


The human papilloma virus (HPV) vaccination recommendations and funded programs for adults: A targeted literature review

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ABSTRACT

HPV vaccination in adults provides opportunities for individuals who were previously ineligible, or who missed vaccination as adolescents, thereby reducing HPV-related disease burden. This targeted literature review summarizes the HPV vaccination recommendations and guidelines by National Immunization Technical Advisory Groups and professional societies, and public funded programs for adults. Of the 152 jurisdictions examined, 62 offered HPV vaccination recommendations for general adults. Of these, 84% included both genders and 68% included sub-populations. Four jurisdictions had recommendations for adult sub-populations only. Overall, 38 jurisdictions had funded programs for general adults and 17 targeted specific sub-populations. The most reported upper eligible age for recommendations or guidelines was 26 y and 45 y, and 26 y for funded programs. People with HIV and immunosuppressed individuals were the most common sub-populations included. While economic reasons may influence funding for HPV vaccination among adults, clinical guidelines are more likely to advise vaccination on an individual basis, regardless of age.

ARTICLE HISTORY

Received 2 June 2025
Revised 6 August 2025
Accepted 17 August 2025

KEYWORDS


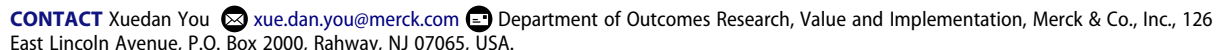
Papillomavirus vaccines; human papillomavirus (HPV); vaccination programs; health policy; adult; practice guidelines as topic, recommendations


Introduction

Human papilloma virus (HPV) is a ubiquitous pathogen with far-reaching implications for global health. Among the over 200 identified genotypes, approximately 40 are easily transmissible through direct skin-to-skin or mucosal contact in the anogenital area, mouth, and throat.^{1,2} These HPV types are categorized into low-risk and high-risk genotypes based on their oncogenic potential. While low-risk HPVs primarily cause benign neoplasms such as anogenital warts and recurrent respiratory papillomatosis (RRP), high-risk HPVs are associated with various cancers, including oropharyngeal, cervical, anal, vulvar, vaginal, and penile malignancies.¹

The introduction of HPV vaccines in 2006 marked a pivotal moment in cancer prevention. Currently, six prophylactic HPV vaccines are licensed globally, offering protection against different combinations of HPV genotypes.³ These include bivalent vaccines (HPV-2, Cervarix, Cecolin and Walrinvax, also known as 2vHPV, covering types 16 and 18), quadrivalent vaccines (HPV-4, Gardasil/Silgard and Cervavac, also known as 4vHPV, covering genotypes 6, 11, 16, and 18), and the nonavalent vaccine (HPV-9, Gardasil-9/Silgard 9, also known as 9vHPV, covering genotypes 6, 11, 16, 18, 31, 33, 45, 52, and 58). The World Health Organization (WHO) recommends routine HPV vaccination for girls age 9–14 years (y) in all countries, recognizing its potential to significantly reduce the burden of HPV-related diseases.³

To maximize effectiveness, HPV vaccines should ideally be administered before virus acquisition. Consequently, young adolescents represent the primary target population for vaccination programs, aiming to provide protection before potential exposure through sexual activity.³ Whilst the vaccination of

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/21645515.2025.2550095>

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secondary target populations such as boys, females aged ≥ 15 y, older males or men who have sex with men (MSM), is also recommended where feasible and affordable.³ According to the WHO, 146 member states have incorporated HPV vaccines into their National Immunization Programs (NIPs), with a growing trend toward including both girls and boys.⁴ The proportion of adolescents who started the HPV vaccine series increased by an average of 5% each year between 2013 and 2017.⁵ As of 2023, 27% of girls and 20% of boys globally had received at least one dose of the HPV vaccine, demonstrating substantial progress in vaccine uptake.⁴

However, the narrative of HPV prevention extends beyond adolescence, as adults remain at risk for HPV infection and related diseases throughout their lifespan. A study of women in Colombia showed that while the 5-y cumulative risk of HPV infection was highest in the 15–19 age group (42.5%), it remained significant even in older age groups: 30.0% for women aged 25–29 y and 21.9% for those 30–44 y old.⁶ In men aged 18–70 y, a multinational study encompassing Brazil, Mexico, and the USA found the incidence of new genital HPV infections to be 38.4 per 1000 person-months, with no significant variation by age.⁷ These findings underscore the persistent risk of HPV infection in adults, supporting the consideration of vaccination strategies beyond adolescence. Many adults missed vaccination opportunities as adolescents or were not eligible under earlier guidelines. Recognizing this gap in protection, some countries have introduced ‘catch-up’ vaccination programs for unvaccinated young and middle-aged adults, with vaccines licensed without upper age limits in some jurisdictions, and up to age 26 or 45 in others.⁸

HPV vaccine licensure for adults is based on robust evidence from clinical trials, conducted in cohorts reflective of real-world populations, with varying HPV exposure status. Whilst HPV vaccines were anticipated to be strictly prophylactic in nature, inclusion of exclusively uninfected individuals in trials or vaccination programs is impractical, since approximately 85% females and 91% males of sexually active individuals become infected with HPV during their lifetime.⁹ Clinical trials have demonstrated the efficacy and safety of HPV vaccines in adults up to and beyond age 26, with analyses conducted for various vaccine-targeted HPV type.^{10–17} For instance, the FUTURE III trial, involving 3,819 women aged 24–45 y, showed a per-protocol efficacy of 88.7% for the quadrivalent vaccine against a combined endpoint of persistent HPV infection, external genital lesions, and/or cervical intraepithelial neoplasia grade 1 or worse.¹⁸ Moreover, durable protection was demonstrated in extension of these efficacy trials.^{19–22} There is abundant evidence supporting the safety of HPV vaccines. In clinical trials of 9vHPV, 4vHPV, or 2vHPV conducted in various age groups, few serious adverse events were reported, and no vaccine-related deaths occurred.^{23–25} Importantly, people already infected with HPV can still benefit from vaccination. While HPV vaccines are prophylactic and will not help clear or treat already existing infections,^{11,26,27} they prevent future re-infection and resulting disease with the same type, and new infections and resulting disease from other genotypes.^{18,28–30}

Adult access to HPV vaccination currently typically follows two main pathways. The first is through NIPs, where the vaccine is offered at no or reduced cost to specified age groups as part of a broader public health strategy. The second pathway is on an individual basis, where adults can access the vaccine through healthcare providers based on clinical guidelines and recommendations. In this case, individuals usually bear the cost themselves or through private insurance.³¹ The availability and preference for these pathways vary globally, reflecting diverse healthcare systems and public health priorities.

Despite the proven efficacy and availability of HPV vaccines, implementation of vaccination recommendations is not uniform across global jurisdictions, and vaccine uptake remains suboptimal in many countries. This inconsistency underscores the need for a comprehensive overview of the current global landscape of HPV vaccination among adult populations. A structured literature review was conducted with the aim of understanding the extent of current recommendations, guidelines, and public funded HPV vaccination programs for adult populations (≥ 18 y) globally, including adult high-risk sub-populations (population defined by certain conditions, behaviors or other risk factors). This study had two core objectives: Firstly, to identify all national, sub-national, and/or local HPV vaccination recommendations or guidelines by National Immunization Technical Advisory Groups (NITAGs), medical or professional societies for adult populations describing the specifics of each recommendation or guideline in the context of their target populations. Secondly, to identify all national, sub-national, and/or local public funded HPV vaccination programs for adult populations, including details regarding target populations, program funding, implementation and termination years, and vaccination settings.

This research seeks to provide valuable insights for healthcare professionals and policymakers on opportunities to strengthen existing adult vaccination policies and formulate new policies where none currently exist. By illuminating the current state of adult HPV vaccination strategies worldwide, we hope to contribute to the ongoing efforts to reduce the global burden of HPV-related diseases and cancers.

Methodology

Targeted literature searches (up until May 31, 2024) across a total of 152 jurisdictions were conducted using a phased approach consisting of three different stages. Selection of jurisdictions was based on greatest population sizes, according to the World Development Indicators database, World Bank (1 July 2023).³²

Phase 1: Targeted search of official websites and professional sources

Phase 1 consisted of two sub-phases. During Phase 1a, recommendations and guidelines for HPV vaccination in adults (≥ 18 y) and certain adult high-risk sub-populations were identified and examined. These guidelines were provided by NITAGs, Ministry of Health (MOH), and professional societies. The NITAGs is an independent expert advisory committee that provides evidence-based recommendations to guide national immunization policies and strategies. The MOH is the government department responsible for public health policy and the overall health system in many countries. The NITAGs work closely with the MOH to develop vaccination policies. The high-risk sub-populations are defined by age and certain conditions, behaviors, or other risk factors. These include people with HIV (PWH), individuals with non-HIV immunosuppression, MSM, transgender individuals, those with RRP, women with cervical precancer, Individuals with other HPV diseases or infections and other subgroups (Figure 5). For Phase 1b, funded HPV vaccination programs aimed at adults and sub-populations were reviewed. The distinction between recommendations or guidelines and programs was that the former typically offers guidance to healthcare providers on who should receive the vaccine and when, based on a combination of available evidence and expert opinion, whereas the latter offered an implementation framework for delivering the vaccine.

