Vaccination with inactivated influenza virus has been a cornerstone of efforts to reduce the burden of disease due to influenza for many years. However, live attenuated influenza vaccines targeted to strains of influenza A (monovalent H1N1 or H3N2 or bivalent H1N1/H3N2 vaccines), influenza B (monovalent vaccines), or both (trivalent H1N1/H3N2/B vaccines) have also been extensively evaluated as an attractive method to prevent influenza infection. In 2003, the trivalent vaccine FluMist (MedImmune Vaccines, Inc., Gaithersburg, MD) became the first live attenuated influenza vaccine approved for use in the United States. Administered intranasally, the trivalent live attenuated influenza vaccine has been shown to be efficacious against influenza infection, leading to a reduction in the incidence of culture-confirmed influenza in children and a decrease in febrile upper respiratory tract episodes and days of work lost due to illness in adults.

However, one concern with the use of the live attenuated influenza vaccines has been the potential risk of secondary transmission of the vaccine virus from recent vaccinees to non-immune, high-risk individuals. As a result, FluMist was not recommended for use in immunocompromised individuals and vaccine recipients were strongly advised to avoid close contact with immunocompromised individuals for at least 21 days after vaccination. Due to this advisory, some hospitals furloughed employees who had been vaccinated with live attenuated influenza vaccine from direct patient care duties for several weeks.

Specific data regarding mucosal shedding of vaccine virus following intranasal administration of live attenuated influenza vaccine are limited. Studies in children noted that vaccinees could shed vaccine virus for up to 21 days after vaccination, but data from adults suggested the degree and duration of shedding was substantially lower. Thus, we conducted a prospective study of mucosal shedding of vaccine virus at various intervals in adults following vaccination.

ABSTRACT

OBJECTIVE: To characterize the probability and duration of viral shedding among adults given trivalent live attenuated influenza vaccine (LAIV).

DESIGN: Prospective surveillance study.

METHODS: Nasal wash samples were collected from adult volunteers at baseline and on days 3, 7, 10 and 10 through 21 following intranasal LAIV vaccination. The presence, titer, and identification of each specific strain of influenza virus shed were determined by standard methodology.

RESULTS: Twenty subjects received LAIV. No samples were positive for influenza virus at baseline. After LAIV vaccination, influenza virus was recovered from 10 of 20 vaccinees on day 3, from 1 of 18 vaccinees on day 7, and from none of the samples on days 10 or 17 through 21. Vaccinees who shed vaccine virus were significantly younger than those who did not (mean age, 26.4 vs 38.6 years; P < .01). Although the presence of specific mucosal immunoglobulin A to influenza B was associated with significantly less shedding of influenza B after vaccination (P = .02), associations of shedding with other measures of immunity were not detected.

CONCLUSION: The duration of shedding of vaccine virus after LAIV in adults is limited and may be associated with an individual’s prior influenza vaccination history (Infect Control Hosp Epidemiol 2005;26:494-500).
TABLE 1
RECOVERY OF INFLUENZA VIRUS FROM NASAL WASH SPECIMENS IN ADULTS FOLLOWING INTRANASAL VACCINATION WITH THE TRIVALENT LIVE ATTENUATED INFLUENZA VACCINE

<table>
<thead>
<tr>
<th>Post-Vaccination Day</th>
<th>No. of Subjects Tested</th>
<th>No. of Specimens Positive</th>
<th>Proportion of Subjects With Shedding</th>
<th>Exact CI&lt;sub&gt;95&lt;/sub&gt;</th>
<th>Influenza Strain(s) Shed (No. of Subjects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
<td>0</td>
<td>0%</td>
<td>0–16.8%</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>10</td>
<td>50%</td>
<td>27.2–72.8%</td>
<td>A H1N1 alone (1), A H3N2 alone (1), both A strains (1), B alone (6), all three strains (1)</td>
</tr>
<tr>
<td>7</td>
<td>18</td>
<td>1</td>
<td>5.5%</td>
<td>0.1–27.3%</td>
<td>B (1)</td>
</tr>
<tr>
<td>10</td>
<td>19</td>
<td>0</td>
<td>0%</td>
<td>0–17.6%</td>
<td>None</td>
</tr>
<tr>
<td>17–21</td>
<td>20</td>
<td>0</td>
<td>0%</td>
<td>0–16.8%</td>
<td>None</td>
</tr>
</tbody>
</table>

CI<sub>95</sub> = 95% confidence interval.

**METHODS**

**Study Subjects**

Healthy adults 18 to 49 years old were recruited for this study. Individuals with a current or past history of egg or egg product allergy, allergic reactions to prior influenza vaccinations, immunodeficiency due to underlying conditions or medications, a previous history of Guillain–Barré syndrome, or any medical or psychiatric condition that precluded their compliance were excluded. Individuals with an acute respiratory tract infection or immunocompromised household contacts were also excluded. This study was reviewed and approved by the Vanderbilt University Institutional Review Board. All subjects provided written informed consent.

**Vaccination**

All enrolled subjects were vaccinated with trivalent live attenuated influenza vaccine (FluMist), administered intranasally (0.25 mL in each nostril). Each 0.5-mL total dose was formulated to contain $10^{6.5–7.5}$ 50% tissue culture infectious doses (TCID<sub>50</sub>) of each of the live attenuated influenza vaccine reassortants of the influenza strains recommended by the U.S. Public Health Service for the 2003–2004 season: A/New Caledonia/20/99 (H1N1), A/Panama/2007/99 (H3N2) (A/Moscow/10/00-like), and B/Hong Kong/330/2001.

