

Assessing health outcomes and cost-effectiveness of adult HPV vaccination in Italy

Alhaji Cherif¹, Cody Palmer¹, Mario Lombardi², Sara Boccalini³, Angela Bechini³, Cristina Salvati³, **Francesca Senese²**

¹Merck & Co., Inc., Rahway, NJ, USA, ²MSD Italy, Rome, Italy, ³Department of Health Sciences, University of Florence, Italy

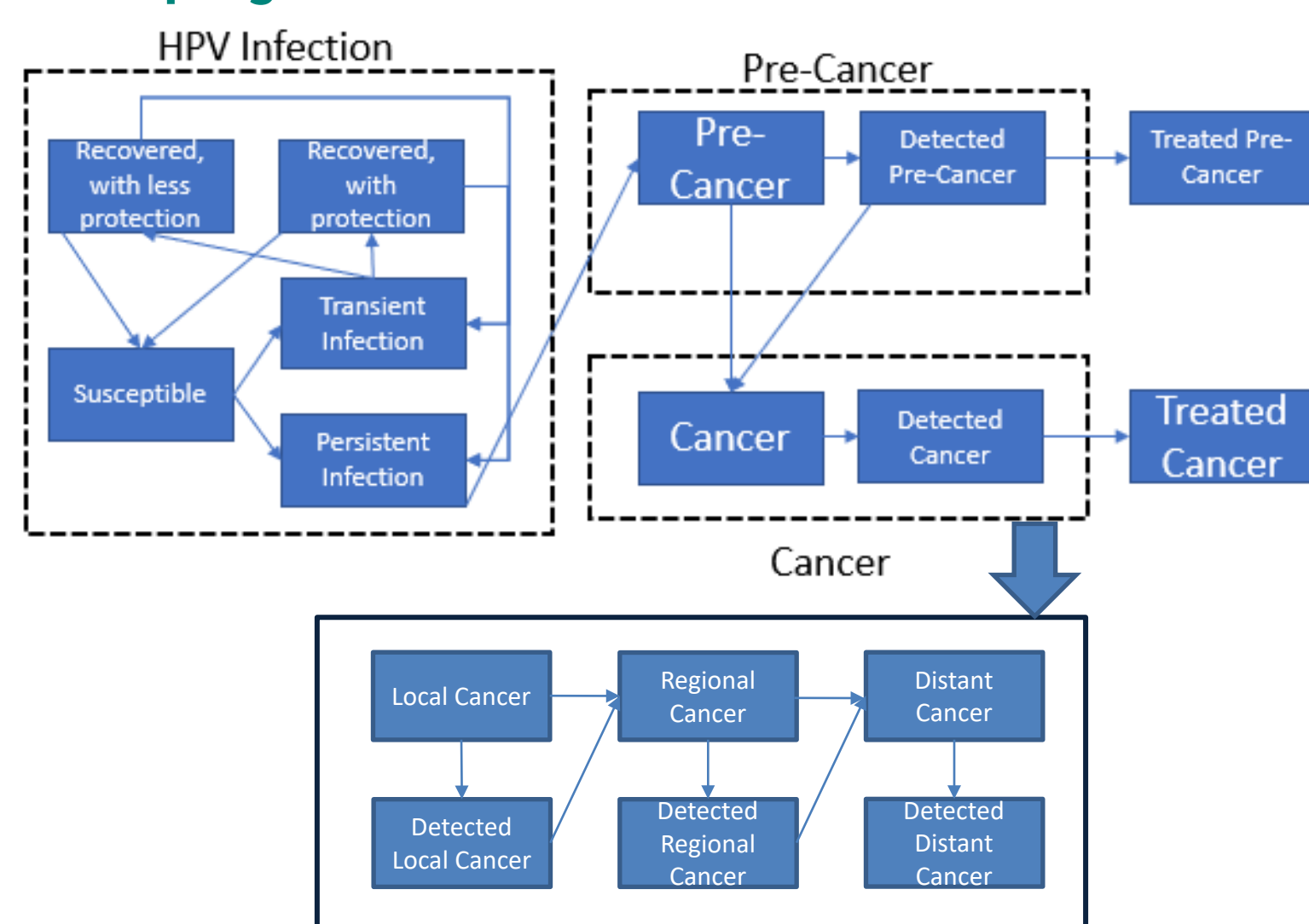
Background

- Human papillomavirus (HPV) is a prevalent sexually transmitted infection that can lead to various types of cancer and genital warts
- The implementation of vaccination programs has been shown to be an effective strategy in reducing the burden of HPV-related diseases
- In 2017-2019, Italian NIP recommended universal immunization at 12 years old in both males and females and for some at-risk groups (treated women and MSM)
- Recently, NIP 2023-2025 has extended the recommendation for catch-up vaccination of females up to age 26 and males up to age 18
- Even though the catch-up recommendation included in NIP 2023-25 represents a good public health achievement, some other interventions and age extensions might prove viable and affordable in Italy
- This study investigates the health outcomes and cost-effectiveness of different vaccination strategies to prevent HPV-related diseases in Italy

Aims and Methods

- To evaluate the impact of different vaccination strategies, we adapted a published dynamic age-structured HPV transmission infection and disease progression model¹ to Italian incidence/prevalence data² (see Figure 1). The model includes demographics, sexual behavior, natural history of HPV-related cancers and diseases, screening and treatment patterns. Additionally, model is then linked to economic model that accounts for cost of vaccination, treatment, screening and diagnosis, and health-related quality of life (see refs 1-5, and references therein)
- We compare the health outcomes and cost-effectiveness of the following vaccination strategies:
 - Old national immunization program (NIP) 2017-2019: gender neutral vaccination of adolescent males and females in their 12th year of life,
 - New NIP 2023-2025: catch-up vaccination of young adult females up to age 26 and males up to age 18
 - New NIP 2023-2025 plus opportunistic vaccination of single cohorts for females aged 30, 35 and 40 years old upon their routine cervical screening appointments (HPV-DNA test)
 - New NIP 2023-2025 plus catch-up vaccination of mid-adult female up to age 45 years and young adult male up to age 18 years
- For each (b)-(d), we consider a duration of 3-, 5-, 10- and 100-year