Data sources

In Phase 1a, searches were conducted for official government (national or local) backed vaccine data sites including the WHO (<https://www.who.int/health-topics/vaccines-and-immunization>), the Pan American Health Organisation (<https://www.paho.org/es/temas/inmunizacion> <https://www.paho.org/en/epi-country-profiles>), position papers, Expanded Program on Immunization (EPI) country profiles and the European Centre for Disease Control (ECDC) vaccination schedule tool (<https://vaccine-schedule.ecdc.europa.eu/>) whereby a single data source could provide relevant information for multiple jurisdictions. Official websites from each jurisdiction were also explored including NITAGs and professional societies, national or regional health departments, national epidemiological centers, country-specific health bulletins, Health Technology Assessment (HTA)/reimbursement agencies, non-governmental organization (NGO) reports, and other associated websites. The searches primarily focused on the 11 main professional societies listed in each jurisdiction; obstetrics and gynecology, gynecologic oncology, infectious diseases, general medicine/family medicine/preventive medicine, urology, dermatology and venereology, head and neck oncology, HIV/AIDS, immunology and rheumatology, transplant medicine, and pediatrics. During Phase 1b, programs were searched using official websites of identified payers and specific documents related to HPV vaccination using relevant keywords within payer websites.

Study selection process

The search process involved using a set of keywords relevant to HPV vaccination recommendations in English first, followed by the same keywords in the official local language(s) of the jurisdiction. Each website containing a recommended age group for general adult HPV vaccination was considered as one source of recommendation. The search aimed to identify at least four sources of recommendations for general adults and specific sub-populations. In cases where fewer than four sources of recommendations were identified, the search terms were expanded in both English and the local language to double-check if general adult or sub-populations recommendations were available in that jurisdiction (Supplementary Figure S1).

Phase 2: Targeted review of medical databases

Data sources

Search strings were developed to identify evidence including published literature from biomedical databases (Supplementary Table S1). MEDLINE® and Embase® were searched using the embase.com interface and PubMed was searched to identify MEDLINE® In-process citations, which provided records for articles before those records were indexed with MeSH or converted to out-of-scope status. “Ahead of Print” citations that preceded the article’s final publication in a MEDLINE-indexed journal were also searched in PubMed®. A combination of Emtree subject headings (Embase®), MeSH (medical subject headings, PubMed®), and free-text terms were used to retrieve all the relevant publications. Since the first vaccine for the prevention of HPV-related disease was licensed in 2006, all database searches were conducted from January 1, 2006, to May 31, 2024. Conference proceedings were also searched from the past 3 y (2022–2024) to retrieve the latest studies that had not yet been published in journals as full-text articles, or to supplement the results of previously published studies.

Study selection process

Following study identification, an initial screening (based upon titles and abstracts) was undertaken by a single reviewer and uncertainties were discussed with a second reviewer. All studies were included based on a pre-specified Population, Interventions, Comparisons, Outcomes, Timeframe, and Study design (PICOTS) inclusion criteria (Supplementary Table S2). The full texts of relevant studies were then reviewed to determine a final list of included studies eligible for inclusion in the review. Similar to the initial screening, a single reviewer screened full-text articles and uncertainties were resolved with a second reviewer.

Phase 3: Pearl growing approach

Following validation of results from phases 1 and 2, jurisdictions with limited data (≤ 2 sources of information) were subject to additional keyword-based searches on Google. A pearl growing approach was then employed, encompassing backward citation mining of relevant reviews and included evidence, as well as forward citation mining using PubMed and ScienceDirect. Results from phases 1 and 2 were also validated by MSD subject matter experts working in the specific jurisdictions. This comprehensive strategy aimed to mitigate potential gaps in evidence resulting from indexing-related issues.

Results

Based on population size, a total of 152 jurisdictions were included in the searches (Supplementary Table S3). These jurisdictions were subsequently categorized into WHO regions for summaries and comparisons. The number of jurisdictions reviewed in each region were as follows: Africa ($n = 46$), Americas ($n = 24$), Eastern Mediterranean ($n = 16$), Europe ($n = 43$), Southeast Asia ($n = 5$), and Western Pacific ($n = 18$) (Supplementary Table S3). Among the 152 jurisdictions examined, 43.4% (66/152) offered recommendations or guidelines for HPV vaccination in general adults (≥ 18 y) and/or certain adult high-risk sub-populations. Funded vaccination programs for adults (≥ 18 y) were available in 25% (38/152) jurisdictions (Figure 1).

Recommendations, guidelines and funded programs among general adults

Across the 152 searched jurisdictions, 40.8% (62/152) jurisdictions provided recommendations or guidelines specifically for general adults aged 18 and above (Supplementary Table S4). Forty-two out of these 62 jurisdictions (67.7%) issued recommendations or guidelines for specific sub-populations in addition to general adults. Of these 62 jurisdictions, 41 had recommendation or guidelines issued by NITAGs or MOH (Figure 2 and Table 1), while 35 had recommendation or guidelines issued by professional societies (Figure 2 and Table 2). Recommendations from professional societies were predominantly from obstetrics and gynecology, followed by infectious diseases, and oncology. Other significant contributors included

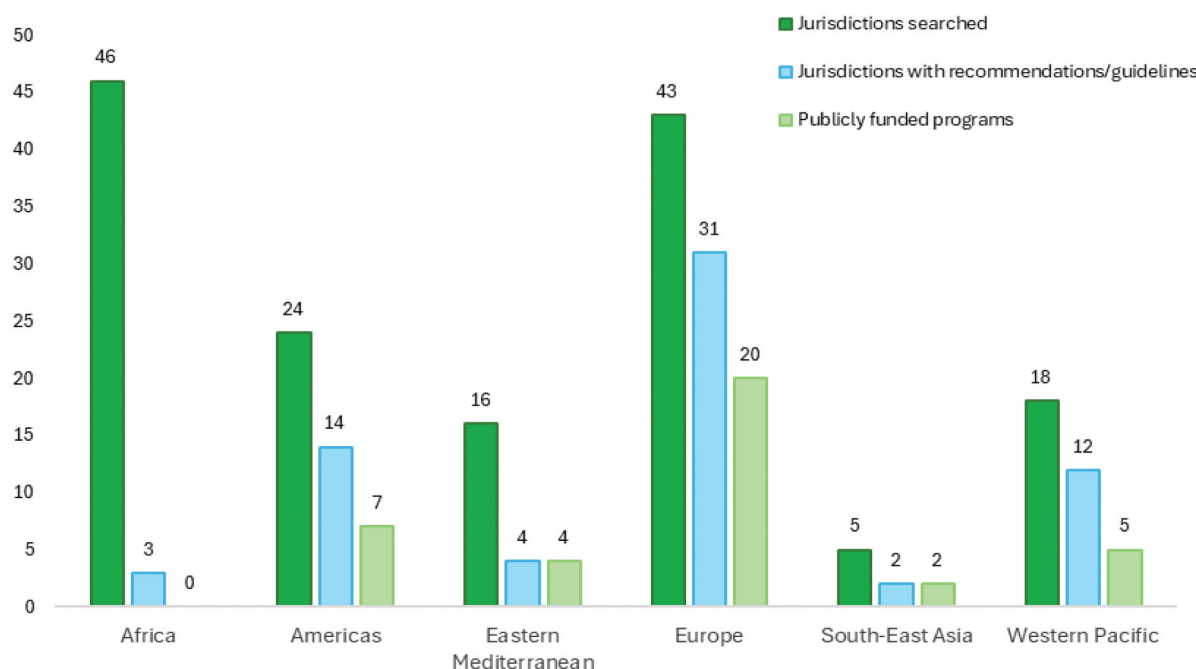


Figure 1. Number of HPV vaccination recommendations or guidelines and publicly funded programs (general adults and sub-populations age ≥ 18 y) in searched jurisdictions. See *Supplementary Table S3* for detailed information regarding recommendations or guidelines, and publicly funded programs.

