Impact of school-entry requirements on adolescent vaccination coverage, timeliness, & seasonal variation

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Disclosures

- JLM, YKT, and BKR have no potential conflicts to report.
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- NTB has served on paid advisory boards or received research grants from Merck, GSK, and FDA, and now serves as chair of the CDC-funded National HPV Vaccination Roundtable.

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- The opinions expressed are the author’s own and do not reflect the view of the National Institutes of Health, the Department of Health and Human Services, or the United States government.
Human papillomavirus (HPV) and vaccine

- Most common sexually transmitted infection in the US
- High disease burden
  - Genital warts
  - Anogenital cancers
- Three, 3-dose HPV vaccines available
  - Recommended for routine use in all 11-12 year old adolescents
- Suboptimal rates of uptake
  - Girls: 60% (initiation, 2014)
  - Boys: 42% (initiation, 2014)

Source: CDC, 2016; Chesson, 2012
Adolescent vaccination coverage

Revised APD* definition

- ≥1 Tdap
- ≥1 MenACWY
- ≥1 HPV (F)
- ≥1 HPV (M)

Source: CDC, 2016
State variation in adolescent vaccination coverage (2014)

<table>
<thead>
<tr>
<th></th>
<th>Tdap</th>
<th>MenACWY</th>
<th>HPV 1 (girls)</th>
<th>HPV 1 (boys)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>88%</td>
<td>79%</td>
<td>60%</td>
<td>42%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Lowest</strong></td>
<td>71% (ID)</td>
<td>46% (MS)</td>
<td>38% (KS)</td>
<td>23% (IN)</td>
</tr>
<tr>
<td><strong>Highest</strong></td>
<td>95% (CT)</td>
<td>95% (PA)</td>
<td>76% (RI)</td>
<td>69% (RI)</td>
</tr>
</tbody>
</table>

- **Highest** to **Lowest** ratios:
  - Tdap: 1.3x
  - MenACWY: 2.1x
  - HPV 1 (girls): 2.0x
  - HPV 1 (boys): 3.0x
School-entry requirements for vaccination

Tetanus, Diphtheria, Pertussis Mandates for Secondary Schools
February 2016

Type of Requirements
- Tdap
- No Td or Tdap requirement

Source: Immunize.org
School-entry requirements for vaccination

Meningococcal Prevention Mandates for Elementary and Secondary Schools
February 2016

Source: Immunize.org
School-entry requirements for vaccination

**Human papillomavirus (HPV) Mandates for Children in Secondary Schools**

February 2016

Source: Immunize.org
Methods

- Separately for Tdap booster, MenACWY, and HPV vaccine (1\textsuperscript{st} dose, girls), examined yearly (2007-2012)...

- Independent variables:
  - State policies requiring each vaccine

- Dependent variables:
  1. Vaccination coverage (% of 13-17 year olds vaccinated)
  2. Timeliness (% vaccinated by age 13)
  3. Summer peaks (% doses administered in June-August)

- Analysis: ecological, longitudinal, weighted multivariable regression
Results: States’ policies and vaccination patterns

Range of values over study period

<table>
<thead>
<tr>
<th></th>
<th>Tdap booster</th>
<th>MenACWY</th>
<th>HPV vaccine ♀</th>
</tr>
</thead>
<tbody>
<tr>
<td>School-entry requirements (n), 2007-2012</td>
<td>7-42</td>
<td>0-14</td>
<td>0-2</td>
</tr>
<tr>
<td>Vaccination coverage (%), 2008-2012</td>
<td>41-85%</td>
<td>42-74%</td>
<td>37-54%</td>
</tr>
<tr>
<td>Timeliness (%), 2008-2012</td>
<td>9-67%</td>
<td>10-57%</td>
<td>11-41%</td>
</tr>
<tr>
<td>Summer peaks (%), 2008-2011</td>
<td>43-61%</td>
<td>44-62%</td>
<td>39-63%</td>
</tr>
</tbody>
</table>
Results: School-entry requirements and coverage

- Tdap booster: +22% *
- MenACWY: +24% *
- HPV vaccine: +<1% *

*p<.05

% adolescents vaccinated

- Without policy
- With policy

(NATIONAL CANCER INSTITUTE
Cancer Prevention Fellowship Program)
Results: School-entry requirements and **timeliness**

- **Tdap booster**: +25% *p<.05
- **MenACWY**: +27% *p<.05
- **HPV vaccine**: +4%
Results: School-entry requirements and summer peaks

- Tdap booster: +5% * (p<.05)
- MenACWY: +6% *
- HPV vaccine: +25% *

% doses administered June-Aug

Without policy
With policy

*p<.05
Results: Spillover effects of school-entry requirements

<table>
<thead>
<tr>
<th>HPV vaccination coverage by states’ policies about other adolescent vaccines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tdap booster policies</td>
</tr>
<tr>
<td>Without</td>
</tr>
<tr>
<td>With</td>
</tr>
<tr>
<td>+8%*</td>
</tr>
<tr>
<td>MenACWY policies</td>
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<tr>
<td>Without</td>
</tr>
<tr>
<td>With</td>
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<tr>
<td>+4%*</td>
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Remember, HPV vaccine policies associated with <1% increase in HPV vaccination coverage.

*p<.05
Results: School-entry requirements and concomitant vax

- Tdap + HPV:
  - Without policy: 10%
  - With policy: 24%
  - Increase: +4%
  - *p < 0.05

- MenACWY + HPV:
  - Without policy: 20%
  - With policy: 24%
  - Increase: +4%
  - *p < 0.05
Discussion

- School-entry requirements associated with increases in coverage for targeted vaccines
  - Differences in timeliness and summer peaks supports causal inference
  - Lack of randomization
- Tdap booster and MenACWY requirements had spillover associations with HPV vaccination coverage
  - Larger effect sizes than HPV vaccine requirements
  - Potentially through concomitant vaccination
Implications

Whether or not mandatory vaccination will prevent cervical cancer in prepubescent girls, as a cash transfusion it'll do wonders for our bottom line.

Not the old sacrifice—young virgins to appease the god—mercy trick again.

Donor ($300. A top)

Merck Inc.

YMMV Corp. Watch Org
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Methods: Independent variables

- States’ school-entry requirements (2007 to 2012) for uptake of
  - Tdap booster
  - MenACWY
  - HPV vaccine
- Source: Immunize.org and state health department websites
Methods: Analysis

- Longitudinal, weighted multivariable regressions

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<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
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<td>Other reqs.</td>
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<tr>
<td>Summer peaks</td>
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State variation in HPV vaccination coverage

1+ dose HPV vaccine (girls, 13-17), NIS-Teen 2014

- Kansas: 38%
- Rhode Island: 76%
- Tennessee: 20%
- DC: 57%