

# Uptake of 2009 H1N1 vaccine among adolescent females

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**Key words:** influenza, vaccination, pandemic, H1N1, adolescents, infectious disease, health behavior

**Abbreviations:** HPV, human papillomavirus; MSA, metropolitan statistical area; SD, standard deviation; OR, odds ratio; CI, confidence interval; ref, referent group

**Background:** The public health response to the threat of pandemic influenza A (H1N1) virus during the 2009–2010 influenza season was extensive. To better understand the lower than expected vaccine uptake, we aimed to characterize correlates of 2009 H1N1 vaccination among adolescent females in the US and examine accessibility of the vaccine to parents.

**Results:** Overall, 22% (221/944) of mothers indicated their daughters had received 2009 H1N1 vaccine. H1N1 vaccination was higher among daughters who had received 2009 seasonal influenza vaccine (49% vs. 11%, OR = 7.00, 95% CI: 4.18–11.73) or whose mothers expressed higher trust in their daughters' healthcare providers (26% vs. 11%, OR = 2.28, 95% CI: 1.10–4.73). Among mothers of unvaccinated daughters, 20% (150/723) indicated they wanted to get their daughters 2009 H1N1 vaccine but were unable to. Vaccination among daughters and accessibility of the vaccine to parents did not differ by race, socioeconomic status or health insurance status.

**Discussion:** One explanation for the lower than expected uptake of 2009 H1N1 vaccine is that many parents were unable to get their daughters the vaccine despite wanting to do so. Concomitant administration with seasonal influenza vaccine may increase uptake of novel influenza vaccines.

**Methods:** We collected data from a national sample of mothers of adolescent females ages 11–14 years (n = 944) during December 2009 using an online survey.

Epidemiologic evaluation found that influenza-associated pediatric hospitalization and mortality rates were higher during the 2009–2010 influenza season than in other recent influenza seasons, mostly due to infection with influenza A (H1N1) virus.<sup>1</sup> Public health officials identified children and adolescents six-months to 24 years old as one of five priority groups for receiving doses of 2009 influenza A (H1N1) monovalent vaccination when they first became available in the US.<sup>2</sup> Examination of vaccination behavior in the setting of the extensive public health response to pandemic 2009–2010 H1N1 influenza provides useful information for understanding how people might respond during future influenza pandemics.

Most research on intentions to get 2009 H1N1 vaccine, use of the vaccine or other H1N1 protective behaviors has focused on healthcare workers or other adult populations.<sup>3–7</sup> Few studies have examined these topics among children or adolescents. Of the little research done, results indicated that about 60% of parents intended to get their children 2009 H1N1 vaccine,<sup>8,9</sup> though a national assessment found only 28% of children ages 5–18 years had actually been vaccinated.<sup>10</sup>

Correlates of vaccination and potential explanations for lower than expected 2009 H1N1 vaccine uptake among adolescents

have not been well examined. For example, it is not clear how many additional parents wanted the vaccine for their children but were unable to get it. In past influenza seasons with a limited supply of vaccine available, many people attempted to get vaccinated but were not successful in doing so.<sup>11</sup> We aimed to characterize correlates of 2009 H1N1 vaccination among adolescent females ages 11–14 years in the US and examine accessibility of the vaccine to their parents.

In December 2009, we interviewed a national sample of mothers of adolescent females ages 11–14 years who were members of an existing national panel of US households maintained by an online survey company.<sup>12</sup> The survey company composed the panel using a dual frame approach combining list-assisted, random-digit dialing and address-based sample frames, which provided a probability-based sample of US households.<sup>13</sup> Households containing at least one panel member receive free Internet access in exchange for panel members completing multiple Internet-based surveys each month. In households with existing computer and Internet access, panel members accumulate points for completing surveys that can later be redeemed for small cash payments. Our survey focused primarily on mother-daughter communication about human papillomavirus

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(HPV) vaccine, but it also examined 2009 H1N1 vaccination, the focus of this report.

The survey company invited 1,681 mothers to complete our cross-sectional, online survey. Among those mothers, 1,009 responded to the invitation and had a daughter ages 11–14 years, making them eligible to participate in the study (511 never responded to the invitation and 161 responded but did not have a daughter ages 11–14 years). A total of 951 mothers (response rate = 66%),<sup>14</sup> provided informed consent and completed a survey. Compared with participants, non-participants were less likely to have a college degree. Participants and non-participants did not differ on other demographic factors. As seven mothers did not provide H1N1 vaccination information about their daughters, we report data from 944 mothers. The Institutional Review Board at the University of North Carolina approved the study.