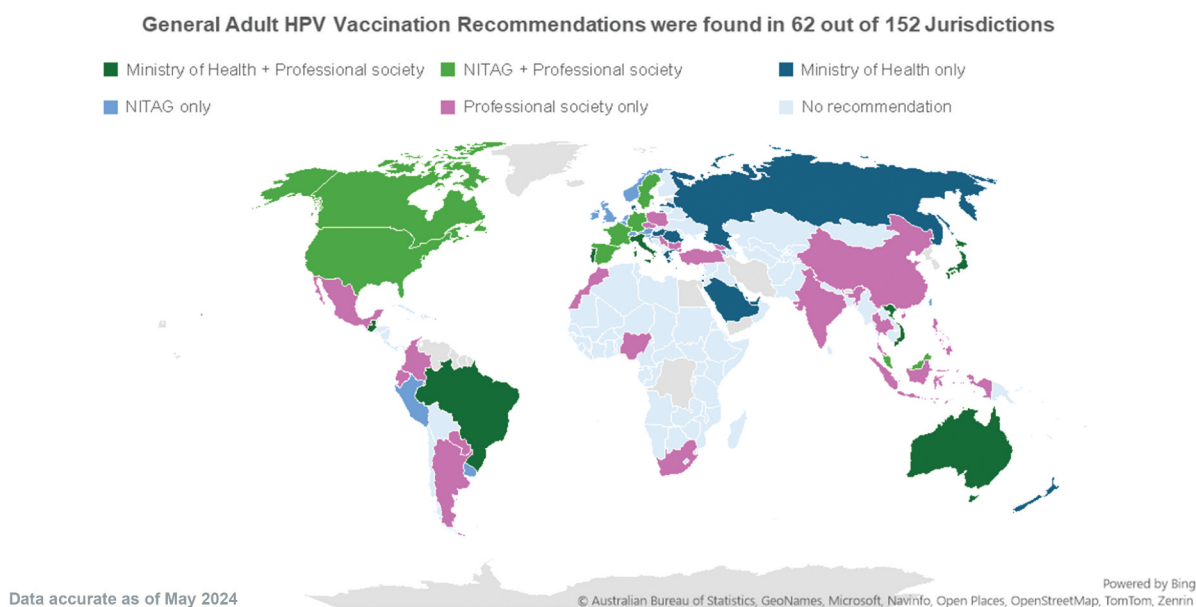


Figure 2. HPV vaccination recommendation or guidelines for general adults (age ≥ 18 y) across geographies. See *Supplementary Table S4* for detailed information regarding recommendations or guidelines.

dermatology, urology, and public health organizations. Various national cancer societies, immunization groups, and multidisciplinary medical associations also provided recommendations across different countries (Supplementary Table S5 and Table S6). More than half of the jurisdictions (32/62; 51.6%) had positive recommendations for vaccinating general adults aged 27 or above, with 16 of these recommendations issued by NITAGs or MOH. Additionally, three jurisdictions (USA, Australia, and Germany) had recommendations against vaccinating general adults aged 26 or 27 or above.

Table 1. HPV vaccination recommendations or guidelines by NITAGs and MOH for general adults.

Region	Jurisdiction	Organization issued the recommendation/guideline	Year	Gender of the target population	Age of the target population
Americas	Brazil	Ministry of health and NITAG	2022	F	9–26 y
Americas	Canada	National Advisory Committee on Immunization (NACI)	F: 2007 M: 2012	F/M	9–26 y (can be administered to 27 y and older at ongoing risk of exposure)
Americas	Guatemala	Ministry of Public Health and Social Assistance (MSPAS), Spanish Agency for Medicines and Health Products	2020	F/M	1. 2vHPV: 15 y and above 2. 4vHPV: 14 y and above 3. 9vHPV: 15 y and above
Americas	Guatemala	Ministry of Public Health and Social Assistance (MSPAS)	Nov 2021 to May 2022	F*	15–47 y
Americas	Paraguay	First Inter-Society National Consensus on Adult Immunization	2023	F/M	19–45 y (with comorbidities)
Americas	Peru	NITAG, Ministerio de Salud, Peru	2022	F/M	Up to 18 y
Americas	Puerto Rico	Puerto Rico follows CDC and ACIP recommendations	2019	F/M	11–26 y 27–45 y under shared clinical decision making
Americas	Uruguay	National Advisory Commission Ministry of Public Health (Ministerio de Salud Pública)	2022	F/M	11–26 y
Americas	USA	The Advisory Committee on Immunization Practices (ACIP)	2019	F/M	Up to 26 y (Vaccination is not recommended for all adults > 26 y. Some adults ages 27 through 45 y might decide to get via shared clinical decision-making)
Europe	Armenia	Republican Advisory Experimental Committee on Immunization	2019	F/M	14–45 y
Europe	Austria	The Federal Ministry for Social Affairs, Health, Care and Consumer Protection (BMSGPK) and experts from the National Vaccination Committee	2023	F/M	9–30 y (from the age of 30, vaccination can be done upon request)
Europe	Belgium	Superior Health Council	2017	F/M	15–26 y
Europe	Croatia	Croatian Institute of Public Health	2024	F/M	9–25 y
Europe	Denmark	Danish Minister of Health	2019	F/M	12–18 y
Europe	France	Comité technique des vaccinations (technical vaccination committee) (CTV)	F: 2007 M: 2021	F/M	11–19 y
Europe	Germany	The Standing Committee on Vaccination (STIKO)	2024	F/M	≥18 y can also benefit from HPV vaccination
Europe	Greece	Ministry of health	2022	F/M	9–18 y
Europe	Hungary	National Center for Public Health and Pharmacy	2018	F/M	18–54 y (55+ y individual consideration)
Europe	Ireland	National Immunisation Advisory Committee (NIAC)	2022	F/M	9–24 y
Europe	Israel	Ministry of health	2015	F/M	9–45 y (27–45 y should consult with the attending physician regarding receiving the vaccine)
Europe	Italy	Ministry of Health of Italy (Ministero della Salute)	2023	F/M	Females: 12–26 y Males: 12–18 y
Europe	Latvia	Recommendations of State Immunisation Council; Center for Disease Prevention and Control	2022	F/M	18–55 y (in the 27–55 y and later age group, vaccination potential benefit can be evaluated individually, in consultation with a specialist)
Europe	Netherlands	Health Council (GR)	2019	F/M	9–26 y
Europe	Norway	The Norwegian Institute of Public Health	2023	F/M	15 y and above
Europe	Portugal	General Directorate of Health Vaccination Technical Committee	2020	F/M	10–26 y
Europe	Romania	Ministry of Health	2023	F/M	Females: 11–18 y and 19–45 y Males: 11–18 y
Europe	Russian federation	Ministry of Health of the Russian Federation	2023	F/M	9–26 y
Europe	Slovenia	NITAG	2023	F/M	11–26 y
Europe	Spain	AEP vaccine advisory committee (CAV-AEP)	2024	F/M	9–26 y
Europe	Sweden	National Board of Health and Welfare	2012	F	18–26 y
Europe	Switzerland	Federal Office of Public Health and Federal Commission for Vaccination	2015	F/M	11–26 y

(Continued)

Table 1. (Continued).

Region	Jurisdiction	Organization issued the recommendation/guideline	Year	Gender of the target population	Age of the target population
Europe	United Kingdom	JCVI	2019	F/M	12–25 y
Western Pacific	Australia	Australian Government Department of Health and Aged Care/Australian Immunisation handbook	2023	F/M	9–25 y
Western Pacific	Australia	Australian Government Department of Health and Aged Care/Australian Immunisation handbook	2023	F/M	Negative recommendation: ≥26 y are not recommended
Western Pacific	Japan	Ministry of Health, Labour and Welfare (MHLW)	From April 2022 to March 2025	F	17–26 y
Western Pacific	Malaysia	Malaysian society of infectious diseases and chemotherapy, Advisory Committee on Immunisation Practices (ACIP)	2019	F/M	13–26 y 27–45 y (shared clinical decision-making)
Western Pacific	New Zealand	New Zealand Immunisation Schedule (Ministry of health)	2020	F/M	15–26 y
Western Pacific	Taiwan	Taiwan ACIP	2020	F/M	19–26 y
Western Pacific	Vietnam	Ministry of Health guidance on screening and control of cervical cancer	2019	F/M	9–26 y
Eastern Mediterranean	Kuwait	Kuwaiti Ministry of Health	2023	F/M	9–45 y
Eastern Mediterranean	Saudi Arabia	The public health authority (PHA)	2023	F	15–26 y
Eastern Mediterranean	Qatar	The Ministry of Public Health (MoPH)	NA	F/M	11–26 y
Eastern Mediterranean	UAE (Abu Dhabi) #	Department of Health (DOH)	2018	F	15–26 y
Eastern Mediterranean	UAE (Abu Dhabi) #	Abu Dhabi Public Health Centre (ADCPH)	2019	F	15 y and above
Eastern Mediterranean	UAE (Dubai) #	The Dubai Health Authority (DHA)	2023	F/M	9–45 y; (For age 27–45 y: Based on shared clinical decision making)
Eastern Mediterranean	UAE	Emirates Health services (EHS)	2024	F/M	13–26 y, 27–45 y, based on shared clinical decision making

See Supplementary Table S5 for detailed information regarding recommendations or guidelines.

*Females who did not complete their series previously.

#Dubai and Abu Dhabi operate independently from the Federal Ministry of Health, maintaining their own healthcare regulatory bodies.

Abbreviations: F: Female; M: Male; UAE: United Arab Emirates; UK: United Kingdom; USA: United States of America.

Age ranges, including adolescents (<18 y) were considered as they encompassed adult patients as well.

The upper eligible age for general adults' recommendations or guidelines varied considerably among the jurisdictions (Figure 3). The majority of recommendations for these adult populations were made between 2019 and 2023. The most reported upper eligible age was 26 y and 45 y in 19 jurisdictions each. No upper age limit was reported in 12 jurisdictions (Figure 3). Of note, when analyzing geographies which had over ten recommendations (Europe, Western Pacific and the Americas), the Americas provided the greatest proportion of recommendations with an age limit of 45 and above (66.7%; 8/12) compared to the Western Pacific (58.3%; 7/12) and Europe (44.8%; 13/29). Furthermore, 83.9% (52/62) jurisdictions had recommendations for both males and females, whilst the remaining 16.9% (10/62) had female-only recommendations for general adults.

