

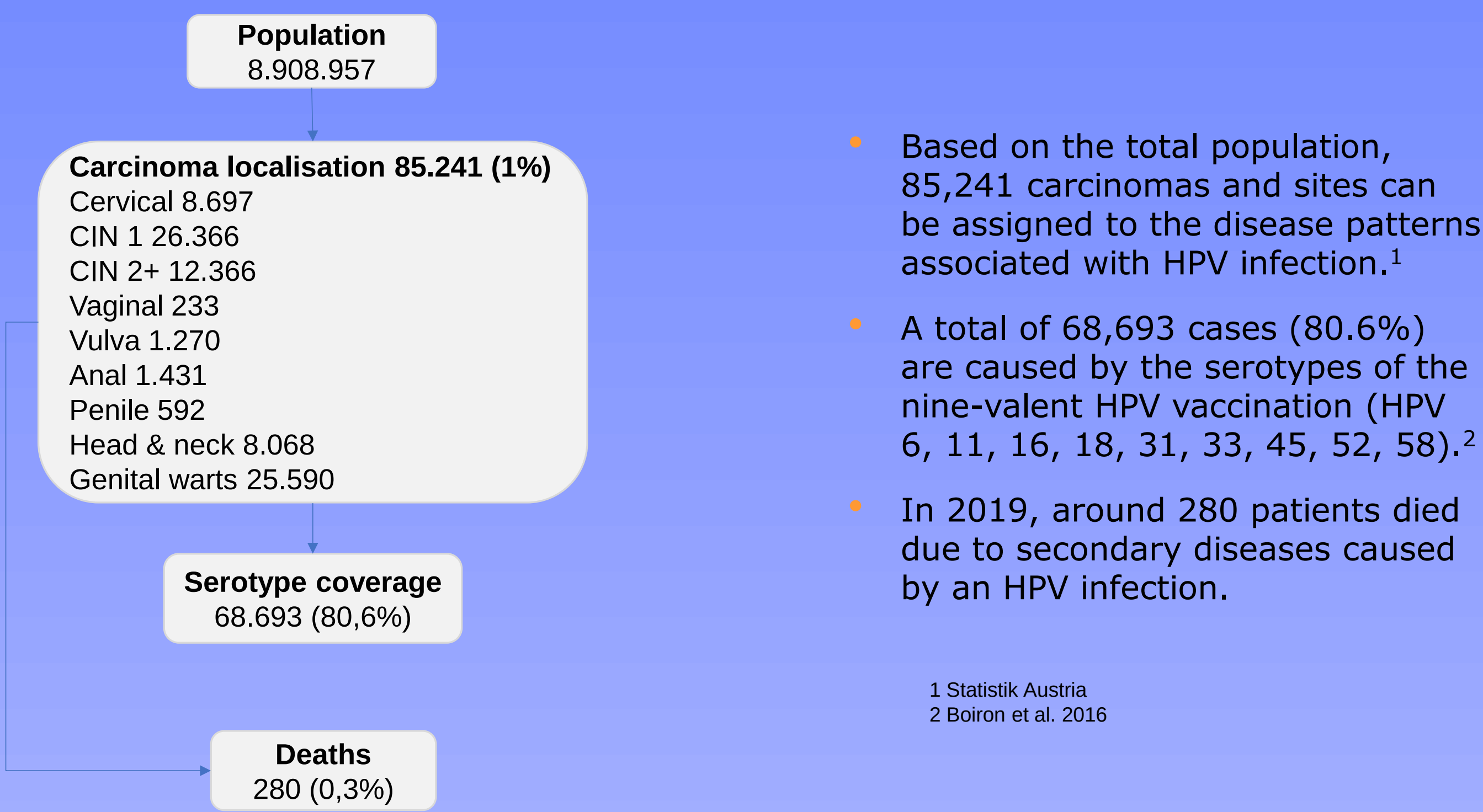
A public health and budget impact analysis (BIA) of human papilloma virus (HPV) vaccination in the Austrian population

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Objectives

Infections with human-papilloma-virus (HPV) are common in humans, and it is considered the most prevalent sexually transmitted infection. Over 200 types have been identified; 13 high-risk types. About 7% of cancers in developed-countries are infection-related; half associated with HPV. Vaccination is included in the Austrian national-vaccination-program and offered to children between age 9-11 free of charge; 12-14 with price discount and >15 at their own expense. The aim of the budget impact analysis (BIA) is to quantify the monetary-impact due to the current situation of HPV vaccination, expressed as world with vaccination, compared to a world without vaccination.

