decreased their cervical cancer rates. For example, Australian health system has achieved a substantial decline in HPV incidence because of its extensive vaccination program and its system of routine health check-ups (24). The implementation of HPV vaccination programs together with advanced screening systems will enable Kazakhstan to achieve its goal of decreasing cervical cancer cases over time. However, the implementation of these programs will need to deal with the existing challenges, such as the hesitancy for taking the vaccine, and providing better and more accessible cervical cancer screenings.

The 2023 study conducted in Almaty demonstrates that healthcare professionals possess limited knowledge about HPV vaccination and their vaccination practices. The study found that one-third of healthcare providers had sufficient understanding of HPV and only 28 percent of those providers stated they

would give vaccine recommendations to their patients and children. The study found that healthcare providers who understood vaccine safety better and had greater confidence about it were more likely to recommend vaccination to their patients which shows that training healthcare workers to handle vaccine misconceptions will help programs succeed (25).

Besides the present-day screening program, Kazakhstan has set in motion an HPV vaccination campaign. The first trial vaccination program started in 2013 was met with substantial resistance from the public and was eventually stopped due to concerns about the vaccine's safety and effectiveness (23, 26, 27). Recent evidence from a 2022-2023 study shows that parents in Kazakhstan show strong vaccine hesitancy toward the HPV vaccine. Only 28.7% reported willingness to vaccinate their child, while 35.3% were unwilling and 36.1% were uncertain. People showed hesitancy about the vaccine because they had limited knowledge about HPV and its connection to cervical cancer and because they belonged to various socio-demographic groups which included different educational and income levels and regional backgrounds when Central and West Kazakhstan showed the lowest level of acceptance. The study results indicate an urgent need to fix existing knowledge gaps which vaccines face through vaccination campaigns (28). In 2024, the government brought back the HPV vaccination program targeting girls 11-13 years old, as part of a broader plan to reduce the prevalence of cervical cancer (21). Although vaccination campaigns have been successful in reducing cervical cancer in some countries (27), the full impact of this program will eventually take time to show up. The vaccination success in Kazakhstan will be noticeable after 10-15 years when the country begins to see a drop in HPV-related cancer cases (29).

The vaccination process has not changed the fact that routine screening is still crucial for screening purposes of non-vaccinated women or those who have been vaccinated but at a later stage of the infection. The screening has been by far the most effective way to detect and trace back the cases of women with precancerous changes who may otherwise progress to invasive cervical cancer (9). Still, screening uptake remains limited and continues to be one of the major challenges in healthcare (26).

Kazakhstan has committed to adding the HPV vaccine to the national vaccination program by the fall of 2024. This is a major step forward for the country as it plans to reduce the incidence of cervical cancer, because the HPV vaccine is effective in preventing the virus types that are responsible for the majority of cervical cancers. The vaccination program is expected

to begin with girls aged 11, and then boys will be gradually included as well to make it gender-neutral. This program not only strengthens the screening program but also gives huge support to the fight against cervical cancer in Kazakhstan (22, 30).

Cervical cancer remains a major public health issue in Kazakhstan due to its high incidence and constant death rate. The country still finds it difficult to have enough participation, particularly among women in rural areas, although the screening and immunization programs have been put in place as an attempt to solve the problem. The existing program implementation has achieved only partial success because the ongoing regional differences between communities need more effective solutions to support rural areas. The existing gaps require public awareness

improvements together with better service accessibility and enhanced follow-up care. The combination of HPV vaccination and regular screening would lead to a significant reduction in the cervical cancer incidence in Kazakhstan over time.

#### Cervical Cancer Screening in Kazakhstan

Kazakhstan's cervical cancer screening program has undergone considerable transformations over the years (Table 2). Initially, the screening of cervical cancer in Kazakhstan was mainly opportunistic, meaning that women were only screened if they sought medical help or were specifically referred by the healthcare professionals (11, 23). From the very beginning up to 2005, the program used cytology testing only with Romanowsky staining as the only diagnostic method (23, 31).

**Table 2. Timeline of Cervical Cancer Screening Development in Kazakhstan**

Year / Period	Key activities	Description
Before 2005	Opportunistic screening	Cervical cancer screening was mainly opportunistic and performed when women visited healthcare facilities. Cytology using the Romanowsky staining method was the primary diagnostic approach.
2005	Introduction of organized cytological screening	The government initiated a structured screening program starting with women aged 30-34 years.
2006	Expansion of the screening population	Screening eligibility expanded to include women aged 18-49 years. The Papanicolaou method (Pap test) began to be introduced as the standard screening method.
2008	Cervical cancer screening program	The cervical cancer screening program was implemented, targeting women aged 30-60 years with a screening interval of five years.
2009	Nationwide adoption of the Pap test	Cytological screening using the Papanicolaou technique became the standard method across Kazakhstan.
2013	Introduction of liquid-based cytology (LBC)	LBC was introduced to improve sample quality and increase the sensitivity of cervical cancer screening.
2016	Decline in screening coverage	Screening participation declined from approximately 72.9% in 2008 to about 45.9%, highlighting challenges in program reach and participation.
2017	Updated National cervical cancer screening program	The State Cancer Screening Program was implemented, targeting women aged 30-70 years with a screening interval of four years.