Funded vaccination programs among general adult population were available in 38 jurisdictions (Figure 4 and Table 3). The majority of funded programs were identified in Europe (n = 20), followed by Americas (n = 7), Western Pacific (n = 5), Eastern Mediterranean (n = 4) and Southeast Asia (n = 2) (Figure 4 and Table 3). No funded programs were identified in Africa. Among the 38 funded programs identified, the upper eligible age varied with most programs having an upper eligible age limit of 26 y (n = 16). Six jurisdictions set the age limit at 18 y, while five extended it to 45 y (Table 3). Additionally, three jurisdictions had limits of 19 and 25 y each. There were individual jurisdictions with upper limits of 20, 21, 24, 29 y, as well as lifetime eligibility (Table 3).

Gender-neutral funded adult programs (both males and females) were identified in 26 jurisdictions, with female-only funded adult programs identified in 12 jurisdictions. Three-dose (n = 19), two-dose (n = 11)

Table 2. HPV vaccination recommendations or guidelines by professional societies for general adults.

Region	Jurisdictions	Organization issued the recommendation/guideline	Year	Target population gender	Age of the target population
Americas	Argentina	Argentine Society of Dermatology	2016	F/M	9–26 y
Americas	Brazil	Brazilian Society of Immunizations (SBIIm)	2023	F/M	9–45 y
Americas	Canada	Canadian Cancer Society (CCS)	NA	F/M	F: 9–45 y M: 9–26 y
Americas	Canada	Canadian Paediatric Society (CPS)	NA	F/M	13 y and older
Americas	Canada	Joint Statement from SOGC, GOC and CSOHNS	2021	F/M	9–45 y
Americas	Colombia	Colombian Association of Infectious Diseases (ACIN)	2016	F/M	F: 9–45 y M: 9–26 y
Americas	Colombia	The Colombian Society of Pediatrics (SCP), the Colombian Association of Infectious Diseases (ACIN)	2023	F/M	9–18 y
Americas	Ecuador	Ecuadorian Society of Pathology of the Lower Genital Tract and Colposcopy Núcleo	NR	F/M	9–26 y (who have not been previously vaccinated) 27–45 y (based on physician-patient discussion and analysis)
Americas	Mexico	National Institute of Geriatrics	2017	F	9–26 y
Americas	USA	American Society of Clinical Oncology (ASCO)	2017	F	9–26 y
Americas	USA	American Urology Association (AUA)	2018	F/M	13–45 y
Americas	USA	The American Cancer Society (ACS)	2020	F/M	9–26 y
Americas	USA	The American Cancer Society (ACS)	2020	F/M	Negative recommendation: adults older than 26 y (aged 27–45 y) not recommended
Americas	USA	American College of Obstetricians and Gynecologists (ACOG)	2020	F/M	13–26 y (27–45 y: shared clinical decision making)
Americas	USA	Joint statement of 21 medical societies*	2021	F/M	13–26 y (27–45 y: shared clinical decision making)
Americas	USA	American Academy of Dermatology (AAD)	NA	F/M	9–26 y
Americas	USA	American Academy of Family Physicians (AAFP)	NA	F/M	F: 9–26 y M: 9–21 y
Europe	Bulgaria	National Expert Non-Governmental Coalition	2023	F/M	Any age after 9 y (There is no upper limit for the placement of the HPV vaccine)
Europe	Czech Republic	The State Institute of Health	2006 to 2021	F/M	18–26 y
Europe	France	The French National Authority for Health (HAS, Haute autorité de santé)	F: 2007 M: 2019	F/M	15–19 y
Europe	Georgia	Georgian government	2023	F	13–26 y
Europe	Germany	German Association of the Scientific Medical Societies (AWMF)**	2021	F/M	15–26 y
Europe	Germany	German Association of the Scientific Medical Societies (AWMF)	2021	F/M	Negative recommendation: Against recommending 27 y or older
Europe	Italy	Calendario per la vita (4 scientific societies of GPs, pediatricians and public health specialists)	2019	F/M	F: 13–26 y M: 13–21 y
Europe	Poland	Polish Society for Colposcopy and Cervical Pathology	2023	F/M	>9 y (without any age limit) Vaccination in individuals aged ≥ 46 based on physician-patient discussion and analysis
Europe	Poland	National Institute of Public Health National Institute of Hygiene – National Research Institute	2023	F/M	>9 y (No upper age limit is given)
Europe	Portugal	Portuguese Society of Gynecology	2017	F/M	F: 9–45 y M: 9–26 y
Europe	Serbia	IJZ of Serbia	2020	F/M	F: 9–26 y M: 9–21 y
Europe	Spain	Consejo Interterritorial Del Sistema Nacional De Salud (CISNS)	2024	F/M	12–26 y
Europe	Spain	13 Spanish scientific societies***	2012	F/M	9–26 y
Europe	Spain	Spanish Association of Cervical Pathology and Colposcopy (AEPCC)	2016	F	Over 25 y of age
Europe	Sweden (Stockholm)	Region Stockholm's pharmaceutical committee's expert group for vaccinations and infection control	2023	F/M	Up to 26 y
Europe	Türkiye	EKMUD (Turkish Infectious Diseases and Clinical Microbiology Specialists Association)	2023	F/M	>9 y (no upper age limit for HPV vaccination)
Europe	Türkiye	KLİMİK (Turkish Clinical Microbiology and Infectious Diseases Association)	2023	F/M	>9 y (no upper age limit for HPV vaccination)

(Continued)

Table 2. (Continued).

Region	Jurisdictions	Organization issued the recommendation/guideline	Year	Target population gender	Age of the target population
South-East Asia	India	Federation of Obstetric and Gynecological Societies of India (FOGSI)	2023	F/M	F: 15–45 y M: 15–26 y
South-East Asia	India	Association of Physicians of India (API)	2020	F/M	For young adults (15–26 y)
South-East Asia	India	Indian Medical Association LifeCourse immunization	2018	F	15–45 y
South-East Asia	India	Indian Academy of Pediatrics (IAP) Advisory Committee on Vaccines and Immunization Practices (ACVIP)	2023	F/M	15–26 y
South-East Asia	Indonesia	Association of Internal Medicine Specialists	2023	F/M	F: 19–45 y M: 19–26 y
South-East Asia	Indonesia	Indonesia Paediatric Association	2023	F	9–18 y
Western Pacific	Australia	National center for immunization research and surveillance	2023	F/M	14–25 y
Western Pacific	China	Chinese Preventive Medicine Association; Chinese Association for Maternal and Child Health Studies	2023	F	9–45 y
Western Pacific	China	Hainan Provincial Health and Family Planning Commission	2018	F	9–45 y
Western Pacific	China	Vaccine and Immunization Branch, Chinese Preventive Medicine Association	2024	F	9–45 y
Western Pacific	China	Gynecological Oncology Society of Chinese Medical Association; Chinese Society for Colposcopy and Cervical Pathology	2024	F	9–45 y
Western Pacific	China	Chinese Medical Association	2022	F	9–45 y
Western Pacific	China	Affiliated Association for Standardized Management and Practice of Immunization Program, China Association for Vaccines	2023	F	9–45/30 y (A local product was approved for use in females aged 9–30 y)
Western Pacific	Hong Kong	The Scientific Committee on Vaccine Preventable Diseases (SCVPD)	2022	F	9–18 y
Western Pacific	Japan	Japan Society of Obstetrics and Gynecology	2021	F	15–26 y 27–45 y (upon request)
Western Pacific	Korea	The Korean Society of Gynecologic Oncology	2019	F/M	F: 9–45 y M: 9–26 y
Western Pacific	Korea	Korea Centers for Disease Control and Prevention (KCDC)	2023	F	15–26 y 15–45 y
Western Pacific	Korea	The Korean Association of Urogenital Tract Infection and inflammation (KAUTI)	2023	F/M	15–26 y up to age 45 (under the judgment of healthcare provider)
Western Pacific	Korea	The Korean Society of Infectious Disease (KSID)	2023	F/M	F: 13–26 y (27–45 y after consultation with a healthcare professional)
Western Pacific	Malaysia	Population and Family Development Board Malaysia (LPPKN) under the provision of Ministry of Women, Family and Community Development (KPWKM)	2012	F	M: 9–26 y 18 y
Western Pacific	Malaysia	Malaysian society of infectious diseases and chemotherapy	2023	F/M	13–26 y
Western Pacific	Taiwan	Taiwan Association of Family Medicine	2020	F/M	19–26 y 27–45 y (shared clinical decision)
Africa	Morocco	SMSM (Moroccan Society of Medical Sciences)	2023	F	11–25 y
Africa	Nigeria	The Society of Obstetrics and Gynecology of Nigerian	2019	F	16–26 y
Western Pacific	Philippines	Philippine Society for microbiology and infectious disease (PSMID)	2018	F/M	16–26 y
Western Pacific	Singapore	National Childhood Immunisation Schedule and National Adult Immunization Schedule	2022	F	9–26 y
Western Pacific	Singapore	Society of Infectious Diseases Singapore (SIDS)	2023	F/M	9–26 y (May be considered for adults aged 27 to 45 y)
Western Pacific	Singapore	Society for Colposcopy & Cervical Pathology of Singapore (SCCPS)	2020	F/M	9–26 y
Africa	South Africa	Expanded Programme on Immunisation (EPI)	2015	F	9–20 y

(Continued)

Table 2. (Continued).

