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PERSPECTIVE

Modeling cervical cancer elimination: a pathway to inform policy decisions

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In May 2018, the Director-General of the World Health Organization (WHO) called for global action to eliminate cervical cancer[1]. This call marked the beginning of an ambitious international effort to scale up 3 key strategies: human papillomavirus (HPV) vaccination, cervical cancer screening, and treatment of precancerous lesions and cancer. Subsequently, the WHO and its partners developed a global strategy to accelerate the reduction of cervical cancer incidence, with an ultimate goal of achieving elimination within the next century. This Global Strategy represents a formal international commitment and is anchored in the 90-70-90 targets to be achieved by 2030. In parallel, several countries have also set national commitments, such as Sweden's pledge to achieve elimination by 2027 and Australia's target of achieving elimination by 2035.

Cervical cancer elimination and modeling studies

Eliminating cervical cancer requires substantial and sustained investment in prevention and control programs. Before the large-scale implementation of these efforts, assessing the feasibility of elimination, identifying conditions under which elimination can be achieved, and estimating the time frame required to realize this goal are crucial. These steps cannot be addressed through direct observation, because the effects of prevention and control require decades to manifest at the population level. In this context, mathematical models serve as essential tools for synthesizing available epidemiological data, simulating disease progression, and assessing the long-term effects of various intervention strategies. The evidence generated by these models can in turn inform policy decisions. Specifically, they can be used to estimate the potential decreases in incidence and mortality achieved from HPV vaccination and cervical screening, and to compare the effectiveness of various intervention scenarios.

Modeling evidence supporting the global 90-70-90 elimination targets

Initial modeling efforts were conducted in Australia to assess the feasibility of cervical cancer elimination. With sustained high coverage of HPV vaccination and cervical screening, elimination within the next 20 years was found to be potentially achievable in Australia[2]. This study provided the first quantitative evidence that elimination can be a realistic goal in well-resourced settings with mature programs. Subsequently, a global modeling study that expanded this assessment to all countries demonstrated that while elimination was technically feasible in most settings, it required rapid and extensive scale-up of interventions. In particular, for low- and middle-income countries (LMICs), which carry 85% of the global cervical cancer burden, accelerated introduction of HPV vaccination and screening would be essential to narrow the equity gap[3].

To provide technical evidence to support global decision-making, the WHO convened the Cervical Cancer

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Elimination Modeling Consortium (CCEMC), comprising 3 independent modeling teams using the Harvard model, the Policy1-Cervix model, and the HPV-ADVISE model. These teams applied their transmission-dynamics models to 78 LMICs and evaluated the long-term effects of various intervention strategies. Results from 2 coordinated publications projected that high girls-only HPV vaccination coverage could decrease cervical cancer incidence by 89% over the next century. However, in many countries, particularly those with higher baseline incidence and lower vaccine coverage, vaccination alone would be insufficient to achieve the elimination threshold of 4 cases per 100,000 women annually. Incorporating 2 lifetime screens would accelerate the effects and make elimination feasible in a broader range of settings[4,5].

Together, these modeling efforts helped define key technical elements of the global strategy. A threshold of 4 new cases per 100,000 women annually was used to define elimination. This threshold was supported across studies and has been used by the WHO. In addition, the combined findings contributed to the development of the 90-70-90 targets, i.e., 90% of girls fully vaccinated with HPV vaccine by age 15 years, 70% of women screened with high-performance tests by 35 years of age and again by 45 years of age, and 90% of women identified with cervical disease receiving treatment[6]. The coordinated use of modeling has provided a strong foundation for strategic decision-making at the global level (**Figure 1**).

Context-specific modeling for tailored national-level elimination strategies

Although global targets provide a common framework, country-level modeling remains critical to assess the feasibility of elimination and to identify the most suitable strategy pathways under various national conditions. Hence, alongside the CCEMC studies, many other modeling efforts have been conducted to assess the feasibility and timelines for cervical cancer elimination in specific settings.