Figure 1: Patientflow WITHOUT HPV vaccine



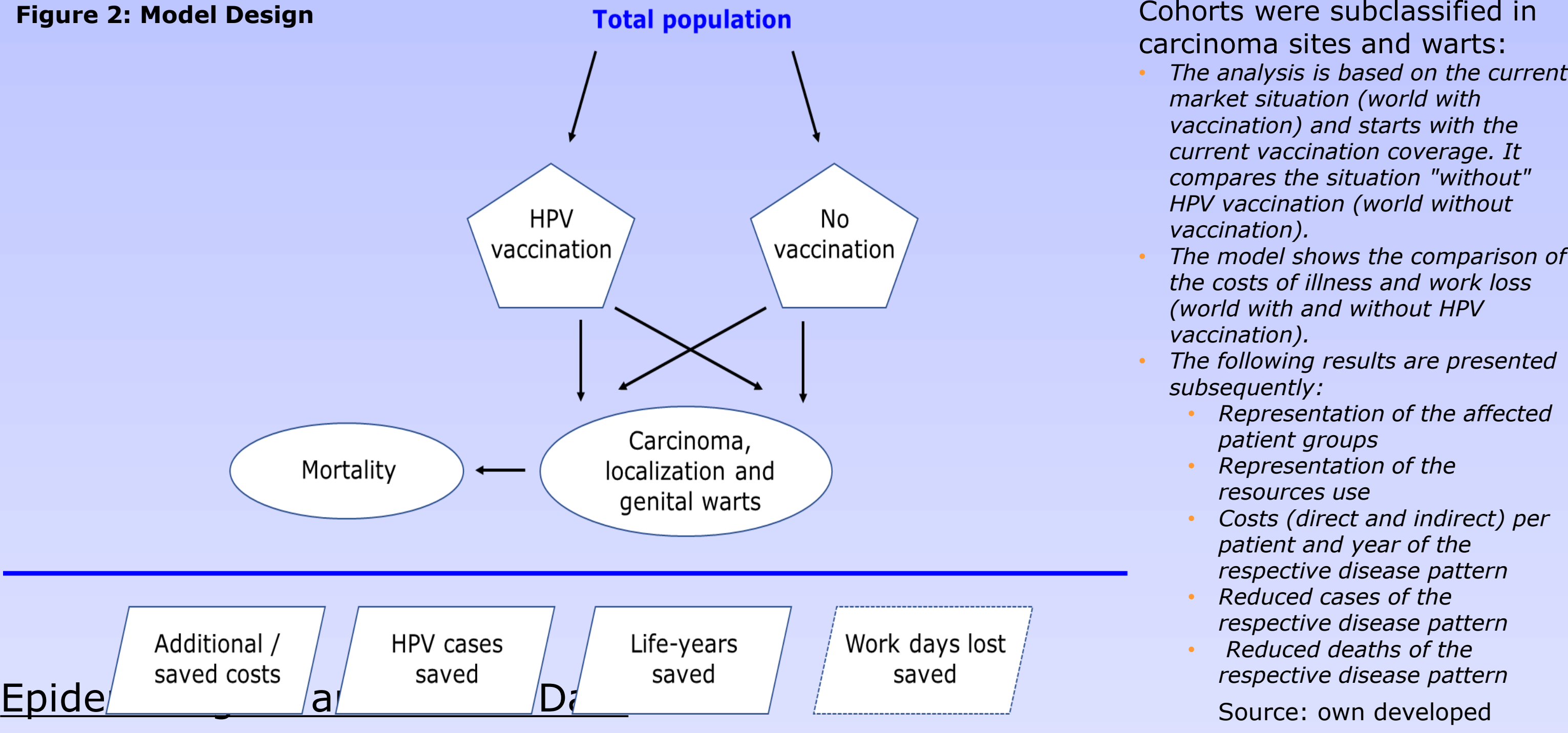
Source: own developed

- Based on the total population, 85,241 carcinomas and sites can be assigned to the disease patterns associated with HPV infection.¹
- A total of 68,693 cases (80.6%) are caused by the serotypes of the nine-valent HPV vaccination (HPV 6, 11, 16, 18, 31, 33, 45, 52, 58).²
- In 2019, around 280 patients died due to secondary diseases caused by an HPV infection.