The year 2005 saw the birth of an organized cytological screening by the government, starting with women aged 30-34 and then progressively opening up to women aged 18-49 by 2006 (8). In the year 2008, the government initiated the State Cancer Screening Program targeting women aged 30-60 with a five-year interval for the screenings (23, 32). This changeover to a more structured approach was a crucial step for the country in its struggle against cervical cancer.

The screening tests' quality has also improved significantly. If at the beginning, the Romanowsky method was used, since in 2006 the Pap test as a

screening method was applied and recognized as the standard across the country (23, 31, 32). By the year 2009, in Kazakhstan, all the examinations were conducted by the Papanicolaou technique.

Later, in 2013, Kazakhstan made a crucial move in its pap screening program by introducing the LBC method, which provides better specimen quality and reduces the risk of mistakes in the detection of early lesions (23, 33). LBC is a technique that uses a liquid medium to preserve cervical cells more efficiently than the traditional methods and, thus, provides the pathologist with a more uniform and less thick layer of

cells for examination. Moreover, LBC has been shown to increase the sensitivity of cervical cancer screening, thus allowing detection of precancerous lesions at an earlier stage.

Despite the improvements in screening methods and facilities, Kazakhstan still faces a problem in getting more people screened, particularly in rural areas where participation is low. The screening program indeed targets a large part of the population, including about 80% of women aged 25-64 (32), but still, the total participation is not very good, and therefore, the program is not very effective. As per the HPV Information Center, screening coverage has dropped alarmingly from 72.9% in 2008 to 45.9% in 2016 (23).

Women living in rural areas of Kazakhstan face particular barriers to taking part in screening activities, such as the low awareness of the program, limited access to medical services, and transport difficulties (9). Evidence from Kazakhstan suggests that low screening uptake is primarily driven by insufficient awareness, low perceived risk, and lack of knowledge about the importance of screening, in addition to structural barriers such as access and time constraints (9). Several barriers hinder screening uptake, and potential solutions have been proposed (Table 3). The differences in access and awareness of cervical cancer screening are also reported in other underdeveloped countries (15).

**Table 3. Barriers to Cervical Cancer Screening and Potential Solutions in Kazakhstan**

Barrier	Evidence	Potential Solutions
Limited public awareness	Many women lack knowledge about cervical cancer, HPV, and the importance of regular screening. Low health literacy contributes to delayed screening.	<ul style="list-style-type: none"> <li>- Public education campaigns via media and community outreach.</li> <li>- Workplace-based awareness programs.</li> <li>- Culturally tailored educational materials.</li> </ul>
Cultural and social stigma	Screening may be perceived as embarrassing or shameful. Some communities discourage gynecological exams.	<ul style="list-style-type: none"> <li>- Community engagement to normalize screening.</li> <li>- Use of female healthcare providers for screening.</li> <li>- Inclusion of religious and community leaders in awareness campaigns.</li> </ul>
Limited access to healthcare facilities	Rural and remote populations have difficulty accessing screening services due to distance, transportation, and lack of local clinics.	<ul style="list-style-type: none"> <li>- Mobile screening units and outreach programs.</li> <li>- Telemedicine consultations to guide women to local services.</li> <li>- Strengthen primary healthcare capacity in rural areas.</li> </ul>
Financial barriers	Screening costs, travel expenses, or lost wages may prevent women from attending screening, despite partial public coverage.	<ul style="list-style-type: none"> <li>- Ensure free or subsidized screening nationwide.</li> <li>- Integrate screening into routine primary care visits.</li> <li>- Provide transportation support for rural populations.</li> </ul>
Healthcare system limitations	Shortage of trained personnel, inconsistent follow-up, and lack of organized screening programs reduce screening uptake.	<ul style="list-style-type: none"> <li>- Train more gynecologists and nurses in cytology and HPV testing.</li> <li>- Implement organized, population-based screening programs with recall systems.</li> <li>- Standardize guidelines and quality assurance protocols.</li> </ul>
Fear and anxiety	Fear of diagnosis, pain, or medical procedures can deter women from attending screening.	<ul style="list-style-type: none"> <li>- Counseling services and patient education on screening process.</li> <li>- Clear communication on the benefits and low risks of screening.</li> <li>- Peer support groups sharing positive screening experiences.</li> </ul>
Inconsistent policy implementation	Variability in regional health policies leads to unequal access and coverage.	<ul style="list-style-type: none"> <li>- Nationwide standardization of screening programs.</li> <li>- Regular monitoring and evaluation of program coverage.</li> <li>- Policy support for HPV vaccination integration with screening.</li> </ul>

Cervical cancer rates in Kazakhstan vary across regions. For example, the eastern part of the country, such as East Kazakhstan, has the highest incidence, while the southern region has the lowest (15). One reason for those differences could be the unequal availability of screening, along with socio-economic and cultural factors that determine access to healthcare (9). Reduced screening participation is, especially, characteristic of rural areas, which might be the reason for the higher cancer rates in these regions to some extent.