In high-income settings with established prevention programs, elimination is projected to be achievable within decades. For example, in Australia, high-coverage HPV vaccination and screening could lead to elimination within

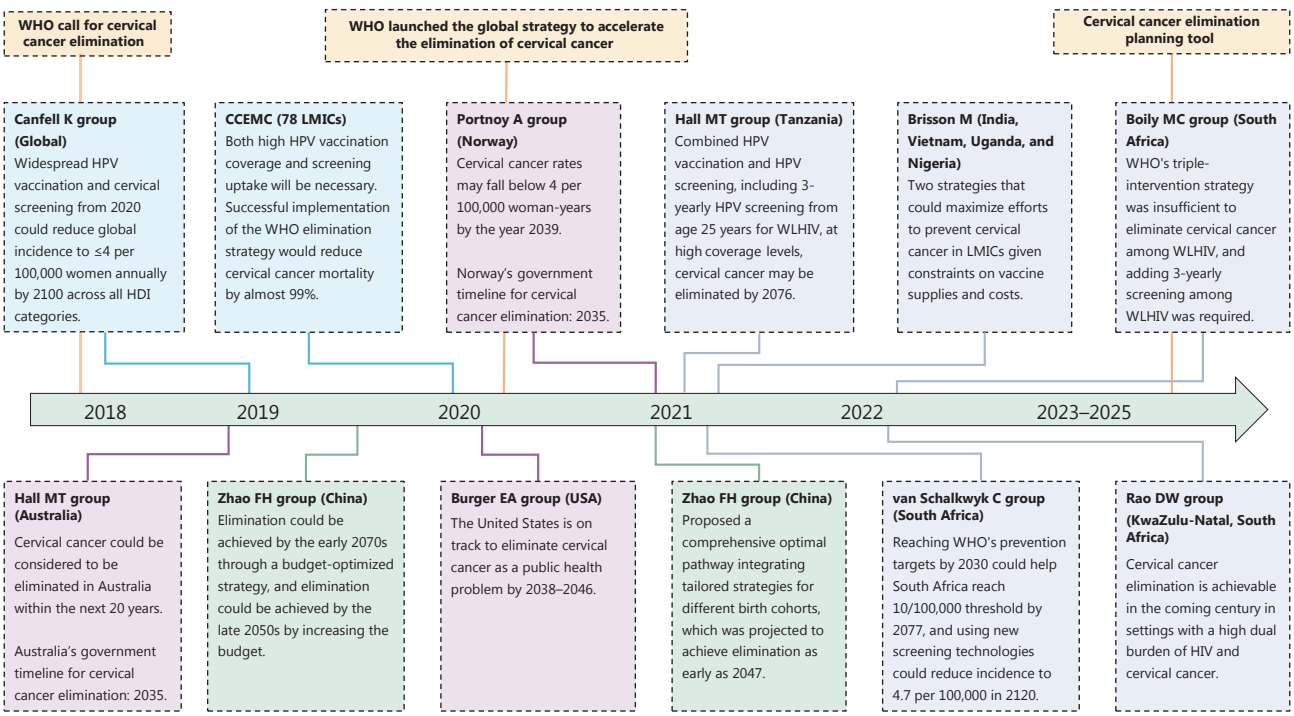


Figure 1 Timeline of key modeling studies and WHO milestones on cervical cancer elimination. Yellow: WHO-led call, strategy, and action for cervical cancer elimination. Blue: Global and regional modeling studies. Pink: Studies from high-income countries. Green: Studies conducted in China. Purple: Studies focused on low- and middle-income countries (LMICs). WHO, World Health Organization.

20 years[2]. Similarly, the United States has been projected to achieve elimination between 2038 and 2046 under current policies, and faster progress would be possible if screening coverage were further increased[7]. In Norway, existing cervical cancer control strategies are expected to achieve elimination by 2039[8]. A recent study from Greece has estimated that the goal of elimination could be achieved by 2047 if current levels of HPV vaccination and screening are maintained[9].