The survey item assessing 2009 H1N1 vaccination read, “This year, you may have heard about a type of the flu called H1N1, also known as Swine Flu. This is not the seasonal flu. Has [daughter’s name] received H1N1 flu vaccine?” Mothers who indicated their daughters had not received H1N1 vaccine were then asked, “Did you want to get [daughter’s name] H1N1 flu vaccine but were unable to?” We included this item to examine accessibility of 2009 H1N1 vaccine to parents. The survey assessed seasonal influenza vaccination using the item, “Each fall a seasonal influenza or flu vaccine becomes available. It can be given as a shot injected into the arm or as a mist that is sprayed in the nose (also called FluMist). This is not the H1N1 or Swine Flu vaccine. Has [daughter’s name] received a seasonal flu vaccine this flu season (since this summer)?” The survey also collected information on various characteristics of the mothers, daughters and their households (Table 1). We defined “urban” as living in a metropolitan statistical area (MSA) and “rural” as living outside of an MSA.<sup>15</sup>

We used logistic regression to identify correlates of 2009 H1N1 vaccination, entering all variables associated ( $p < 0.10$ ) in bivariate analyses into a multivariate model. The same method was used to identify correlates of accessibility of 2009 H1N1 vaccine to parents. Analyses using Intercooled Stata Version 10.1 (College Station, TX) applied sampling weights<sup>16</sup> to account for the study design. Percentages are weighted and frequencies are unweighted.

Most mothers were age 40 or older (57%), non-Hispanic white (63%), married or living with a partner (89%), did not have a college degree (70%), reported a household income of at least \$60,000 (52%) and lived in urban areas (82%). The daughters’ mean age was 12.5 years (standard deviation [SD] = 1.2). Although most mothers indicated their daughters had health insurance (93%) and a preventive care visit in the last year (74%), only 28% reported their daughters had received 2009 seasonal influenza vaccine.

Overall, 22% (221/944) of mothers indicated their daughters had received 2009 H1N1 vaccine (Table 1). In adjusted analyses, H1N1 vaccination was higher among daughters who had received 2009 seasonal influenza vaccine than those who had not (49% vs. 11%, odds ratio [OR] = 7.00, 95% confidence interval [CI]: 4.18–11.73). Mothers who expressed higher trust in their

daughters’ healthcare providers were also more likely to report H1N1 vaccination among their daughters (26% vs. 11%, OR = 2.28, 95% CI: 1.10–4.73).

Among mothers whose daughters had not been vaccinated, 20% (150/723) indicated they wanted to get their daughters 2009 H1N1 vaccine but were unable to (Table 2). In adjusted analyses, mothers whose daughters had received 2009 seasonal influenza vaccine were more likely to report they wanted to get their daughters H1N1 vaccine but were unable to (34% vs. 17%, OR = 2.75, 95% CI: 1.48–5.11). Mothers from the northeast region of the US, were less likely than mothers from the west to report they wanted to get their daughters H1N1 vaccine but were unable to (15% vs. 27%, OR = 0.46, 95% CI: 0.21–0.99).

Less than a quarter of mothers in this national sample indicated their adolescent daughters (ages 11–14 years) had received 2009 H1N1 vaccine by December 2009, an estimate similar to another national study.<sup>10</sup> A novel finding is that 20% of mothers of unvaccinated daughters indicated they wanted to get them the vaccine but were unable to, highlighting the potential difficulty some individuals encountered in obtaining 2009 H1N1 vaccine during the fall of 2009. In other words, vaccination levels might have almost doubled if 2009 H1N1 vaccine had been more readily available during this time. These parents may have had later opportunities to vaccinate their children, as 2009 H1N1 vaccine became more readily available by early 2010. However, even if these mothers had all been able to obtain 2009 H1N1 vaccine for their daughters, vaccination levels would have still been lower than expected based on previous estimates of parents’ intent to get their children H1N1 vaccine (about 60%).<sup>8,9</sup>

Daughters’ receipt of seasonal influenza vaccine was a strong correlate of 2009 H1N1 vaccination, comparable to findings among adults.<sup>6</sup> Similar to past influenza seasons,<sup>17</sup> less than 30% of daughters had received seasonal influenza vaccine, despite recommendations that children and adolescents should receive an annual influenza vaccine.<sup>18</sup> Furthermore, less than half of daughters who received 2009 seasonal influenza vaccine also received 2009 H1N1 vaccine, though some parents may not have been able to get their daughters 2009 H1N1 vaccine due to vaccine unavailability. Taken together, our results suggest that seasonal influenza vaccination continues to be suboptimal among adolescents and missed opportunities for H1N1 vaccination occurred during provider visits for seasonal influenza vaccine. At the time, inactivated seasonal and H1N1 vaccines could be given during the same visit if different anatomic sites were used.<sup>2</sup> While the 2010–2011 seasonal influenza vaccine includes the 2009 H1N1 virus,<sup>19</sup> concomitant administration is a vaccine delivery strategy that may help maximize vaccine coverage in future situations where multiple influenza vaccines are recommended.