Methods

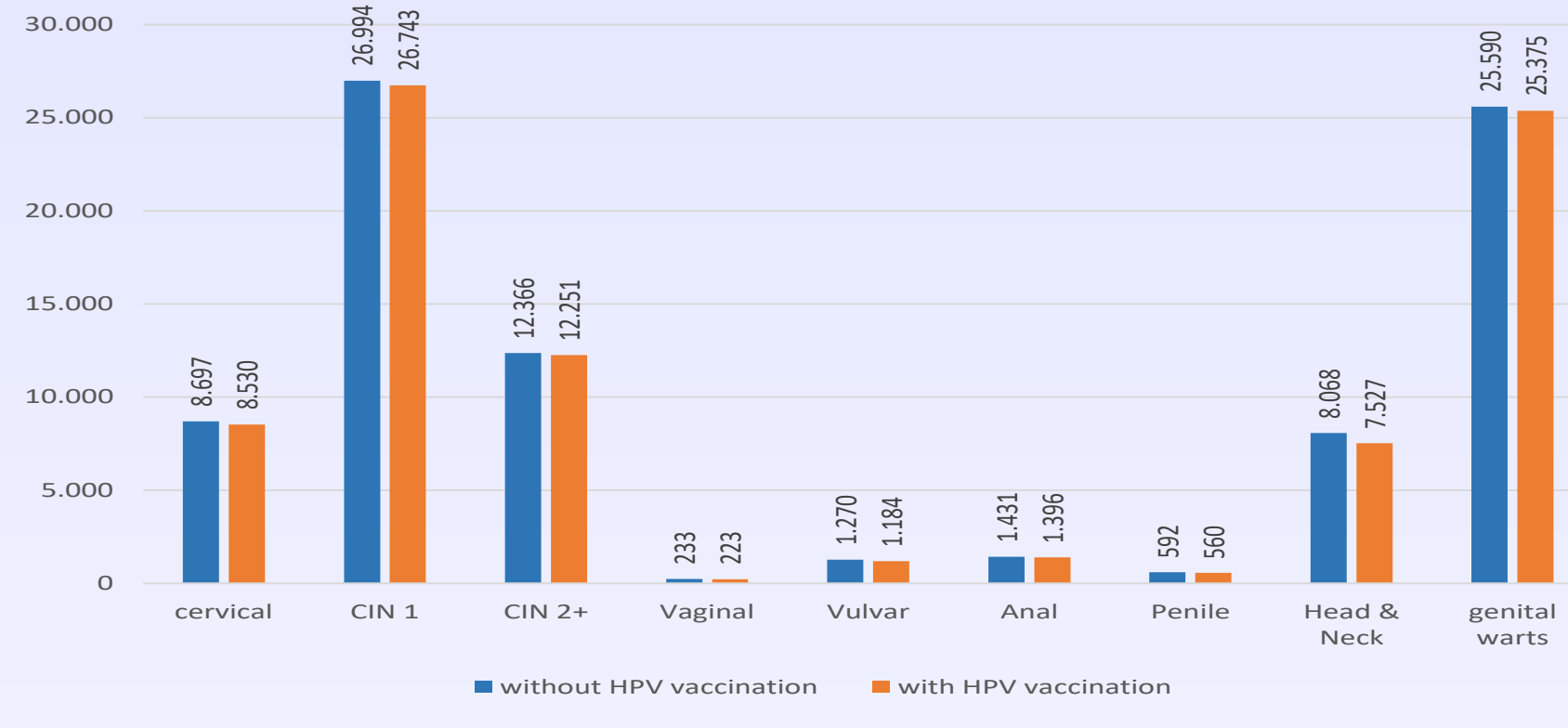
A multi-cohort, population-based model was developed over a 5-year time-horizon (2019 – 2023), which included the following states: cervical, anal, vulvar, vaginal diseases, genital warts, related disease and mortality. In the world with vaccination the percentage of immunized individuals is 7.7% 1st year to 8.3% 5th year. The shift from the four-valent to the nine-valent HPV vaccine was considered. Results showed which savings could be achieved from the health-care-systems perspective and from the societal perspective. Vaccination costs are based on the present pharmacy-selling-price, which is paid out-of-pocket.