In contrast, the timelines for LMICs are often prolonged, because of resource constraints. Modeling in South Africa has indicated that elimination is unlikely within 100 years under current intervention levels. Achieving elimination in South Africa calls for coupling the 90-70-90 strategy with more intensive screening for women living with HIV[10]. Similarly, in Tanzania and other high-HIV burden countries, enhanced efforts are also necessary[11-13].

National-level modeling is also essential for identifying elimination strategies appropriate for local conditions. In India, modeling highlighted the cost-effectiveness of single-dose vaccination to expand coverage and decrease costs[14]. Comparable findings were reported in other sub-Saharan African countries, where single-dose strategies could accelerate elimination efforts under limited-resource settings[15,16]. These examples underscore how context-specific modeling guides feasible pathways tailored to health system constraints. The variations in elimination timelines largely reflect the substantial disparities that exist among countries, driven by differences in vaccination history, screening capacity, health system resources, and population risk profiles. Model-based projections must be grounded in valid data and realistic assumptions specific to each context.

Model-based strategies and optimal pathway for cervical cancer elimination in China

In China, a series of modeling studies have been conducted to inform cervical cancer elimination strategies. The first foundational study projected that elimination could be achieved by the early 2070s through a budget-optimized strategy, if current resource constraints were assumed to continue[17]. A subsequent study proposed a comprehensive optimal pathway integrating tailored strategies for different birth cohorts, which was projected to achieve elimination as early as 2047 while generating net economic savings from a societal perspective[18]. A follow-up modeling study indicated that immediate nationwide scale-up of HPV vaccination and screening could avert 14.8–15.8 million cervical cancer cases and 5.75–6.11 million related deaths, save $21.7–27.7 billion in costs, and enable China to achieve cervical cancer elimination by the 2060s[19].

Another study has explored how to optimize the use of available doses, considering vaccine supply constraints. Prioritizing the routine vaccination of girls 9–14 years of age, rather than undertaking multi-age cohort campaigns, was projected to provide greater long-term benefits in terms of cases and deaths averted under supply-limited conditions[20]. Additionally, modeling work informed pricing strategies for integrating HPV vaccines into the national immunization program (NIP). One study determined that for nationwide two-dose HPV vaccination program, $26–$36 per-dose would be cost-effective, while a price below $5 would be required to achieve cost savings[21]. Screening strategies have also been evaluated, HPV self-sampling and screen-and-treat approach has been found to be cost-effective in underserved settings[22]. In addition, switching from bivalent to nonavalent HPV vaccines has been projected to be a cost-effective option under current pricing structures[23].

These modeling studies highlight the critical roles of tailored strategies, cost-effectiveness evaluations, and technological advancements in guiding China's efforts to eliminate cervical cancer. They provide crucial evidence to inform policy decisions and optimize resource allocation, thereby fostering the sustainable success of elimination efforts in China.

Cervical cancer elimination planning tool: empowering LMICs with a modeling-based roadmap

Although modeling studies have been conducted at the global level and in certain countries, a critical need persists for tools that can accommodate diverse national contexts, particularly in LMICs. To address this need, the International Agency for Research on Cancer, in collaboration with the University of Sydney and other partners, developed the Cervical Cancer Elimination Planning Tool (EPT)[24]. This publicly available online tool is designed to assist LMICs in developing cervical cancer strategies that are both effective and sustainable, and tailored to their demographic profiles and health system capacities. The EPT simulates the long-term effects of vaccination, screening, and treatment interventions, provides country-specific projections to support planning. By translating

modeling insights into an accessible and context-relevant format, it helps governments map out practical pathways toward elimination.

The EPT complements both the CCEMC's global modeling work and national-level studies, providing actionable guidance to directly inform decision-making in diverse settings. Importantly, the EPT was specifically designed to support localized modeling in LMICs, where resource limitations and heterogeneous infrastructure have historically impeded the use of modeling-based approaches. By providing robust and adaptable projections, the tool empowers LMIC governments to align national action plans with the WHO 90-70-90 targets while accounting for local realities.