### **Future opportunities for cervical cancer prevention worldwide and in Kazakhstan with a focus on screening and self-sampling**

Globally and in Kazakhstan, the future of cervical cancer prevention is increasingly centered on the screening strategies that are effective, equitable, and well-covered. Despite the substantial advances in cytology and HPV testing, currently the average global screening rates are still not meeting the WHO target of 70%, especially in the case of low- and middle-income countries where participation is often limited by structural, cultural, and logistical barriers (32, 34). One country that fully represents this problem is Kazakhstan, with declining screening coverage and persistent rural/urban inequalities that need to be resolved with better technology in the screening delivery.

Integrating HPV self-sampling into organized cervical cancer screening programs is a promising method to eliminate these gaps. The growing body of evidence suggests that the testing of HPV on self-collected vaginal samples through PCR-based assays presents high sensitivity and specificity equivalent to those of clinician-collected cervical samples, with sensitivity for high-grade cervical lesions often going beyond 90% (11, 35). Self-sampling has been a constant factor in getting people to participate in screening, with the greatest effect on under-screened women, those living in rural or isolated areas, and groups experiencing cultural or personal barriers to pelvic exams (35, 36).

From the perspective of public health, self-sampling has the potential to address several key barriers to screening uptake associated with low screening participation, which are: the lack of proper health care services, fear of gynecological examination, the burden of time, and the concern about confidentiality. It has been demonstrated in studies that women are very content with the self-sampling methods, and they feel it gives them control and they accept it as an option, the rates of acceptance going sometimes over 80-90% in different places and with different groups of people (35, 37). For Kazakhstan,

particularly, such features of self-sampling make it very suitable; there the rural women do have hard times concerning access, awareness, and transport issues (9).

Moreover, economic evaluations support the adoption of self-sampling as a potential new screening method. Besides, HPV testing through self-sampling has turned out to be less expensive in comparison with cytology or HPV testing done by the clinician due to less personnel costs and wider screening coverage (38) (32). Dry sample collection devices and mail or community-based distribution of kits is especially important in resource-poor areas with large populations, like Kazakhstan, where there is a centralized lab infrastructure but the access to the population is uneven (35) (29).

Importantly, the successful implementation of self-sampling requires more than test availability. Organized invitation systems, clear follow-up routes for HPV-positive women, consistent triage and laboratory controls to ensure that no one is lost to follow-up and clinical efficacy is achieved (26, 34) (21, 28). Besides, the awareness campaigns directed toward women and healthcare professionals are necessary as the lack of knowledge and the reluctance of providers still pose obstacles to the widespread adoption of primary HPV testing and self-sampling methods (35, 39, 40) (29, 33, 34).

In Kazakhstan, introducing self-collection as an additional option in the national screening program might double the participation of non-attending women while at the same time supporting the current clinic-based services. Targeted pilots in rural areas, combined with culturally appropriate education and clear referral protocols, would follow WHO guidelines and help achieve the 70% screening target of the WHO 90-70-90 cervical cancer elimination strategy (28). Kazakhstan could serve as a regional example by promoting the use of evidence-based innovations like HPV self-sampling for screening, reducing gaps, and accelerating victories in the battle against cervical cancer.

From a policy viewpoint, enhancing cervical cancer prevention in Kazakhstan requires strengthening of organized screening efforts and the elimination of disparities in access to preventive services. Particular attention should be given to women living in rural areas, where participation in screening remains lower. The three essential steps include expanding outreach activities and increasing public awareness about cervical cancer prevention and providing timely follow-up services to women who receive positive screening results. The national screening program can bring practical benefits for women who avoid clinic-based screenings through the implementation of HPV self-

sampling. The combined implementation of these strategies together with current HPV vaccination programs will help Kazakhstan achieve the WHO 90-70-90 cervical cancer elimination targets.

This review provides an overview of cervical cancer epidemiology, screening, vaccination, and emerging prevention strategies in Kazakhstan, but a few limitations should be noted. Since this is a narrative review, it doesn't follow the strict rules of a systematic

review, which means some of the studies included may be biased. Data on cervical cancer in Kazakhstan are limited and sometimes inconsistent, making direct comparisons difficult. This review, on the other hand, uses both national and international evidence to show the main gaps in cervical cancer prevention and suggest practical ways to improve screening uptake and strengthen prevention efforts across the country.

## Conclusion

Cervical cancer remains a public health problem in Kazakhstan, with screening coverage below WHO targets and persistent urban-rural disparities. The primary objectives for development work need to focus on three areas, which include enhancing scheduled medical assessments, establishing better patient treatment systems, and increasing public

understanding of health services. The combination of HPV vaccination with HPV self-sampling tests, which provide easier access to testing, will boost screening rates and early cancer detection in Kazakhstan, helping the country achieve WHO cervical cancer elimination targets.

## Supplementary Files

Supplementary files available from: <https://www.archivesmch.org/supfile/746/Supplementary-File-AMCH002.pdf>

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**Data Availability Statement:** Not applicable.

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