THE EFFECT OF GENDER-NEUTRAL HPV VACCINATION PROGRAM WITH DIFFERENT VACCINATION COVERAGE RATES

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BACKGROUND / OBJECTIVES

In Denmark, access to publicly financed HPV (Human Papilloma Virus) vaccination for 12-year old females has been an option since 2009. Males are not included in the program. From 2009 to 2013, vaccination rates were high (>70%), but in 2014, 2015 and 2016, the vaccination rates were low (34%-57%). The vaccination rate among males has been 3%-5% until now.

The nine-valent (HPV9) vaccine is now the applied vaccine in the program, and from 2019, it is expected that 12-year old males will be included in the public vaccination program. Therefore, we now present updated modelling analyses of the vaccination. These analyses take the reduced vaccination rates and the improved protection from the HPV9 vaccine into account.

METHODS

A dynamic HPV transmission model was calibrated to a Danish setting and used to estimate the incremental costs and effects associated with different vaccination strategies compared to cervical cancer screening only. In total, the transmission dynamics of all nine HPV types covered by the HPV9 vaccine were included and herd immunity was taken into account.

The model includes a high level of detail. This requires many input parameters. The model parameters involve the following categories:

- Demographics
- Sexual behavioural data
- Screening parameters
- Natural history of disease
- Treatment patterns
- Cancer mortality
- Vaccine properties
- Vaccination coverage by strategy
- Costs
- Health-related quality of life

In the model, the actual vaccination rates for the first nine years were applied (2-dose vaccination of 12-year old females only). Gender-neutral strategies with 2-dose vaccination of 12-year old males via a publicly financed program were included from year 10 and onwards (i.e. vaccination rates higher than 5%).

Different scenarios were analysed (Table 1). In Table 1, the vaccination rates for year 1-8 reflect the actual rates for the first eight years of the program (i.e. 2009-2016). This implies that these rates are the same for all scenarios. The 3% vaccination rate for males in year 1-8 reflects the percentage of males who paid for the vaccination themselves.

Scenario 1a is with female only vaccination program. In scenario 1a, it is assumed that the female vaccination rate will return to the same high level as in the first 5 years. This is displayed as an increase to 60% in year 9, followed by an assumed vaccination rate of 65% in year 10 and of 70% from year 11 and onwards.

Scenario 1b is a gender-neutral vaccination (GNV) program because it is assumed that the vaccination of males will be included in the program from year 10 and onwards. This is reflected by a rate of 55% in year 10 and 65% from year 11.

In scenario 2a and 2b, it is assumed that the low vaccination rate observed in year 8 is maintained. Scenario 2b is the GNV program but with a low participation for both females and males.

The incremental effects were estimated as the number of avoided HPV-related cancers, pre-cancers and deaths.

Table 1. Vaccination rates for different scenarios

	Scenario 1a (female only vaccination, high VCR)		Scenario 1b (GNV, high VCR)		Scenario 2a (female only vaccination, low VCR)		Scenario 2b (GNV, low VCR)
Year	Vaccination rate, females	Vaccination rate, males	Vaccination rate, females	Vaccination rate, males	Vaccination rate, females	Vaccination rate, males	Vaccination rate, females
1	71%	3%	71%	3%	71%	3%	71%
2	79%	3%	79%	3%	79%	3%	79%
3	80%	3%	80%	3%	80%	3%	80%
4	80%	3%	80%	3%	80%	3%	80%
5	71%	3%	71%	3%	71%	3%	71%
6	57%	3%	57%	3%	57%	3%	57%
7	40%	3%	40%	3%	40%	3%	40%
8	34%	3%	34%	3%	34%	3%	34%
9	60%	3%	60%	3%	34%	3%	34%
10	65%	5%	65%	55%	34%	5%	34%
10+	70%	5%	70%	65%	34%	5%	34%

Note: The vaccination rates are for completed vaccinations (i.e. 2 doses).
VCR: Vaccination coverage rate. GNV: Gender-neutral vaccination.

RESULTS

The updated model simulations show that, in the long run, a GNV program leads to a more rapid decrease in the HPV prevalence compared to female only vaccination. This is especially the case for males but also in the female population. This obvious effect of the GNV program will improve the protection in females and males since the number of avoided HPV-related cancers and deaths increases.

In Table 2 it can be seen that even for females GNV increases the number of avoided cases of cervical, vaginal and vulvar cancer. In addition, GNV significantly increases the number of avoided cases of anal, penile, and head and neck cancer in men. It is also seen that a low overall vaccine coverage leads to a notable decrease in the number of avoided HPV-related cancers.

In terms of cost-effectiveness, both female only and gender-neutral vaccination are cost-effective. The highest incremental cost-effectiveness ratio (ICER) is estimated to 5,890 €/QALY (quality adjusted life year) for scenario 1b (GNV, high VCR).

Table 2. Incidence reduction HPV9 vaccination vs. screening only

	Scenario 1a (female only vaccination, high VCR)	Scenario 1b (GNV, high VCR)	Scenario 2a (female only vaccination, low VCR)	Scenario 2b (GNV, low VCR)
Cervical cancer	-44.8%	-46.5%	-30.4%	-32.8%
Vaginal cancer	-39.4%	-41.1%	-26.8%	-29.1%
Vulvar cancer	-39.3%	-40.9%	-26.5%	-28.7%
Anal cancer				
Females	-34.0%	-36.2%	-23.0%	-25.7%
Males	-24.5%	-33.2%	-16.3%	-23.2%
Penile Cancer	-8.3%	-23.8%	-5.6%	-14.4%
Head and neck cancer				
Females	-34.8%	-37.2%	-22.3%	-25.0%
Males	-23.4%	-34.4%	-14.5%	-22.5%
Genital warts				
Females	-65.5%	-70.8%	-39.1%	-44.6%
males	-48.4%	-64.2%	-26.2%	-38,9%

CONCLUSIONS

From a public health perspective, attention to the low vaccine coverage should be paid since it leads to an increasing number of HPV-related cancers and deaths. Initiatives that increase the vaccination rates should be supported. In addition, GNV increases the number of avoided HPV-related cancers, pre-cancers and deaths – especially when the female vaccination rates are low. Overall, GNV leads to a significantly better protection in males, for example when it comes to head and neck cancer.

CONFLICT OF INTEREST

Incentive is a paid vendor to MSD. JO is employee of Incentive. TlF & AG are employees of MSD. JB served as a consultant for MSD.