Mathematical models used in cervical cancer elimination

Beyond parameter inputs, model structure critically influences projections. In the United States, the Cancer Intervention and Surveillance Modeling Network (CISNET) has supported coordinated cervical cancer modeling through 5 independently developed models: MGH-Cervical (MGH), HSPH-Cervical (Harvard), UMN-Cervical (Minnesota), STDSIM-MISCAN-cervix (Erasmus), and Policy1-Cervix (UYSD). These models simulate HPV transmission, disease progression, and intervention effects, and have informed HPV vaccination and screening policies. HSPH-Cervical and Policy1-Cervix have contributed to the CCEMC studies[4,5], and the Policy1-Cervix platform also underpins EPT[24].

Five CISNET cervical cancer models differ in the structure and scope. HSPH-Cervical, UMN-Cervical, and Policy1-Cervix include dynamic HPV transmission components linked to individual-level disease progression models, whereas the STDSIM-MISCAN-cervix model consists of MISCAN-Cervix, a static microsimulation model for disease progression, combined with STDSIM, a separate dynamic transmission model used to simulate HPV spread. MGH-Cervical uniquely integrates HIV transmission and HIV disease progression with the HPV natural history and transmission model, and focuses on high HIV-prevalence settings. The models also differ in the grouping of HPV types and precancer stages, and the inclusion of co-factors such as anogenital warts or HIV.

Beyond the CISNET models, other simulation platforms have played important roles in cervical cancer elimination studies. HPV-ADVISE, developed by the Public Health Agency of Canada, is an individual-based dynamic transmission model designed to simulate HPV infection and cervical cancer natural history progression. This model has been used to support HPV vaccination policy decisions in North America and has contributed to the CCEMC's global modeling efforts[4,5,25]. OncoSim-Cervical, led by Canadian Partnership Against Cancer and Statistics Canada, is a microsimulation model combining HPV transmission and cervical cancer natural history. Applied in British Columbia, the model projects that elimination could be achieved under scenarios of improved vaccination and HPV-based screening.

Each modeling approach has distinct features, and no single model can answer all questions. **Table 1** provides a comparative overview of commonly used cervical cancer models, outlining their model structures, major outcomes, challenges, and core assumptions. The selection of an appropriate model depends on the research objective, availability of local data, and target population. Tailoring or adapting models to reflect specific national or subnational contexts remains a key direction for future work.

Bridging the gap between modeling and practice

Although modeling studies provide valuable guidance on how and when cervical cancer elimination might be achieved, translating these insights into real-world effects remains a major challenge. Political commitments, social engagement, and operational actions are critical to bridge the gap between the modeling and the achievement of goals.

Setting ambitious global benchmarks could not only strengthen government commitment and prioritization, but also attract attention and resource allocation from international partners to accelerate progress in low-resource settings. From a technical perspective, single-dose HPV vaccination, point-of-care HPV DNA testing, a screen-and-treat strategy, and HPV self-sampling can expand coverage and decrease disparities, particularly in LMICs.

Furthermore, to translate modeling insights into actionable strategies, several priority areas warrant further attention, including innovative screening approaches, enhanced data availability, digital solutions to improve service delivery, and robust monitoring systems.

Artificial intelligence (AI) is emerging as a promising adjunct in cervical cancer screening. AI-assisted cytology shows sensitivity for high-grade lesions comparable to that of expert cytologists, while substantially reducing workloads.

