Potential Impact of an RV144-like HIV Vaccine in Diverse Epidemic Settings

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RV144 trial

- Results published December 2009
- 16,402 participants in Thailand
- Vaccine regimen
  - ALVAC (weeks 0, 4, 12, 24)
  - AIDSVAX B/E (weeks 12, 24)
- Overall efficacy over 42 months
  - Intention to treat: **26.4%** (p=0.08)
  - Per-protocol: **26.2%** (p=0.16)
  - Modified ITT: **31.2%** (p=0.04)
- But trial data suggest that efficacy may decline over time...
Curve fit to RV144 trial data

\[ \text{Efficacy} = 0.78 e^{-0.06t} \]

HIV vaccine modeling consortium

- UNAIDS and CDC convened consortium in early 2010
- Invited independent groups of epidemiologists and mathematical modelers
- Research question:
  
  What is the impact of a modestly effective HIV vaccine with waning efficacy (similar to RV144) on the HIV epidemic?

- Presented preliminary results at AIDS Vaccine Conference in Atlanta (September 2010)
- Published special issue of Vaccine (August 2011)
Reference case

Modelers identified a clear reference case to facilitate model comparisons

- Single vaccination campaign with waning efficacy
- Vaccination of adult population: 30% or 60% coverage
- Modeled outcome: proportion of HIV infections averted over 10 years

Additional analyses (optional)

- Periodic booster vaccinations, assuming restoration of immunity
- Effect of behavioral risk compensation
- Cost-effectiveness

All other modeling assumptions and parameters were allowed to vary between groups
## Results summary
(10-year horizon; 60% vaccination coverage)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Setting</th>
<th>Baseline HIV Prevalence</th>
<th>HIV Infections Averted</th>
<th>With Boosters (frequency)</th>
<th>Vaccinations per Infection Averted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nagelkerke et al, Thailand</td>
<td>&lt;2% (all)</td>
<td>14%</td>
<td>58% (1y)</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Schneider et al, Thailand</td>
<td>1% (all)</td>
<td>7%</td>
<td>25% (2y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25% (MSM)</td>
<td></td>
<td>38% (1y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andersson and Stover, Thailand</td>
<td>1.4% (all)</td>
<td>10%</td>
<td>35% (1.4y)</td>
<td>1725 (all)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>220 (high-risk)</td>
<td></td>
</tr>
</tbody>
</table>
HIV infections prevented
(10-year horizon)

- 0%
- 2%
- 4%
- 6%
- 8%
- 10%
- 12%
- 14%

30% coverage
60% coverage

Thailand (i)
Thailand (ii)
Thailand (iii)
South Africa (iii)
Soweto, South Africa (iv)
United States (vi)
KwaZulu-Natal, South Africa (vii)
New South Wales, Australia (vii)
Impact of periodic boosters
(10-year horizon; assuming full restoration of immunity)

HIV infections prevented

<table>
<thead>
<tr>
<th>Country</th>
<th>One-time vaccination</th>
<th>5-year boosters</th>
<th>2-year boosters</th>
<th>1-year boosters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soweto, South Africa</td>
<td>5%</td>
<td>30%</td>
<td>35%</td>
<td>25%</td>
</tr>
<tr>
<td>United States</td>
<td>10%</td>
<td>30%</td>
<td>35%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Lessons learned (1)

- Model-based analyses were broadly consistent, despite widely different assumptions.
  - A single vaccination campaign reaching 60% of adults averts approximately **10%** of new HIV cases.

- If effective, periodic booster vaccinations substantially improve infections averted.
  - Bi- or tri-annual boosters prevent **20-27%** of cases.
  - Annual boosters prevent **35-58%** of cases.

- Prioritization to groups at higher risk of HIV improves program efficiency.
  - Can prevent **80%** as many infections, with 10% of required vaccinations, compared to universal adult vaccination.
Lessons learned (2)

- Vaccination with partially effective HIV vaccines can be cost-effective.
  - At $100 per regimen, vaccination in South Africa costs $2,700/case averted, or $10,000/life-year gained.
  - At $500 per regimen, vaccination in USA costs <$100,000/QALY gained.

- Behavioral risk compensation post-vaccination does not eliminate vaccination benefits.

- Rate of efficacy decline affects short- and long-term epidemic outcomes.
Key remaining questions

- What is the rate of efficacy decline and duration of protection?
- How does efficacy differ among individuals at higher risk of HIV infection?
- What is the role of a vaccine in a portfolio of interventions?
- What is the immunological impact of vaccine boosters?
- Is there evidence of behavioral risk compensation post-vaccination?
Related posters

Abstract **WEPE-654**
Elisa Long et al.
*A model-based consensus on the impact of an RV144-like HIV vaccine in diverse epidemic settings*

Abstract **TUPE-179**
Katharine Kripke and Matthew Hamilton
*Differing models, same results: testing the consistency of seven HIV vaccine impact models across seven populations*
Acknowledgments

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