Region	Jurisdictions	Organization issued the recommendation/guideline	Year	Target population gender	Age of the target population
Western Pacific	Thailand	The Royal Thai College of Obstetricians and Gynaecologists (RTCOG)	2020	F/M	9–26 y (26–45 y females: shared clinical decision)
Western Pacific	Thailand	The Pediatric Infectious Disease Society of Thailand (PIDST)	2023	F/M	9–26 y (shared clinical decision in those >26 y)
Western Pacific	Thailand	Infectious Disease Association of Thailand (IDAT)	2023	F/M	9–26 y (27–45 y: vaccination is also beneficial)
Western Pacific	Vietnam	Vietnam Association of Preventive Medicine	2023	F	9–26 y

Abbreviations: ed: Edition; F: Female; M: Male; USA: United States of America.

See *Supplementary Table S6* for detailed information regarding recommendations or guidelines.

Age ranges, including adolescents (<18 y), were considered as they encompassed adult patients as well.

*AAP, AACR, AAOMS, ACS, ACOG, AHNS, AOA, ASCCP, ASRM, AUA, CREOG, CUCOG, IDSA, IDSOG, ISE, NMA, NASPAG, SASGOG, SFP, SGO, SGS, SOGH, SRS.

**Lead medical society: Paul Ehrlich-Gesellschaft für Chemotherapie e.V. (PEG), HPV Management Forum. Participating societies and organizations: Professional Association of German Dermatologists (BVDD), Professional Association of Gynecologists (BVF), Professional Association of Pediatricians (BVKJ), German Dermatological Society (DDG), German Society for Epidemiology (DGEpi), German Society for Gynecology and Obstetrics (DGGG), German Society for Gynecology and Obstetrics (DGGG) – Workgroup Cervix Pathology and Colposcopy, German Society for Oto-Rhino-Laryngology, Head and Neck Surgery (DGHNO-KHC), German Society for Infectiology (DGI), German Society of Pediatrics and Adolescent Medicine (DGKJ), German Society of Coloproctology (DGK), German Society for Pediatric Infectiology (DGPI), German Urological Association (DGU), German Cancer Society (DKG) – Workgroup Gynecological Oncology, German Cancer Research Center (DKFZ), German STI Society (DSTIG), Women Support Group Cancer – Federal Association, Society for Virology (GfV), Study Group Colposcopy.

***Microbiology and Health Association, Spanish Association of Coloproctology, Spanish Association of Cervical Pathology and Colposcopy, Spanish Association of Pediatrics, Spanish Association of Urology, Spanish Association of Vaccinology, Spanish Society of Gynecology and Obstetrics, Spanish Society of Preventive Medicine, Public Health and Hygiene, Spanish Society of Primary Care Physicians, Spanish Society of General and Family Physicians, Spanish Society of Medical Oncology, Spanish Society of Otorhinolaryngology and Cervical-Facial Pathology, Spanish Chemotherapy.

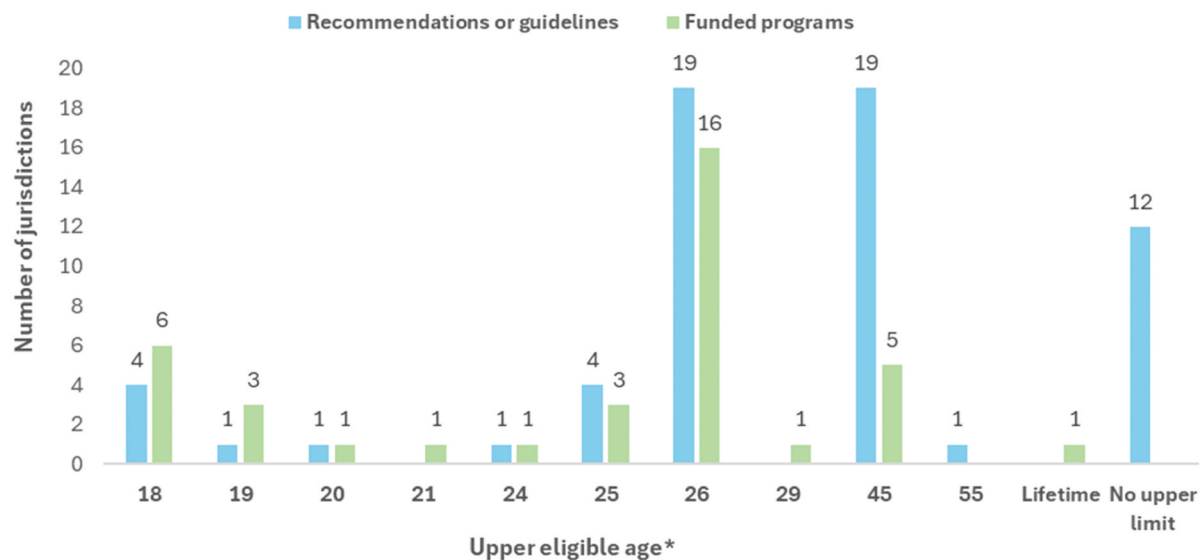


Figure 3. Upper eligible age in HPV vaccination recommendations or guidelines and funded programs in general adult population in the searched jurisdictions. *For those jurisdictions with more than one recommendation or guidelines for age, the highest age limit was selected. In certain jurisdictions, the upper eligible age applies only to females, although the recommendations encompass both males and females. In Australia, recommendations were against vaccinating individuals older than 26 or 27 y; therefore, the upper eligible age is considered as 25 y. See *Supplementary Table S4* for detailed information regarding recommendations or guidelines and *Table 3* for detailed information on publicly funded programs.

Summary of General Adult HPV Vaccination Funded Programs in 38 out of 152 Jurisdictions

■ General adult (age ≥ 18 years) funded program available ■ No general adult (age ≥ 18 years) funded programs

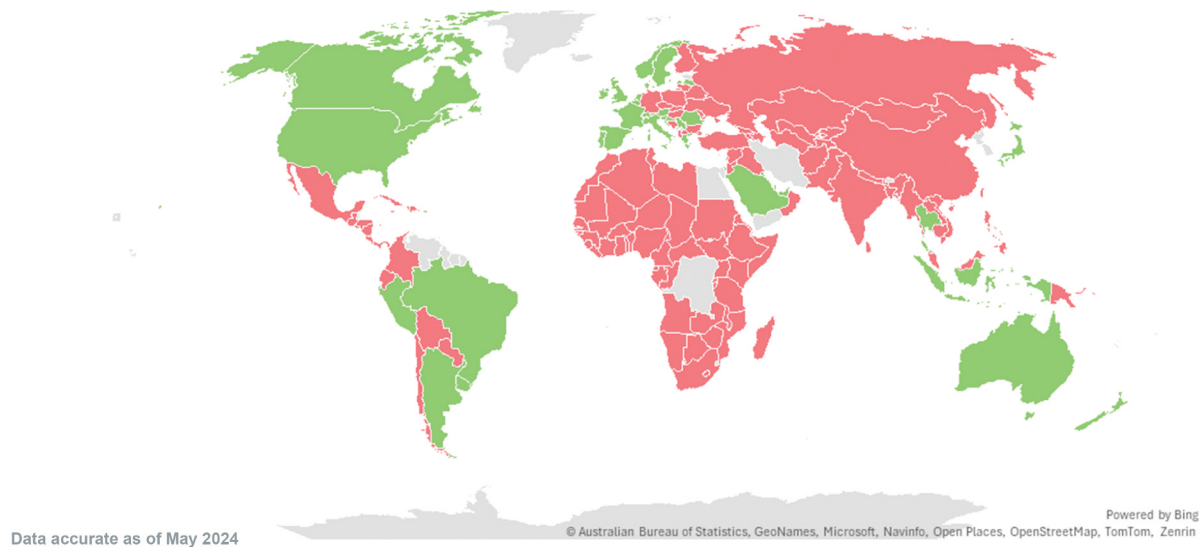


Figure 4. Publicly funded HPV vaccination programs for general adults (age ≥ 18 y) across geographies. Note: Countries in grey were not included in the search scope (n = 152 countries in total). See *Supplementary Table S8* for detailed information regarding publicly funded programs.

and single dose (n = 5) schedules were identified among the funded programs. Of note, an identified Argentinian and Saudi Arabia funded program prescribed either one or two doses, and a Croatian funded program provided a dosing schedule of either two or three doses (Table 3)

Recommendations, guidelines and funded programs in sub-populations

In 46 jurisdictions, recommendations and guidelines for HPV vaccination have been extended to high-risk sub-populations (Figure 5 and Supplementary Table S7). In HPV vaccination recommendations and guidelines, PWH were the most common sub-populations included (n = 41), followed by individuals with non-HIV immunosuppression (n = 29), MSM (n = 22), immunosuppressed-not further specified (n = 17), women with cervical precancer (n = 13), Individuals with other HPV infections or disease (n = 10), transgender people (n = 5) and RRP patients (n = 3). A total of 12 jurisdictions issued recommendation for other high-risk subgroups (Figure 5).