Table 1 Characteristics of frequently used cervical cancer models

Model	Model structure	Major outcomes	Challenges	Core assumptions
MGH-Cervical (MGH)*	Dynamic compartmental model with 3 integrated components: (1) HPV and HIV transmission, (2) HIV progression (CD4/viral load) with ART, and (3) HPV-induced precancer and cancer development	Assessing population-level health outcomes with *vs.* without HPV vaccination to gauge vaccination effects in an HIV-affected population	Highly specialized to HIV co-endemic scenarios; requiring detailed HIV epidemiological data and is calibrated to a specific region, thus potentially limiting generalizability	Women living with HIV are assumed to have a higher risk of HPV acquisition, lower risk of clearance, and more rapid progression associated with CD4 cell count, compared with women without HIV. Women clearing HPV are considered to develop low-level natural immunity, whereas men clearing HPV are regarded as not developing natural immunity. Cancer progression is modeled in 3 stages (local, regional, and distant), with HIV status influencing both progression and mortality.
HSPH-Cervical (Harvard)*	Hybrid model linking a dynamic HPV transmission component (compartmental, simulating 9 HPV types) with a static individual-based cervical carcinogenesis model	Evaluating the effectiveness, feasibility, and cost-effectiveness of various screening and vaccination strategies	Does not model non-cervical HPV-associated cancers; does not explicitly model HIV	CIN1 is not modeled as an explicit state; instead, persistent HPV infection was assumed to represent CIN1. HPV infection is modeled to be able to progress directly to CIN2 or CIN3 (non-sequential progression). After invasive cancer develops, no regression is allowed, and women remain in stage-specific survival states. Multiple HPV infections are modeled independently, and type-specific immunity is considered, allowing reinfection. Cross-protection for bivalent and quadrivalent vaccines is explicitly modeled. The model is also expanded to simulate other HPV-associated cancers.
UMN-Cervical (Minnesota)	Comprising 2 linked models: a dynamic individual-based HPV transmission model and a cohort-based cervical disease progression model (HPV infection through CIN and cancer).	Quantifying the population-level effects of vaccination and screening	Using grouped HPV type categories (beyond HPV-16/18, pooling other high-risk types) in modeling assumptions	Sexual behavior is calibrated according to data from the U.S. NSFG. HPV infection can skip stages, progressing directly to any CIN state or regressing in a non-sequential manner. Cancer was modeled according to FIGO stages I–IV, then mapped to SEER categories. Cervical cancer survivors are assumed not to be at risk of recurrence. The baseline scenario posits perfect vaccine efficacy with lifelong immunity. Waning or vaccine failures are examined only in sensitivity analyses.
STDSIM-MISCAN -cervix (Erasmus)	Integrating findings of MISCAN-CERVIX (static micro-simulation model) and STDSIM (a stochastic microsimulation model for the transmission of HPV)	Projecting cervical cancer incidence and mortality (by age, stage, and year), and evaluating long-term effectiveness and cost-effectiveness of screening and vaccination strategies	Core model is static and does not explicitly simulate HPV transmission or herd immunity (requires coupling with a separate HPV transmission model for such analyses)	CIN1/2 lesions are allowed to arise without HPV infection, but are assumed not to progress to cancer. The model uses detailed FIGO staging (I–III) with sequential progression to clinical cancer and death. The duration of HPV infection and CIN lesions is considered equal across HPV types, and transitions are modeled with fixed duration distributions.
Policy1-Cervix (UYSD)*	Comprehensive model combining a dynamic HPV transmission/vaccination component with detailed natural history (HPV infection through CIN1–3 and cancer) and screening modules	Evaluating effectiveness and cost-effectiveness of various screening and vaccination strategies across populations	Requiring substantial locale-specific data and calibration; model accuracy depends on incorporation of local screening behaviors and demographic patterns	HPV types are grouped as 16, 18, High-5 (31/33/45/52/58), and other high-risk categories. Infections across these groups are modeled as independent and could occur simultaneously. CIN states allows "two-step" transitions, whereby CIN1 can directly progress to CIN3 or regress to normal. Women treated for precancer are assumed to continue to have elevated lifetime risk and to require additional follow-up.