Figure 2: Model Design



Basically, the HPV vaccination is prophylactically effective and therefore recommended for administration prior to entering the sexually active age with the completed 9th year of life (Austrian vaccination scheme 2020).

Figure 3: HPV cases saved in 2019



Immunization (7,70%) leads to a reduction of HPV cases (for example, for 2019 83,789 cases instead of 85,241 cases without vaccination).

The "efficacy" of the vaccination (9-valent vaccination) is considered according to gender and HPV 16 and 18 as well as HPV 31, 33 ,45 ,52 and 58 (weighted) (table 2).

Table 2: Efficacy of HPV vaccination

Carcinoma sites	HPV 16	HPV 18	HPV 31, 33, 45, 52 und 58	Weighted efficacy
Cervical (total distribution)	0.82		0.18	84.3%
Vaginal (total distribution)	0.84		0.16	72.4%
Vulva (total distribution)	0.88		0.12	75.8%
Anal (total distribution)	0.97		0.03	86.5%
Penile (total distribution)	1.00			86.2%
Head and neck (total distribution)	1.00			86.2%
Genital warts (total distribution)				99.0%
CIN (total distribution)				98.8%

HPV vaccination does not have a therapeutic effect, but HPV vaccination can prevent two thirds of recurrences after conization (Austrian vaccination scheme 2020).

Source: Boiron et al. 2016; own calculations



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Immunization rate

The probability of receiving vaccination was set to 7.70% for the first year. The HPV vaccination rate was calculated from the sales data of the past 3 years (2016-2018) and was projected as an average trend into the future (2019-2023).

Table 3: Vaccination rate over 5 years

Age groups	Year 1 (2019)	Year 2 (2020)	Year 3 (2021)	Year 4 (2022)	Year 5 (2023)
9-11	4.62%	4.68%	4.74%	4.80%	4.98%
12-14	2.70%	2.73%	2.77%	2.80%	2.91%
>15	0.39%	0.39%	0.40%	0.40%	0.42%
Total	7.70%	7.80%	7.90%	8.00%	8.30%

Source: own calculations

Direct costs

The BIA includes costs of inpatient and outpatient HPV treatment, including medication and the inpatient and outpatient treatment of the carcinoma sites and genital warts. Costs were presented from the payer perspective. The vaccination costs are partly borne by the population and partly represent private health expenditure. The HPV vaccination is offered to children between age 9-11 free of charge; 12-14 with price discount (about 58.00 €; pharmacy selling price) and >15 at their own expense (205.20 €; pharmacy selling price).

Indirect costs

The costs of work loss associated with HPV are classified as indirect costs. Indirect costs are calculated on the basis of the employment rate by age group (proportion of the population in employment). The duration of work loss is calculated for each disease associated with HPV infection. Costs were presented from the societal perspective.

Results

Based on the current vaccination coverage annual savings of 37.7 million € (m€) (1st year) to 41.6 m€ (5th year) [total: 197.1 m€ over 5 years] could be achieved. Direct costs contributed between 28.7 m€ (1st year) to 31.5 m€ (5th year) [total: 149.3 m€] to total saving. The society is relieved due to a vaccination strategy. The savings in indirect costs range from 9.2 m€ (1st year) to 10.1 m€ (5th year) [total: 47.8 m€]. The costs of vaccination are partly borne by the patient (≥12 years), who make private payments of 3.7 m€ (1st year) to 4 m€ (5th year) [total: 19.3 m€].