A limited number of publicly funded programs for sub-populations were identified (n = 17), employing varied approaches, from targeted regional programs to comprehensive national initiatives. Out of these 17 jurisdictions, 14 were inclusive of funded programs for general adults while three jurisdictions solely focus on sub-populations. PWH was the sub-populations with the most funded programs globally (n = 10), followed by individuals with non-HIV immunosuppression (n = 9), MSM (n = 8), immunosuppressed-not further specified (n = 5), women with cervical precancer (n = 5), individuals with other HPV infections or disease (n = 4), transgender people (n = 3) and RRP patients (n = 3). A total of seven jurisdictions implemented funded programs in other high-risk subgroups (Figure 5).

Immunosuppressed

People with HIV (PWH).

Recommendations. Overall, 41 jurisdictions issued recommendations or guidelines for people living with HIV. Less than half (17/41; 41.5%) were issued in Europe, 13 were issued in the Americas, followed by 9 in the Western Pacific. Only one jurisdiction each in Eastern Mediterranean and Southeast Asia included people with HIV infection in HPV vaccination guidelines (Figure 6). Across these 41 jurisdictions, the upper age limit for HPV vaccination was 19 y old (n = 1), 26 y old (n = 12), 27 y old (n = 2), 40 y old (n = 1),

Table 3. HPV vaccination funded programs in general adults.

Jurisdiction	Females/ Males	Upper eligible age	Year of introduction	Number of doses
Americas				
USA	F/M	26 (shared clinical decision making to age 45 covered by insurance, Medicaid, etc.)	2019	3
Puerto Rico	F/M	26 (shared clinical decision making to age 45)	2023	3
Canada*	F/M	26: Alberta, Yukon, Saskatchewan, New Brunswick, Northwest Territories and British Columbia** 20: Quebec 18: Nova Scotia	2017 [@]	3
Argentina	F/M	26	2017	11–20 y: 1; 21–26 y: 2
Uruguay	F/M	26	2022	2
Brazil	F/M	19	2024	1
Peru	F/M	18	2016	1
Eastern Mediterranean				
Kuwait	F/M	45	2023	3
Qatar	F/M	26	2023	3
UAE (Abu Dhabi)	F	26	2013	3
Saudi Arabia	F	26	2022	15–20 y: 1 or 2 >21 y: 2
South-East Asia				
Indonesia	F	26	2023	3
Western pacific				
Singapore	F	26 (up to 45 y for women who have received first dose before age 27)	2022	3
New Zealand	F/M	26	2017	3
Japan*	F/M [#]	26	F: Apr 2022–Mar 2025, M [#] : 2022*, 2023*, 2024*	3
Australia	F/M	25	2023	1
Hong Kong	F	18	2024–2026	2
Thailand	F	20	2023–2024	2
Europe				
Italy*	F/M	Lifetime gratuity***: Calabria, Liguria, Piemonte, Puglia, Sicilia 49: Molise 26: Emilia Romagna, Lazio, Provincia autonoma di Bolzano, Provincia autonoma di Trento, Umbria, Veneto 25: Valle d'Aosta 18: Friuli Venezia Giulia	2023	3
Romania	F	45 (19–45: 50% funding)	2023	3
Sweden [#]	F	29	2022	2 (3 y apart)
Norway	F	26	2016–2019	3
Israel	F/M	26	2022–2024	3
Netherlands	F/M	26	2017	2
Spain*	F	26: Aragon, Balearics, Navarre 18: Andalusia, Cantabria, Castile and Leon, Valencian Community, Extremadura, Murcia	2021	2
Switzerland	F/M	26	2008–2026	3
Portugal [§]	F/M	26	F: 2008 M: 2020	3
Slovenia	F	26	2009/10	3
UK	F/M	25	2019	3 (switch to 1 dose in 2023)
Croatia	F/M	25	2016	2 or 3
Ireland	F/M	24	2017–2023	1
Austria	F/M	21	2023	2
France	F/M	19	F: 2007 M: 2021	3
Serbia	F/M	19	2021	3
Greece	F/M	18	2023–2025	3
Latvia	F/M	18	F: 2010 M: 2022	2
Belgium	F/M	18	F: 2008 M: 2022	2

(Continued)

Table 3. (Continued).

Jurisdiction	Females/ Males	Upper eligible age	Year of introduction	Number of doses
Denmark	F/M	18	F: 2009 M: 2019	3

*Regional variations.

**In British Columbia, those who miss getting the vaccine in grade 6 remain eligible for the free vaccine as long as they get their first dose before they turn 19, and their last dose before they turn 26.

#In Japan, regional programs were introduced only for males.

***Lifetime gratuity is only for those birth cohorts that were previously eligible for the NIP and catch-up.

§In Portugal, if vaccination starts between ≥ 15 and < 18 y of age: recommended schedule of 3 doses (0, 2, 6 months) to be completed before turning 27 y old, applicable to both HPV4 and HPV9 vaccines and both sexes.

¶In Canada, by 2017, all provinces and territories had publicly funded HPV vaccination programs for girls and boys.

Abbreviations: F: Female; GNV: Gender neutral vaccination; M: Male; NA: Not available; UAE: United Arab Emirates; UK: United Kingdom; USA: United States of America.

#In 2021, Sweden launched a national catch-up HPV vaccination program. The program, supported by research from the Karolinska Institute and funded by the government. This initiative is part of Sweden's efforts to eradicate cervical cancer.

See Supplementary Table S8 for detailed information.

45 y old ($n = 15$) and 55 y old ($n = 1$), with age not specified in nine jurisdictions. Furthermore, most of the jurisdictions ($n = 34$) did not specify gender in their recommendations. Six jurisdictions provided gender-neutral recommendations, applicable to both males and females. Notably, only one jurisdiction issued recommendations specifically for males. In Colombia, Mexico, Thailand and selected provinces of Canada, the recommended age for HPV vaccination was 9–26 y among males and 9–45 y among females. However, in Indonesia the recommended age range was 19–26 y for males and 19–45 y for females (Supplementary Table S7).

Funded programs. Ten jurisdictions of 152 were identified with publicly funded programs for PWH, equally distributed in Europe and the Americas, encompassing both regional and national-level implementation strategies (Figure 6 and Supplementary Table S9).

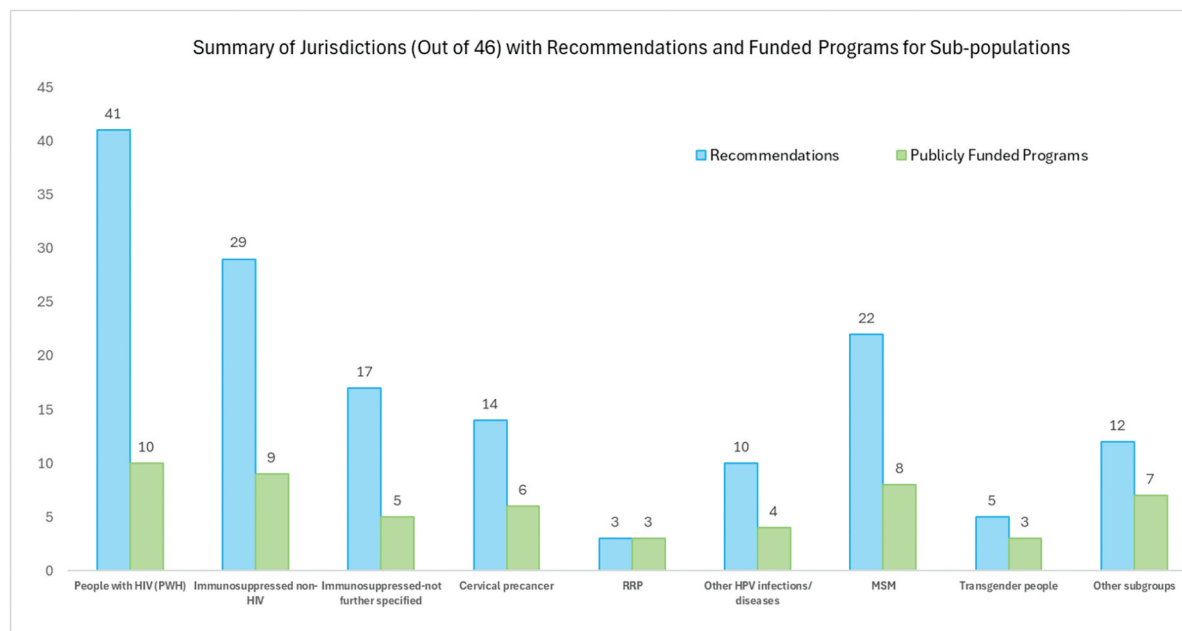


Figure 5. Summary of HPV vaccination recommendations and funded programs for certain sub-populations. Abbreviations: MSM: Men who have sex with men, RRP: Recurrent Respiratory Papillomatosis. See Supplementary Table S7 for detailed information regarding recommendations or guidelines and Supplementary Table S9 for publicly funded programs for sub-populations.

Immunosuppressed-not further specified.