Table 1 Continued

Model	Model structure	Major outcomes	Challenges	Core assumptions
HPV-ADVISE*	Individual-based dynamic transmission model simulating HPV infection, progression, and vaccination; core groups included in LMIC version	Estimating population-level effects, efficiency, and cost-effectiveness of HPV vaccination strategies under resource constraints; supporting WHO global recommendations	Requiring detailed behavioral and sexual activity data for accurate calibration; assumptions regarding core groups might limit generalizability to settings lacking such data	Multiple concurrent infections are allowed, with no cross-type interactions. The model also includs other HPV-associated cancers. Stochastic pair formation is incorporated, with a dedicated MSM sub-model in which vaccinating boys has both direct and indirect effects on MSM, whereas vaccinating only girls has no effects on MSM.
OncoSim-Cervical	Microsimulation model combining HPV transmission dynamics with Monte Carlo simulation of cervical cancer natural history; calibrated to Canadian registry and screening data	Projecting cervical cancer incidence and elimination timelines; assessing effects of HPV-based screening, vaccination, and follow-up interventions; supporting regional policy planning	Highly tailored to the Canadian context, such that parameters reflect local healthcare structure and behaviors; limited generalizability to low-resource or demographically different settings	The model includs only 6 grouped HPV categories (6, 11, 16, 18, other high-risk, and other low-risk types). Vaccination is modeled as a binary state (vaccinated or unvaccinated), with no dose-response or partial-course effects. The baseline scenario posits no waning of immunity and full protection for targeted types. HPV testing is assumed to be 100% sensitive and specific for infection.

*HSPH-Cervical, Policy1-Cervix, and HPV-ADVISE models are used by the Cervical Cancer Elimination Modelling Consortium (CCEMC) for projections in 78 low- and middle-income countries, and have been applied in countries including India, Vietnam, Uganda, Nigeria, Papua New Guinea, and South Africa. The MGH-Cervical model has also been applied in South Africa and Kenya. These applications show that context-specific adaptation of models can provide actionable, country-tailored elimination pathways. HPV, human papillomavirus; HIV, human immunodeficiency virus; ART, antiretroviral therapy; CD4, CD4+ T lymphocytes; CIN, cervical intraepithelial neoplasia; FIGO, International Federation of Gynecology and Obstetrics; NSFG, National Survey of Family Growth.

Similarly, AI-supported colposcopy can improve lesion classification and guide biopsy selection, thus enabling less-experienced providers to approach near-expert performance. These innovations might help strengthen screening quality and capacity in resource-constrained settings. Beyond screening, closing data gaps is essential to ensure models' representativeness and guide effective interventions. Many LMICs face incomplete registries, sparse screening data, and limited treatment information that undermine projections. Advances such as AI can enhance cancer registries by improving data quality and generating more reliable insights. Simultaneously, robust monitoring frameworks remain indispensable, with population-based registries serving as the cornerstone for evaluating intervention effectiveness and adjusting strategies in real time. Digital monitoring platforms complement these approaches by providing timely vaccination and screening data, and, when linked to health information systems, they create dynamic feedback loops that both inform immediate policy needs and refine modeling inputs. In addition, digital tools such as the NHS App in England further demonstrate how mobile health applications enhance uptake, streamline service delivery, and support patient follow-up, which might potentially be adapted to LMIC settings.

Sustained progress toward elimination also depends on cross-border collaboration and diversified financing. International partners can offer technical and capacity support to reduce costs. For LMICs, organizations such as Gavi have played a key role in introducing and scaling up vaccines, which alleviates resource constraints, and promotes equity and ongoing viability.