Figure 5: Total budget-impact

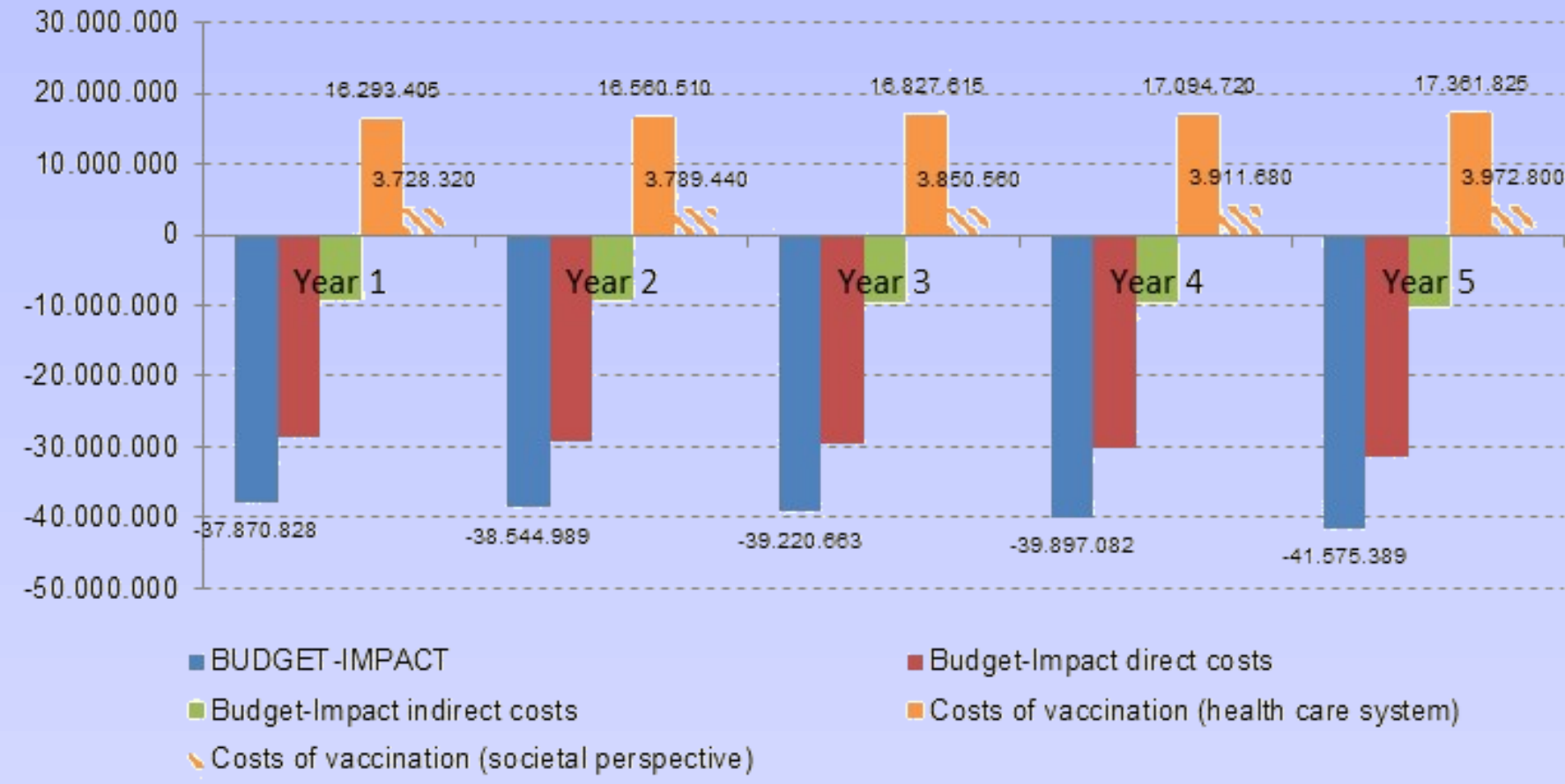


Table 4: Prevented cases due to HPV vaccination

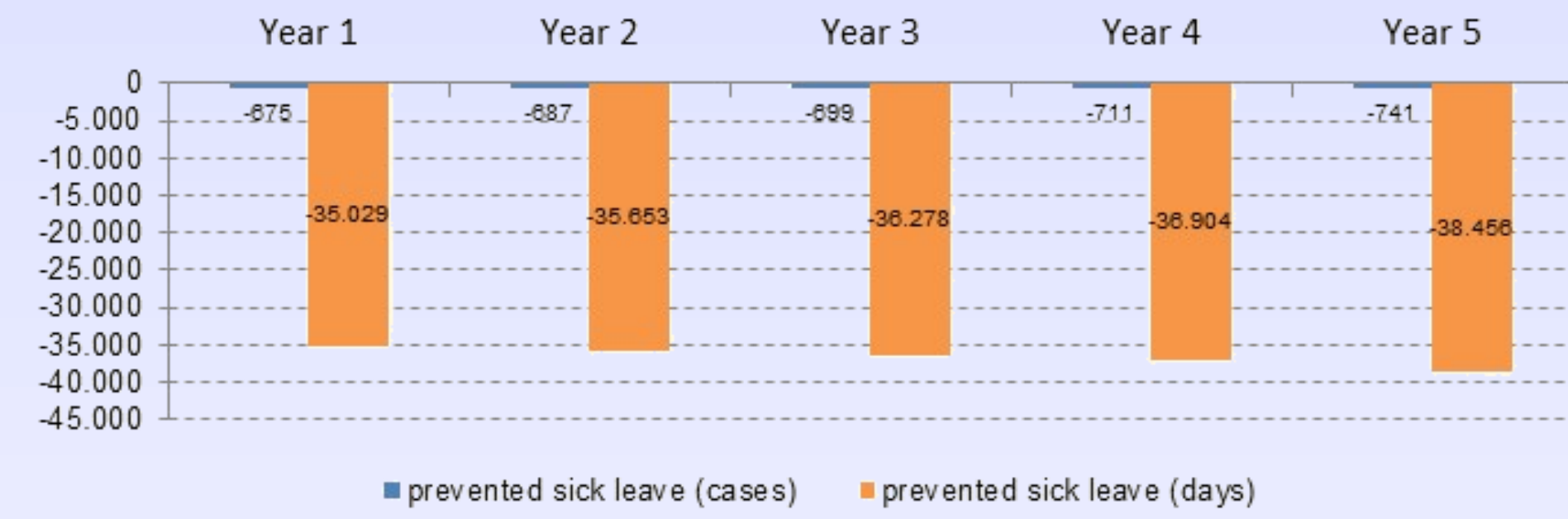
Prevented cases	Year 1	Year 2	Year 3	Year 4	Year 5
HPV cases	-1,451	-1,477	-1,503	-1,529	-1,593
Deaths	-11	-11	-11	-11	-12

Multiplier effects:

- 1 € invested in the HPV vaccine relieves the society by 10.20 €
- 1 € invested in the HPV vaccine saves 1.80 € within the health care system

With the predicted vaccination rate, 7,554 prevented HPV cases and 55 deaths over 5 years result from the vaccination.

Figure 6: Prevented work absenteeism



Source: own calculations

With the forecasted vaccination coverage, the vaccination will result in reduced work absenteeism of -3,512 cases and -182,320 days over 5 years.

Sensitivity Analysis

Table 5: Sensitivity analysis

Vaccination coverage in %	Budget-Impact (in 1,000 €)	HPV cases	Sick leave (cases)
20%	-496,416	-19,026	-8,846
30%	-744,624	-28,539	-13,269
40%	-992,833	-38,052	-17,692
50%	-1,241,041	-47,565	-22,115
60%	-1,489,249	-57,078	-26,538
70%	-1,737,457	-66,591	-30,961
80%	-1,985,665	-76,104	-35,384

Source: own calculations

The sensitivity analysis shows the results as a consequence of a varied vaccination coverage. With a vaccination coverage of 20%, the total budget impact or social savings increases from 496,416 million € over five years to 2,482,081 million €; a vaccination coverage of 50% results in a further increase to 1,241,041 million €. HPV cases are reduced compared to the current situation (95,129 prevented cases over 5 years) to 19,026 prevented cases (20%) or 47,565 prevented cases (50%).

Conclusion

1 € invested in the HPV vaccine relieves the society with 10.20 € and saves 1.80 € in health-care-system.

References

Boiron L, Joura E, Largeron N, Prager B, Uhart M. Estimating the cost-effectiveness profile of a universal vaccination programme with a nine-valent HPV vaccine in Austria. BMC Infect Dis. 2016;16:153. DOI: 10.1186/s12879-016-1483-5. Federal Ministry of Labour, Social Affairs, Health and Consumer Protection. Austrian vaccination scheme 2020. Vienna, Austria. 2019.

Additional literature with the author