Mothers whose daughters had received seasonal influenza vaccine were also more likely to report they wanted to get their daughters 2009 H1N1 vaccine but were unable to. This finding is likely due to these mothers seeking H1N1 vaccination for their daughters more frequently than mothers whose daughters had not received seasonal influenza vaccine, possibly at the same time. Although H1N1 vaccination levels were low in general, it is encouraging that vaccination or accessibility of the vaccine to

**Table 1.** 2009 H1N1 influenza vaccination among adolescent females in the US (n = 944)

|  | No. mothers reporting daughters had received 2009 H1N1 vaccine/ total no. in category (weighted %) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
|--|--|------------------------|----------------------|
| <b>Total</b>   | 221/944 (22)   | --                     | --                   |
| <b>Daughter Characteristics</b>  |  |                        |                      |
| <b>Age (Years)</b>   |  |                        |                      |
| 11   | 68/252 (18)  | ref.                   | --                   |
| 12   | 38/195 (20)  | 1.08 (0.55–2.15)       | --                   |
| 13   | 62/241 (27)  | 1.62 (0.91–2.87)       | --                   |
| 14   | 53/256 (25)  | 1.43 (0.77–2.68)       | --                   |
| <b>Type of Healthcare Provider Daughter Sees Most Often</b>                                      |  |                        |                      |
| Other  | 60/339 (20)  | ref.                   | --                   |
| Pediatrician   | 161/605 (24)   | 1.24 (0.73–2.10)       | --                   |
| <b>Had a Preventive Care Visit in Last Year</b>  |  |                        |                      |
| No   | 41/259 (15)  | ref.                   | ref.                 |
| Yes  | 180/685 (25)   | 1.92 (1.13–3.26)*      | 1.18 (0.66–2.13)     |
| <b>Health Insurance Coverage</b>   |  |                        |                      |
| No   | 8/42 (20)  | ref.                   | --                   |
| Yes  | 213/902 (22)   | 1.13 (0.34–3.74)       | --                   |
| <b>Received Seasonal Influenza Vaccine (since August 2009)</b>                                   |  |                        |                      |
| No   | 84/665 (11)  | ref.                   | ref.                 |
| Yes  | 137/279 (49)   | 7.59 (4.57–12.61)**    | 7.00 (4.18–11.73)**  |
| <b>Mother Characteristics</b>  |  |                        |                      |
| <b>Age (Years)</b>   |  |                        |                      |
| <40  | 60/302 (22)  | 1.14 (0.59–2.18)       | --                   |
| 40–49  | 126/509 (24)   | 1.28 (0.72–2.27)       | --                   |
| 50+  | 35/133 (19)  | ref.                   | --                   |
| <b>Race/Ethnicity</b>  |  |                        |                      |
| White, Non-Hispanic  | 173/714 (21)   | ref.                   | --                   |
| African American, Non-Hispanic   | 15/86 (26)   | 1.34 (0.61–2.94)       | --                   |
| Other Race, Non-Hispanic   | 16/59 (23)   | 1.17 (0.48–2.84)       | --                   |
| Hispanic   | 17/85 (24)   | 1.22 (0.50–2.95)       | --                   |
| <b>Marital Status</b>  |  |                        |                      |
| Divorced, Widowed, Separated, Never Married  | 31/147 (20)  | ref.                   | --                   |
| Married or Living with Partner   | 190/797 (23)   | 1.14 (0.58–2.24)       | --                   |
| <b>Education Level</b>   |  |                        |                      |
| No College Degree  | 111/486 (23)   | ref.                   | --                   |
| College Degree   | 110/458 (22)   | 0.95 (0.63–1.42)       | --                   |
| <b>Satisfied with Quality of Healthcare Daughter Receives</b>                                    |  |                        |                      |
| Very Dissatisfied/Somewhat Dissatisfied/ Neutral   | 12/65 (11)   | ref.                   | ref.                 |
| Very Satisfied/Somewhat Satisfied  | 209/879 (23)   | 2.57 (1.10–5.99)*      | 0.93 (0.39–2.23)     |
| <b>Trusts Daughter's Healthcare Provider So Much that Always Try To Follow His or Her Advice</b> |  |                        |                      |
| Strongly Disagree/Somewhat Disagree/ Neutral   | 33/182 (11)  | ref.                   | ref.                 |
| Strongly Agree/Somewhat Agree  | 188/762 (26)   | 2.87 (1.46–5.63)*      | 2.28 (1.10–4.73)*    |
| <b>Household Characteristics</b>   |  |                        |                      |
| <b>Household Income</b>  |  |                        |                      |
| <\$60,000  | 75/343 (24)  | ref.                   | --                   |