The Chinese government has already taken meaningful steps in response to the modeling evidence, such as expanding free HPV vaccination programs in selected provinces, launching the national Action Plan for Accelerating Cervical Cancer Elimination (2023–2030), and incorporating cervical cancer control into broader health initiatives. These actions reflect the government's recognition of the importance of cervical cancer elimination and commitment to translating research into policy. However, progress toward elimination in China must address considerable regional and socioeconomic disparities. Although a national cervical cancer screening program has been in place since 2009, and HPV vaccination has been pilot tested, coverage remains suboptimal and uneven across areas. Strategies that work in one setting might not be directly applicable to another. Therefore, efforts must be locally adapted, building on existing infrastructure where available, and laying foundations in areas where basic services remain lacking. Including HPV vaccination in the NIP is both beneficial and necessary for promoting equity. China has developed a relatively robust vaccine service infrastructure, including comprehensive immunization information systems, well-established cold chain network and sufficient healthcare workers trained in vaccination services. These strengths place China in a favorable position to integrate HPV vaccination into the NIP, and expand screening and treatment services across diverse regions. In the future, maintaining this momentum requires continued investment, adaptive planning, and well-established monitoring systems to track progress and ensure accountability.

Conclusions

Modeling has laid a robust foundation for policy decisions to achieve cervical cancer elimination. However, successful translation into locally tailored, government-led action is crucial for meeting this ambitious goal. In China, achieving cervical cancer elimination requires sustained commitment to equity, evidence-based policy, and coordinated implementation across all relevant stakeholders.

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Conflict of interest statement

No potential conflicts of interest are disclosed.

Author contributions

Conceived and designed the analysis: Li Zhang and Fanghui Zhao.
Collected the data: Panliang Zhong.
Wrote the paper: Panliang Zhong and Li Zhang.
Revised the paper: Li Zhang.

