Cost-utility analysis of HPV vaccination for cervical cancer prevention in Morocco

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65th World Health Assembly (2012)

Decided to adopt a global target of a 25% reduction in premature mortality from non-communicable diseases (NCDs) by 2025
Cervical cancer predicted to double by 2030 in EMNA

Health and Economic Burden

• Over 100 HPV types
• High risk strains (oncogenic): HPV types 16 & 18
• Low risk strains (non-oncogenic): HPV types 6 & 11

WHO recommends vaccination of preadolescent females in countries where cervical cancer is a public health problem
14 EMNA countries have licensed one of two vaccines against cervical cancer

<table>
<thead>
<tr>
<th>Bivalent</th>
<th>Quadrivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>GlaxoSmithKline</td>
</tr>
<tr>
<td>HPV types included</td>
<td>16, 18</td>
</tr>
<tr>
<td>Dosing schedule</td>
<td>3-dose series: 0, 1 and 6 months</td>
</tr>
<tr>
<td>Duration of protection</td>
<td>5–6 years</td>
</tr>
</tbody>
</table>

BURDEN OF CERVICAL CANCER IN MOROCCO

- 2nd most common after breast cancer.
- Typically common in women above 30 years old.
- CC is responsible for 1978 new diagnosed cases and 1152 death case annually.
- Incidence rate among women aged 50 to 55 is 60 per 100,000 women per year (highest in the region).


**STUDY RATIONALE**

- Not incorporated into a publically funded vaccination program.
- 3 dose course = 4,500 Moroccan Dirhams
- Absence of EE studies

**Aim**

- Is quadrivalent vaccine a cost-effective intervention?

**Objective**

- To perform a cost-utility analysis of HPV vaccination against no vaccination in the context of Morocco.
Vaccination strategy vs. NO vaccination strategy

Action A = Vaccination strategy
Comparator B = No vaccination strategy ‘do-nothing’

Perspective: Healthcare system (Payer)
Analysis type: Health outcome expressed in QALYs
Comparator: No vaccination strategy
Model design: A life time Markov model
Time horizon: 73 years old
Population analysed: 10,000 hypothetical cohort of girls at the age of 12
MODEL ASSUMPTION

- HPV type specific model.
- Markov cycle = 1 year
- At fixed cycles, girls either move to another health state or remain where they are.
- Girls at the age of 12 receive full vaccination course - immunised after one year.
- Vaccine duration is a lifelong
- Vaccine coverage 100%

MODEL INPUTS

- Epidemiological parameters: Prevalence of HPV 16 and 18 in cervical cancer (Morocco specific).
- Vaccine efficacy: % reduction in HPV 16 & 18 persistent infections
- HRQoL parameters: Utilities
- Economic parameter: Direct medical costs
- Decision maker parameters: Discounting rate (3% WHO guideline)
- Transitional probabilities
### BASE CASE COST-EFFECTIVENESS RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Vaccination</th>
<th>No vaccination</th>
<th>Incremental outcomes (Vaccination – No vaccination)</th>
<th>ICER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undiscounted</td>
<td>$472,325,564</td>
<td>$908,876,710</td>
<td>$-436,551,146.15</td>
<td>-3145</td>
</tr>
<tr>
<td>Discounted</td>
<td>$161,341,111</td>
<td>$252,040,532</td>
<td>$-90,699,420.23</td>
<td></td>
</tr>
<tr>
<td><strong>Total QALYs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undiscounted</td>
<td>533,361</td>
<td>454,351</td>
<td>+7,8527</td>
<td></td>
</tr>
<tr>
<td>Discounted</td>
<td>263,713</td>
<td>234,874</td>
<td>+28,839</td>
<td></td>
</tr>
</tbody>
</table>

Vaccination dominates (lower costs and higher QALYs).

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### Average QALYs gained per woman?

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Total no. of women</th>
<th>Total QALYs</th>
<th>Average QALYs per woman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrivalent</td>
<td>10,000</td>
<td>263,713</td>
<td>26.37</td>
</tr>
<tr>
<td>No vaccine</td>
<td>10,000</td>
<td>234,874</td>
<td>23.49</td>
</tr>
</tbody>
</table>

The difference 2.88 represents the average QALYs gained per woman.

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![Graph showing QALYs](chart.png)
### Average cost saved per woman?

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Total no. of women</th>
<th>Total cost</th>
<th>Average cost per woman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrivalent</td>
<td>10,000</td>
<td>$161,341,111</td>
<td>$16,134.11</td>
</tr>
<tr>
<td>No vaccine</td>
<td>10,000</td>
<td>$252,040,532</td>
<td>$25,204.05</td>
</tr>
</tbody>
</table>

Positive-cost saving of $9,069 USD per woman

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### One-way sensitivity analysis

- Each parameter is varied once at a time.
- Top parameters with influential effect on ICER
- ICER robust, remained negative
Probabilistic sensitivity analysis
A scatter plot of the bootstrapped incremental costs and effect pairs were presented on the incremental cost-effectiveness plane.

STUDY LIMITATIONS
- Analysis perspective – Societal perspective?
- Efficacy of Gardasil – Genital warts excluded?
- Transition probabilities – HPV type-specific & age-specific
- Utilities – HPV type-specific & age-specific? local utilities?
- Heterogeneity – sexual behaviour not explored by the model
- Costs
- Model calibration & validation
- Vaccine coverage
- Booster
- Herd immunity
FUTURE RESEARCH

- Address the previously identified limitations
- Use Micro-simulation modelling
  - To assess health benefits associated with herd immunity.
  - To incorporate sexual behaviour
- To assess cost-effectiveness of Gardasil against bivalent vaccination strategy (Cervarix)
- Assessing inclusion of genital warts in analytical modelling
- Boys?

CONCLUSION

- WHO strongly recommends for countries to evaluate the cost-effectiveness of introducing a new vaccine into their national immunization programme before implementing it.
- This work is an attempt to analyze the economic and health benefits of introducing Gardasil®
- Gardasil represents good value for money compared with a ‘no vaccine’ strategy.
- However, further studies are needed
Thank you

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