Note: The adjusted model did not include variables with dashes (--). OR, odds ratio; CI, confidence interval; ref., referent group. \*p < 0.05, \*\*p < 0.001.

**Table 1 continued.** 2009 H1N1 influenza vaccination among adolescent females in the U.S. (n = 944)

|                            |              |                  |    |
|----------------------------|--------------|------------------|----|
| ≥\$60,000                  | 146/601 (21) | 0.86 (0.53–1.38) | -- |
| <b>Urbanicity</b>          |              |                  |    |
| Rural                      | 28/132 (26)  | ref.             | -- |
| Urban                      | 193/812 (21) | 0.77 (0.39–1.54) | -- |
| <b>Region of Residence</b> |              |                  |    |
| West                       | 43/229 (17)  | ref.             | -- |
| South                      | 61/269 (26)  | 1.70 (0.86–3.37) | -- |
| Midwest                    | 72/290 (21)  | 1.34 (0.71–2.53) | -- |
| Northeast                  | 45/156 (23)  | 1.51 (0.78–2.95) | -- |

Note: The adjusted model did not include variables with dashes (--). OR, odds ratio, CI, confidence interval, ref., referent group. \*p < 0.05, \*\*p < 0.001.

parents did not differ by race, socioeconomic status or health insurance status.

Healthcare providers appear to play a central role in H1N1 vaccination, as mothers' trust of their daughters' healthcare providers was correlated with vaccination. Parents' trust in the healthcare system has been shown to be an influential determinant of childhood vaccination.<sup>20</sup> This factor may become increasingly important as controversies surrounding childhood and adolescent vaccination persist.

Study strengths include data on a rapidly emergent public health threat from a national sample, as well as focusing on one of the five priority groups for 2009 H1N1 vaccination. Study limitations include data collection occurring relatively early in the influenza season and reliance on mothers' reports of vaccination, though parents tend to accurately recall their children's influenza vaccination status.<sup>21</sup> We did not collect information regarding why some mothers were unsuccessful in getting their daughters 2009 H1N1 vaccine. Our sample included only mothers of adolescent females ages 11–14 years, and the generalizability of our findings is not known.

Our results provide important insights into 2009 H1N1 vaccine coverage among adolescents in the US. If previous estimates of parents' vaccination intentions are applied to our study,<sup>8,9</sup> it appears that only about one in three parents who intended to get their children 2009 H1N1 vaccine actually did so. Lack of

vaccine availability likely explains a substantial portion of the shortfall. Incorporation of the 2009 H1N1 virus into the 2010–2011 seasonal influenza vaccine will almost certainly increase protection against H1N1 during the upcoming influenza season. However, as new vaccine-preventable agents emerge, it will be important to understand past reasons for low vaccine uptake to anticipate future public health challenges.

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**Table 2.** Accessibility of 2009 H1N1 vaccine to parents of unvaccinated daughters in the US (n = 723)

|   | No. mothers reporting they wanted to get their daughters H1N1 vaccine but were not able to/total no. in category (weighted %) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
|---|---|------------------------|----------------------|
| <b>Total</b>  | 150/723 (20)  | --                     | --                   |
| <b>Daughter Characteristics</b>                             |   |                        |                      |
| <b>Age (Years)</b>  |   |                        |                      |
| 11  | 44/184 (24)   | ref.                   | --                   |
| 12  | 30/157 (19)   | 0.77 (0.34–1.76)       | --                   |
| 13  | 32/179 (15)   | 0.58 (0.28–1.22)       | --                   |
| 14  | 44/203 (20)   | 0.82 (0.39–1.75)       | --                   |
| <b>Type of Healthcare Provider Daughter Sees Most Often</b> |   |                        |                      |

Note: The adjusted model did not include variables with dashes (--). OR, odds ratio; CI, confidence interval; ref., referent group. \*p < 0.05, †p < 0.10.