References

1. World Health Organization. Report by the Director-General. Accelerating cervical cancer elimination; 2018. Available from: https://apps.who.int/gb/ebwha/pdf_files/EB144/B144_28-en.pdf.
2. Hall MT, Simms KT, Lew JB, Smith MA, Brotherton JM, Saville M, et al. The projected timeframe until cervical cancer elimination in Australia: a modelling study. Lancet Public Health. 2019; 4: e19-27.
3. Simms KT, Steinberg J, Caruana M, Smith MA, Lew JB, Soerjomataram I, et al. Impact of scaled up human papillomavirus vaccination and cervical screening and the potential for global elimination of cervical cancer in 181 countries, 2020-99: a modelling study. Lancet Oncol. 2019; 20: 394-407.
4. Canfell K, Kim JJ, Brisson M, Keane A, Simms KT, Caruana M, et al. Mortality impact of achieving WHO cervical cancer elimination targets: a comparative modelling analysis in 78 low-income and lower-middle-income countries. Lancet. 2020; 395: 591-603.
5. Brisson M, Kim JJ, Canfell K, Drolet M, Gingras G, Burger EA, et al. Impact of HPV vaccination and cervical screening on cervical cancer elimination: a comparative modelling analysis in 78 low-income and lower-middle-income countries. Lancet. 2020; 395: 575-90.
6. WHO. Global strategy to accelerate the elimination of cervical cancer as a public health problem; 2020. Available from: https://iris.who.int/bitstream/handle/10665/336583/9789240014107-eng.pdf.
7. Burger EA, Smith MA, Killen J, Sy S, Simms KT, Canfell K, et al. Projected time to elimination of cervical cancer in the USA: a comparative modelling study. Lancet Public Health. 2020; 5: e213-22.
8. Portnoy A, Pedersen K, Trogstad L, Hansen BT, Feiring B, Laake I, et al. Impact and cost-effectiveness of strategies to accelerate cervical cancer elimination: a model-based analysis. Prev Med. 2021; 144: 106276.
9. Palmer C, Skroumpelos A, Sabale U, Gountas I, Trimis G, Karokis A, et al. Strategies to accelerate cervical cancer elimination in Greece: a modeling study. Front Oncol. 2025; 15: 1480942.
10. Boily MC, Barnabas RV, Rönn MM, Bayer CJ, van Schalkwyk C, Soni N, et al. Estimating the effect of HIV on cervical cancer elimination in South Africa: comparative modelling of the impact of vaccination and screening. EClinicalMedicine. 2022; 54: 101754.
11. Hall MT, Smith MA, Simms KT, Barnabas R, Murray JM, Canfell K. Elimination of cervical cancer in Tanzania: modelled analysis of elimination in the context of endemic HIV infection and active HIV control. Int J Cancer. 2021; 149: 297-306.
12. van Schalkwyk C, Moodley J, Welte A, Johnson LF. Modelling the impact of prevention strategies on cervical cancer incidence in South Africa. Int J Cancer. 2021; 149: 1564-75.
13. Drolet M, Laprise JF, Martin D, Jit M, Bénard É, Gingras G, et al. Optimal human papillomavirus vaccination strategies to prevent cervical cancer in low-income and middle-income countries in the context of limited resources: a mathematical modelling analysis. Lancet Infect Dis. 2021; 21: 1598-610.
14. Man I, Georges D, de Carvalho TM, Ray Saraswati L, Bhandari P, Kataria I, et al. Evidence-based impact projections of single-dose human papillomavirus vaccination in India: a modelling study. Lancet Oncol. 2022; 23: 1419-29.
15. Umutesi G, Hathaway CL, Heitner J, Jackson R, Miano CW, Mugambi W, et al. The potential impact of a single-dose HPV vaccination schedule on cervical cancer outcomes in Kenya: a mathematical modelling and health economic analysis. Vaccines (Basel). 2024; 12: 1248.
16. Prem K, Choi YH, Bénard É, Burger EA, Hadley L, Laprise JF, et al. Global impact and cost-effectiveness of one-dose versus two-dose human papillomavirus vaccination schedules: a comparative modelling analysis. BMC Med. 2023; 21: 313.
17. Xia C, Hu S, Xu X, Zhao X, Qiao Y, Broutet N, et al. Projections up to 2100 and a budget optimisation strategy towards cervical cancer elimination in China: a modelling study. Lancet Public Health. 2019; 4: e462-72.
18. Xia C, Xu X, Zhao X, Hu S, Qiao Y, Zhang Y, et al. Effectiveness and cost-effectiveness of eliminating cervical cancer through a tailored optimal pathway: a modeling study. BMC Med. 2021; 19: 62.
19. Gao M, Hu S, Zhao X, You T, Jit M, Liu Y, et al. Health and economic impact of delaying large-scale HPV vaccination and screening implementation on cervical cancer in China: a modelling study. Lancet Reg Health West Pac. 2023; 36: 100768.
20. You T, Zhao X, Hu S, Gao M, Liu Y, Zhang Y, et al. Optimal allocation strategies for HPV vaccination introduction and expansion in China accommodated to different supply and dose schedule scenarios: a modelling study. EClinicalMedicine. 2023; 56: 101789.
21. You T, Zhao X, Pan C, Gao M, Hu S, Liu Y, et al. Informing HPV vaccine pricing for government-funded vaccination in mainland China: a modelling study. Lancet Reg Health West Pac. 2024; 52: 101209.
22. Zhao XL, Zhao S, Xia CF, Hu SY, Duan XZ, Liu ZH, et al. Cost-effectiveness of the screen-and-treat strategies using HPV test linked to thermal ablation for cervical cancer prevention in China: a modeling study. BMC Med. 2023; 21: 149.
23. Gao M, Hu S, Zhao X, You T, Hong Y, Liu Y, et al. Cost-effectiveness analysis of switching from a bivalent to a nonavalent HPV vaccination programme in China: a modelling study. Lancet Reg Health West Pac. 2025; 56: 101499.
24. International Agency for Research on Cancer. The cervical cancer elimination planning tool; 2025. Available from: https://gco.iarc.who.int/ept/.
25. Drolet M, Laprise JF, Chamberland É, Sauvageau C, Wilson S, Lim GH, et al. Switching from a 2-dose to a 1-dose program of gender-neutral routine vaccination against human papillomavirus in Canada: a mathematical modelling analysis. Can Med Assoc J. 2024; 196: E1136-43.

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