Recommendations. Overall, 17 jurisdictions issued recommendations or guidelines for HPV vaccination specifically for unspecified immunosuppressed individuals (Europe n = 8, Western Pacific n = 6, Southeast Asia n = 2, Americas n = 1 [Canada]) (Figure 6). The upper age limit recommended for HPV vaccination varied in Europe: age 19 (n = 1), age 25 (n = 1), age 26 (n = 2), age 27 (n = 1) and not specified in three jurisdictions. Among jurisdictions with specified upper age limit, the recommended limit was 45 y in Western Pacific (n = 2) and gender-specific age ranges in some provinces of Canada (Males 9–26 y and Females 9–45 y). In Southeast Asia, the recommended age group varied from 15–26 y in India to 19–45 y (predominantly in females) in Indonesia (Supplementary Table S7).

Funded programs. Among 152 jurisdictions, five offered publicly funded HPV vaccination programs for unspecified immunosuppressed individuals. These included three from Europe (with national and regional programs), one in selected provinces of Canada (regional), and one in Australia (national, initiated 2023) (Supplementary Table S9).

Individuals with HPV infections or diseases***Women with cervical precancer.***

Recommendations. A total of 14 jurisdictions were identified which had HPV vaccination recommendations or guidelines for women with cervical precancer (Europe n = 8, Western Pacific n = 3, Americas n = 3). Of these 14 jurisdictions, three provided recommendations for women diagnosed with cervical precancer (the Americas = 1, Europe n = 1, Western Pacific n = 1), 7 jurisdictions targeted women undergoing treatment of cervical precancer (Europe n = 3, Western Pacific n = 2, the Americas n = 2) and the remaining 4 European jurisdictions addressed both diagnosed and undergoing treatment groups (Figure 6). Among total 11 jurisdictions targeted women undergoing treatment of cervical precancer, vaccination was administered after treatment in 8 jurisdictions and vaccination timing was not specified in 3 jurisdictions. Age recommendations varied, specifically: ≤45 y in two European jurisdictions (Sweden and Ireland), age 18–26 in one European jurisdiction (Germany), age 9–45 in one Western Pacific jurisdiction (Thailand) and one Americas jurisdiction (Canada) and age 27–45 in the USA. The recommendations for the remaining jurisdictions did not include any upper age limit (Supplementary Table S7).

Funded programs. Of the 152 jurisdictions, only 6 implemented publicly funded programs for women with cervical precancer. These initiatives encompassed both national and regional schemes and were initiated recently, commencing from 2023 onwards (Supplementary Table S9). Two jurisdictions (Sweden and Greece) targeted women undergoing treatment for cervical precancer, two (Canada, Austria) focused on women diagnosed with precancer, while the remaining two (Italy and Spain) implemented funded programs for both diagnosed and treatment groups (Figure 6).

RRP.

Recommendations. Three jurisdictions issued recommendations or guidelines for individuals with RRP (Americas n = 2, Europe n = 1). The province of Manitoba in Canada recommended 9vHPV among females aged 9–45 y and males aged 9–26 y for those with RRP. Brazil recommended three doses of the quadrivalent HPV vaccine among 9–45 y, while Portugal did not recommend any age group for vaccine administration (Supplementary Table S7).

Funded programs. Three jurisdictions implemented publicly funded HPV vaccination programs: National HPV program in Brazil (initiated in 2014) and regional HPV programs in select provinces in Spain (2023) and Canada (2024) (Supplementary Table S9).

Individuals with other HPV infections or diseases.

Recommendations. Overall, 10 jurisdictions issued recommendations or guidelines for HPV vaccination specifically for individuals with other HPV infections or diseases (Americas n = 4, Western Pacific n = 3, Europe n = 2, Southeast Asia n = 1). It included women with abnormal screening (HPV infection or positive HPV test, abnormal Pap: any cytological abnormalities not further specified), women with any anogenital disease not otherwise specified, and individuals with history of anogenital warts (Figure 6). Nine jurisdictions issued recommendations or guidelines for women with abnormal screening, out of which seven jurisdictions had HPV infection or positive HPV test and five had abnormal pap (any cytological

abnormalities not further specified). In the Americas and Western Pacific, the recommended age for HPV vaccination was 9–45 y (males 9–26 y and females 9–45 y). In Southeast Asia (India), the recommended age was 15–45 y (males 15–26 y and females 15–45 y); however, upper age limit is not specified in two jurisdictions of Europe (Supplementary Table S7).

Funded programs. Four jurisdictions implemented publicly funded HPV vaccination programs (Europe n = 3, the Americas n = 1) (Supplementary Table S9). The European initiatives encompassed both national and regional programs. In Canada, Prince Edward Island province launched regional programs in 2024 which funded vaccination among women with abnormal pap screening and individuals with history of anogenital warts. In Europe, a national program implemented in Austria in 2023 targeted the same groups. Meanwhile, Croatia and Italy's public programs, funded vaccination was only identified for those women with HPV infection, or a positive HPV test (Figure 6).

Members of the LGBTQ community

MSM.

Recommendations. Among 22 jurisdictions with recommendations specific to MSM, the majority were issued in Europe (n = 11), followed by the Americas (n = 5), Western Pacific (n = 4), and Southeast Asia (n = 2). Among the 11 European jurisdictions, 8 provided specific upper age limits for HPV vaccination. These limits varied significantly: Denmark set the limit at 25 y; Belgium, France, and Serbia recommended 26 y; while Greece, Ireland, Sweden, and the United Kingdom extended it to 45 y. The Americas showed similar variation with upper age limit of 26 y in Puerto Rico and some provinces of the USA, 40 y in Panama, with no specified limit in Colombia and some Canadian provinces. In South-East Asia, the upper age limit was 26 y whilst it ranged from 26 y to 45 y across jurisdictions in Western Pacific (Supplementary Table S7).

Funded programs. Only eight jurisdictions had publicly funded programs for MSM (Europe n = 6, the Americas n = 2), which encompassed both regional and national initiatives (Figure 6 and Supplementary Table S9).

Transgender.

Recommendations. Five jurisdictions issued recommendations specific to transgender individuals (the Americas n = 3, Europe n = 2). These recommendations uniformly recommended the 9vHPV vaccine across the included jurisdictions. In Europe, the upper age limit for vaccination was set at 45 y, while in the Americas (specifically, some provinces of Canada and the USA), the recommended age group was 9 through 26 y (and for adults aged >26 y) (Supplementary Table S7).

Funded programs. Among the 152 jurisdictions, 3 had publicly funded programs for transgender sub-populations (Europe n = 2, the Americas n = 1). In all three jurisdictions, regional HPV vaccination programs were funded (Supplementary Table S9).

Other sub-populations

Other sub-populations included were characterized by diverse populations of individuals at perceived increased risk of HPV infection. These included individuals with chronic medical conditions (e.g., heart disease, diabetes, chronic lung disease, liver disease, chronic alcoholism, kidney disease/renal failure/ESRD/hemodialysis patients), sexual assault survivors, sex workers/people involved in prostitution, individuals with exposure risk (sexual activity/changing sexual partners, known infection in sexual partners, unprotected sex with multiple partners), refugees and war victims, healthcare workers, special social considerations (incarcerated, street-involved, homeless, individuals in the care of youth protection services or the Ministry of Children and Family Development, in youth custody services centers, individuals attending rehabilitation centers or sexually transmitted disease clinics) and other high-risk groups not further specified.

Recommendations. Twelve of the 152 jurisdictions issued recommendations for other sub-populations (Europe n = 4, the Americas n = 4, Southeast Asia n = 2, Western Pacific n = 1, Eastern Mediterranean n = 1) (Figure 6). The upper age limit for HPV vaccination varied globally: age 26 in Eastern Mediterranean; age 45 in Western Pacific and some jurisdictions of Europe (Lithuania, Spain); 15–26 y for males and 45 y for females in Southeast Asia; and varying in the Americas, from 26 in the USA to 40 in Panama (Supplementary Table S7).

Funded programs. Seven jurisdictions had publicly funded programs for other sub-populations as specified above (Europe $n = 4$, the Americas $n = 3$), encompassing both regional and national initiatives (Figure 6 and Supplementary Table S7).

Discussion

This study revealed considerable variability in HPV vaccination recommendations, guidelines, and funded programs for adults across different jurisdictions globally. Fewer than half (41%) of the searched jurisdictions had developed HPV vaccination recommendations for general adults, and only around a quarter (24%) had publicly funded programs in place. Heterogeneity was observed with regard to the upper eligible age limits for recommendations, guidelines and funded programs. For recommendations or guidelines, the most frequent upper age limit reported was 26, followed by 45 y. Similarly, the most frequent upper age limit was 26 in funded vaccination programs, with ≥ 45 y included in a minority of programs.

Since the initial introduction of HPV vaccines, adolescents prior to potential exposure through sexual activity have been the primary target population in vaccination programs. Therefore, an upper limit for ‘catch-up’ vaccination of age 26 was often selected to cover young adults who may not have been vaccinated earlier. A recent cost-effectiveness study has shown that vaccinating individuals up to age 26 is generally cost-effective, as younger adults are less likely to have been exposed to HPV, they have a higher potential benefit from the vaccine.³³ Meanwhile, it has been suggested that HPV vaccination among adults aged 30–45 y provides limited health benefit at the population level, at a substantial cost.³⁴ Despite this evidence, it has also been suggested that 26 y may not be an appropriate upper limit, as individuals over 26 remain at risk for new HPV infections and could still benefit from vaccination. In the context of the current review, many of the guidelines recommended focusing primarily on adolescent vaccination, with catch-up vaccinations recommended during adulthood for those who missed vaccination during adolescence.