**Table 2.** Accessibility of 2009 H1N1 vaccine to parents of unvaccinated daughters in the US (n = 723) (continued)

|  |              |                               |                               |
|--|--------------|-------------------------------|-------------------------------|
| Other  | 51/279 (21)  | ref.                          | --                            |
| Pediatrician   | 99/444 (20)  | 0.94 (0.52–1.68)              | --                            |
| <b>Had a Preventive Care Visit in Last Year</b>  |              |                               |                               |
| No   | 40/218 (24)  | ref.                          | --                            |
| Yes  | 110/505 (19) | 0.74 (0.39–1.41)              | --                            |
| <b>Health Insurance Coverage</b>   |              |                               |                               |
| No   | 9/34 (12)    | ref.                          | --                            |
| Yes  | 141/689 (21) | 1.85 (0.67–5.11)              | --                            |
| <b>Received Seasonal Influenza Vaccine (since August 2009)</b>                                   |              |                               |                               |
| No   | 91/581 (17)  | ref.                          | ref.                          |
| Yes  | 59/142 (34)  | 2.59 (1.37–4.87)*             | 2.75 (1.48–5.11)*             |
| <b>Mother Characteristics</b>  |              |                               |                               |
| <b>Age (Years)</b>   |              |                               |                               |
| <40  | 41/242 (17)  | 0.56 (0.23–1.37)              | --                            |
| 40–49  | 86/383 (21)  | 0.70 (0.30–1.60)              | --                            |
| 50+  | 23/98 (27)   | ref.                          | --                            |
| <b>Race/Ethnicity</b>  |              |                               |                               |
| White, Non-Hispanic  | 108/541 (18) | ref.                          | --                            |
| African American, Non-Hispanic   | 14/71 (24)   | 1.41 (0.60–3.28)              | --                            |
| Other Race, Non-Hispanic   | 12/43 (21)   | 1.17 (0.43–3.20)              | --                            |
| Hispanic   | 16/68 (24)   | 1.40 (0.53–3.70)              | --                            |
| <b>Marital Status</b>  |              |                               |                               |
| Divorced, Widowed, Separated, Never Married  | 26/116 (26)  | ref.                          | --                            |
| Married or Living with Partner   | 124/607 (19) | 0.65 (0.31–1.36)              | --                            |
| <b>Education Level</b>   |              |                               |                               |
| No College Degree  | 77/375 (20)  | ref.                          | --                            |
| College Degree   | 73/348 (20)  | 1.03 (0.62–1.70)              | --                            |
| <b>Satisfied with Quality of Healthcare Daughter Receives</b>                                    |              |                               |                               |
| Very Dissatisfied/Somewhat Dissatisfied/Neutral  | 10/53 (35)   | ref.                          | --                            |
| Very Satisfied/Somewhat Satisfied  | 140/670 (18) | 0.43 (0.15–1.24)              | --                            |
| <b>Trusts Daughter's Healthcare Provider So Much that Always Try To Follow His or Her Advice</b> |              |                               |                               |
| Strongly Disagree/Somewhat Disagree/Neutral  | 24/149 (18)  | ref.                          | --                            |
| Strongly Agree/Somewhat Agree  | 126/574 (21) | 1.20 (0.56–2.56)              | --                            |
| <b>Household Characteristics</b>   |              |                               |                               |
| <b>Household Income</b>  |              |                               |                               |
| <\$60,000  | 48/268 (22)  | ref.                          | --                            |
| ≥\$60,000  | 102/455 (18) | 0.77 (0.44–1.34)              | --                            |
| <b>Urbanicity</b>  |              |                               |                               |
| Rural  | 15/104 (13)  | ref.                          | --                            |
| Urban  | 135/619 (21) | 1.81 (0.86–3.77)              | --                            |
| <b>Region of Residence</b>   |              |                               |                               |
| West   | 48/186 (27)  | ref.                          | ref.                          |
| South  | 34/208 (17)  | 0.56 (0.27–1.18)              | 0.50 (0.23–1.09) <sup>†</sup> |
| Midwest  | 44/218 (20)  | 0.66 (0.31–1.41)              | 0.63 (0.29–1.33)              |
| Northeast  | 24/111 (15)  | 0.48 (0.23–1.02) <sup>†</sup> | 0.46 (0.21–0.99)*             |

Note: The adjusted model did not include variables with dashes (--). OR, odds ratio; CI, confidence interval; ref., referent group. \*p < 0.05, <sup>†</sup>p < 0.10.

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