Figure 1. Simplified model schematic for HPV transmission dynamics and disease progression



Results

- The results suggest that compared to the 2017-2019 NIP, all scenarios may lead to a marginal decrease in the cumulative cases of all HPV-related cancers
- The duration of the strategy also had an impact on the number of cancer cases, with extending the duration from 3 to 10 years providing between 5.35% and 10.15% reduction in the cancer cases across all strategies
- These strategies required additional cost per QALY gained, with ICER values ranging from €25.699/QALY to € 49.865 per QALY gain.
- The results suggest that catch-up campaigns, depending on the duration, may provide significant health benefits at a reasonable cost with ICERs in Italian context (see Table 1).
- The augmented and expanded catch-up of adult women, through (d) extension of age recommendation up to 45 years or (c) vaccination upon cervical screening, have higher costs and lower QALYs than the old NIP 2017-2019 scenario, nevertheless they prove cost-effective ($\leq$ € 40.000 per QALY) within 10- and 5-year time horizons, respectively
- All the strategies analyzed become cost-effective (€ 40.000 per QALY) within the model cycle horizon.

Table 1. Cost-effectiveness analysis of different strategies, results per 100.000 persons

Strategy	Treatment Cost	Screening Cost	Vaccine Cost	Total Cost	QALY	ICER
a. Old NIP 2017-2019	€ 10.510.016	€ 16.786.400	€ 5.094.220	€ 32.390.636	2.135	-
b. New NIP 2023-2025 (catch up females up to 26 and males up to 18)						
3 Years	€ 10.102.611	€ 16.756.600	€ 6.824.980	€ 33.684.191	2.089	€ 27.610
5 Years	€ 9.984.044	€ 16.750.500	€ 7.259.330	€ 33.993.874	2.074	€ 26.183
10 Years	€ 9.746.982	€ 16.741.700	€ 8.239.100	€ 34.727.782	2.044	€ 25.699
100 Years	€ 8.690.596	€ 16.735.400	€ 13.933.300	€ 39.359.296	1.906	€ 30.381
c. New NIP 2023-2025 + Single Cohorts 30/35/40 upon public cervical screening appointment						
3 Years	€ 10.065.181	€ 16.753.500	€ 7.903.700	€ 34.722.381	2.085	€ 46.145
5 Years	€ 9.958.420	€ 16.748.600	€ 8.114.970	€ 34.821.990	2.072	€ 38.126
10 Years	€ 9.739.481	€ 16.741.300	€ 8.578.760	€ 35.059.541	2.044	€ 29.107
100 Years	€ 8.656.304	€ 16.732.700	€ 15.012.000	€ 40.401.004	1.903	€ 34.411
d. New NIP 2023-2025 + catch-up of males up to 18 and catch-up of females up to 45						
3 Years	€ 10.044.845	€ 16.751.000	€ 8.212.250	€ 35.008.095	2.083	€ 49.865
5 Years	€ 9.927.540	€ 16.745.100	€ 8.646.610	€ 35.319.250	2.069	€ 43.867
10 Years	€ 9.692.403	€ 16.736.600	€ 9.626.370	€ 36.055.373	2.039	€ 38.051
100 Years	€ 8.637.420	€ 16.730.500	€ 15.320.500	€ 40.688.420	1.901	€ 35.365

The colored row are above the cost-effectiveness threshold.

Conclusions

- The Italian HPV immunization program, initiated already in 2007 and ratified in 2017 with the NIP 2017-2019 (which launched gender neutral vaccination of males and females), was sustainable by the NHS
- The catch-up vaccination of young males and females, sanctioned by the New NIP 2023-25, is shown to be extremely cost-effective in the short run compared to previous NIP
- Provided the VCRs attained in the female cohorts since HPV immunization (women born after 1994 are partially vaccinated with sustained VCRs in the youngest cohorts), the expansion of HPV immunization to women upon the cervical screening appointment and/or up to the age of 45, regardless of individual risk, are both cost-effective strategies in the short-run, and merit NITAG attention

References:

- Daniels V, et al. Public health impact and cost-effectiveness of catch-up 9-valent HPV vaccination of individuals through age 45 years in the United States. *Human Vaccines & Immunotherapeutics*. 2021 Jul 3;17(7):1943-51.
- European Cancer Information System. Cancer burden statistics and trends across Europe. (n.d.). <https://ecis.jrc.ec.europa.eu/>
- Screening Cervicale Dati Sorveglianza Passi - Epicentro. (n.d.). <https://www.epicentro.iss.it/passi/dati/ScreeningCervicale>
- Salute, Ministero della. "Vaccinazioni Dell'infanzia E Anti-HPV, Le Coperture Nazionali al 2021." *www.salute.gov.it*, www.salute.gov.it/portale/news/p3_2_1_1_1.jsp?lingua=italiano&menu=notizie&p=dalministero&id=6049#:~:text=Le%20coperture%20relative%20al%202021
- Mennini FS et al. Cost-effectiveness analysis of the nine-valent HPV vaccine in Italy. *Cost-effectiveness & Resource Allocation*. 2017, 15:11