Furthermore, societal changes have led to more diverse sexual practices and partner numbers throughout adulthood. Due to the interaction of age, increased lifetime number of sexual partners and potential for oncogenic HPV infection, it has been suggested that older women may be at risk for HPV acquisition or possibly “reactivation”.³⁵ This is reflected in recent recommendations captured in this study, which have suggested that HPV vaccination may be beneficial for adults over 26, leading to expanded recommendations in some countries (e.g., the United States now recommends shared clinical decision-making for adults aged 27–45). A variety of adult sub-populations were also included across recommendations or guidelines, and funded programs. PWH and immunosuppressed individuals were the most commonly included sub-populations.

Wide geographic disparities were observed across jurisdictions, with the most recommendations or guidelines and funded programs identified for the Americas and Europe. In Africa, it is notable that only three jurisdictions (Morocco, South Africa and Nigeria) had recommendations for HPV vaccination in females, with the recommended age group spanning from 9 to 26 y. Similarly, in Southeast Asia and Eastern Mediterranean region, only a few jurisdictions had recommendations for HPV vaccination in an adult population. By comparison, the majority of jurisdictions in the Western Pacific, North America and Europe were found to have implemented HPV vaccination recommendations for general adults.

These findings characterize the varied global landscape for HPV vaccination, with the trends observed among vaccination recommendations and guidelines for general adults reflective of the delayed HPV vaccine introduction for adolescent populations among low- and middle-income countries compared to high-income countries.³⁶ Most jurisdictions identified recommended HPV vaccination for females, starting at ages ranging from 9 to 26 y. However, many jurisdictions have also expanded their recommendations to also include males across similar age ranges, indicative of the growing recognition of the importance of a gender-neutral approach to HPV vaccination. Certain jurisdictions also provided recommendations for sub-populations, such as PWH, immunocompromised individuals, transplant recipients, and those with autoimmune diseases. The observed regional variations were consistent with the current inequities with regard to HPV vaccination coverage and uptake globally, and coordinated efforts between professional societies, payers and policy makers to improve access to HPV vaccination should be encouraged.

Our study revealed considerable variation between HPV vaccination recommendations, guidelines and government-funded programs. Although many jurisdictions had established guidelines for HPV

vaccination in adults and specific sub-populations, this does not necessarily translate into public funding to action these recommendations. Notably, the existence of recommendations primarily serves to guide clinicians in the provision of optimized patient care and to enable informed decision-making by individuals about vaccination. However, the financial burden of following these recommendations often falls on individuals, particularly in regions like Southeast Asia, Africa, and the Asia Pacific, where publicly funded programs are scarce.

Despite the increasing scope of vaccine recommendations and funded programs among adult populations, as demonstrated by the findings of this review, vaccination hesitancy remains a significant barrier to successful public health campaigns against HPV.³⁷ Vaccination hesitancy is a complex and multifactorial phenomenon that can significantly impede the uptake and effectiveness of HPV vaccination efforts.³⁸ Comprising several components including, confidence (in the vaccine's safety and the healthcare system), convenience (accessibility and ease of obtaining the vaccine), complacency (perceived low risk of HPV-related disease), communication (effectiveness of vaccine information dissemination), and context (socio-cultural, historical, and political factors influencing vaccine acceptance),^{39,40} vaccine hesitancy can vary widely across different populations and jurisdictions, contributing to the disparities observed in HPV vaccination coverage.^{39,41} Such factors complicate HPV vaccine uptake among real-world populations and can negatively impact the overall success of vaccination programs.

HPV vaccination strategies encompass both population programs and individual recommendations. Population programs offer wide-reaching, targeting specific age groups to achieve herd protection and facilitate large-scale data collection. Although the cost-effectiveness of such programs represents an important consideration, with studies having reported that vaccinating individuals up to age 26 is generally cost-effective, whilst HPV vaccination of women and men aged 30–45 y provides limited health benefit at the population level, at a substantial cost.^{20,21} Individual recommendations, conversely, provide a personalized approach, accommodating unique health profiles and allowing for catch-up vaccinations for those who missed the opportunity of vaccination. Whilst population-level programs represent important initiatives to help achieve broader public health goals, their implementation alongside individual-level recommendations help to ensure comprehensive coverage by reaching those that fall outside of the standard inclusion criteria. Both approaches play important roles in HPV prevention, and countries may adopt different strategies based on their specific healthcare systems, resources, and population needs. The choice between population programs, individual recommendations, or a combination of both depends on various factors unique to each jurisdiction's context and public health priorities.

Our study holds some notable limitations. For feasibility reasons, the geographic scope was restricted to the largest 152 jurisdictions by population size. Whilst the populations of these jurisdictions account for approximately 99% of the global population, some nuances among the smaller jurisdictions may have influenced the regional trends observed, particularly in low- and middle-income countries.⁴² Due to feasibility constraints, we solely focused on recommendations provided by specific professional societies within each jurisdiction, which may have led to the omission of additional recommendations from other professional societies. Our analysis included only the most recent or current recommendations and programs, excluding historical details regarding previous changes in policies. While our methodology was comprehensive, it is important to acknowledge the limitations of relying primarily on publicly available data. There is potential for publication bias, as jurisdictions with more robust HPV vaccination programs may be more likely to publish detailed information. Additionally, the lack of standardized reporting across jurisdictions made direct comparisons challenging in some cases. Furthermore, our study did not differentiate between the strengths of recommendations (e.g., strong, moderate, weak) provided by various societies, reflecting varying levels of evidence or consensus. Instead, we consolidated the recommendations identified at a jurisdiction level, which may potentially have masked important nuances in the level of endorsement across jurisdictions. Lastly, as this review had a cutoff date of May 31, 2024, any more recent updates or developments were not accounted for in this study. These limitations highlight the need for continued research and broader analysis in this important area of public health policy.

This comprehensive review of global HPV vaccination recommendations and programs for adults has important implications for public health leaders and clinical policymakers, as there is growing interest around expanding HPV vaccination recommendations and funded programs to include more adults, to maximize population-level protection against HPV-related diseases and recognize individual benefits. In

this regard, this study provides a consolidated summary of the current *status quo* with regard to HPV vaccination in adults and serves as a useful reference point to update recommendations and guidelines and for monitoring subsequent changes to rollout and implementation of adult vaccination programs across the rapidly evolving global landscape. While economic reasons are likely to influence decision-making for funding HPV vaccination among adult populations, clinical guidelines are more likely to include offering vaccination on an individual basis according to their infection risk, regardless of age. With continued progress in implementation of HPV vaccination recommendations and programs for adolescents and sufficient supply of HPV vaccines, we anticipate that jurisdictions will continue to update their guidelines and funding status for HPV programs to include adults.

Conclusion

Overall, 41% of jurisdictions had recommendations or guidelines for HPV vaccination among general adults, and of those, 68% also included sub-populations. Upper age limits also varied between jurisdictions, with age 26 the most frequent upper age limit reported. Funded vaccination programs for general adults were identified in 24% of jurisdictions, and age 26 was also the most frequent upper age limit reported. Sub-populations were included across recommendations or guidelines for 30% of jurisdictions, and only 11% had funded sub-populations programs. PWH and immunosuppressed individuals were the sub-populations most frequently included across recommendations or guidelines, and funded programs. Regional variations were indicative of the disparities in HPV vaccination efforts in Africa and parts of Asia, compared to Europe and the Americas. While economic reasons may influence funding for HPV vaccination among adults, clinical guidelines are more likely to advise vaccination on an individual basis, regardless of age. With continued progress in the implementation of HPV vaccination globally, it will be important to continue to monitor the evolving adult landscape, and additional work to elucidate the heterogeneity observed is required.

Acknowledgments

The authors would like to acknowledge Rishabh Pandey of Parexel International, for his contributions in the initial scoping and development of this study.

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Disclosure statement

XY and Y-TC are employees of Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA and may own stock and/or hold stock options in Merck & Co., Inc., Rahway, NJ, USA. MV is an employee of MSD, Spain and may own stock and/or hold stock options in Merck & Co., Inc., Rahway, NJ, USA. MR is an employee of MSD Sharp & Dohme gmbh, and may own stock and/or hold stock options in Merck & Co., Inc., Rahway, NJ, USA. AJ, AH, and AJ are employees of Parexel, which was hired by MSD. ND has received honoraria for lectures, consulting fees and participated in projects funded by MSD, Merck Canada Inc., Kirkland, QC, Canada and Moderna, and has also received travel and accommodation coverage at scientific meetings from MSD and Merck Canada Inc., Kirkland, QC, Canada.

Funding

Funding for this research was provided by Merck Sharp & Dohme LLC, a subsidiary of Merck & Co., Inc., Rahway, NJ, USA (MSD).

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Ethics approval

This study did not involve human participants. In accordance with the international research ethics guidelines, formal ethics approval was not required for this research.

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