**Patient Follow-Up and Specimen Collection**

Subjects were observed during scheduled clinic visits on days 3, 7, and 10 and between days 17 and 21 after vaccination. At each visit, subjects were assessed for history of symptoms (including headache, sore throat, rhinorrhea, myalgias, fatigue, cough, or fever). Nasal wash specimens were collected from each subject immediately prior to vaccination and at each visit after vaccination. Specifically, 15 mL of lactated Ringer’s solution was instilled into one nostril using a bulb syringe, and the resulting nasal wash was collected from the opposite nostril. The specimens were then inoculated into two tissue culture tubes containing rhesus monkey kidney cells. After incubation at room temperature for 1 hour to allow for virus adsorption, the cultures were incubated in serum-free Eagle/199 medium (Invitrogen, Carlsbad, CA) supplemented with antibiotics. Cultures were read at regular intervals for cytopathic effect. On days 5 and 10 following inoculation, the rhesus monkey kidney cells were hemadsorbed with 0.1% guinea pig red blood cells in phosphate-buffered saline.

Specimens were considered positive for influenza if they exhibited the presence of cytopathic effect or hemadsorption. Positive specimens were initially characterized as influenza A or B using indirect immunofluorescent assay analysis. Positive tissue culture harvests were then plaque in Madin–Darby canine kidney cells, and the plaques were stained with immunoperoxidase using

![Quantitative influenza B mucosal IgA at baseline in subjects vaccinated with live attenuated influenza vaccine, by presence or absence of influenza B shedding after vaccination. Gray horizontal bars denote mean baseline nasal wash influenza B IgA enzyme-linked immunosorbent assay (ELISA) units corrected for total mucosal IgA in each group (as described in reference 13). The comparison of mean baseline IgA values in shedders versus non-shedders yielded a P value of .03.](image-url)
<table>
<thead>
<tr>
<th>Study</th>
<th>Age Range</th>
<th>Vaccine Studied(^*)</th>
<th>Vaccine Dose(^{†})</th>
<th>Only Studied Seronegative Subjects?</th>
<th>No. of Subjects</th>
<th>Days of Specimen Collection Post-Vaccination</th>
<th>Subjects With Viral Shedding (%)</th>
<th>Last Day Shedding Detected</th>
<th>Average Duration of Shedding (d)</th>
<th>Peak Titer of Shed Virus(^{‡})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studies of adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>19–49 y</td>
<td>TV</td>
<td>6.5–7.5</td>
<td>No</td>
<td>20</td>
<td>0, 3, 7, 10, 17–21</td>
<td>50</td>
<td>7</td>
<td>Not measured</td>
<td></td>
</tr>
<tr>
<td>King et al.(^9)</td>
<td>18–58 y</td>
<td>TV</td>
<td>7.0</td>
<td>Yes HIV positive: 28</td>
<td>HIV positive: 4</td>
<td>3–5, 7–10, 28–35</td>
<td>HIV positive: 4</td>
<td>5</td>
<td>Not measured</td>
<td></td>
</tr>
<tr>
<td>Keitel et al.(^18)</td>
<td>18–40 y</td>
<td>a) MVB or BVA</td>
<td>7.1</td>
<td>Yes</td>
<td>38</td>
<td>a) Daily days 1–7</td>
<td>a) 92</td>
<td>b) 95</td>
<td>a) 3.8–4.2</td>
<td>a) 0.5–2.1</td>
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<tr>
<td>Keitel et al.(^20)</td>
<td>18–35 y</td>
<td>MVB (varying doses(^{3}))</td>
<td>6.6–7.6</td>
<td>Yes</td>
<td>a) Dose 7.6: 29</td>
<td>1, 2, 3, 4, 5, 6, 7, 28</td>
<td>a) 100</td>
<td>Not noted</td>
<td>a) 2.4 ± 1.1</td>
<td>a) 0.9 ± 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Dose 6.6: 14</td>
<td></td>
<td>b) 79</td>
<td></td>
<td>b) 2.7 ± 0.3</td>
</tr>
<tr>
<td>Clements et al.(^21)</td>
<td>18–40 y</td>
<td>MVB</td>
<td>7.5</td>
<td>Yes</td>
<td>32</td>
<td>Daily days 1–3</td>
<td>28</td>
<td>Not noted</td>
<td>0.6 ± 0.2</td>
<td>0.8 ± 0.1</td>
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<tr>
<td>Sears et al.(^22)</td>
<td>18–40 y</td>
<td>a) MV H1N1A</td>
<td>7.5</td>
<td>Yes</td>
<td>15</td>
<td>Daily days 1–4</td>
<td>60</td>
<td>Not noted</td>
<td>a) 1.9 ± 1.7</td>
<td>a) 1.8 ± 1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) MV H3N2A</td>
<td></td>
<td>b) 19</td>
<td></td>
<td>b) 0.6 ± 1.1</td>
</tr>
<tr>
<td>Reeve et al.(^28)</td>
<td>20–24 y</td>
<td>MVB</td>
<td>6.2–7.2</td>
<td>No</td>
<td>20</td>
<td>Daily days 1–5</td>
<td>85</td>
<td>4</td>
<td>2.0–2.8</td>
<td>2.5–3.0</td>
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<tr>
<td>Mortiz et al.(^24)</td>
<td>Not noted</td>
<td>MV H3N2A</td>
<td>7.8</td>
<td>No</td>
<td>19</td>
<td>Daily days 1–5</td>
<td>Seronegative: 50</td>
<td>2.2</td>
<td>1.7</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivocal: 14</td>
<td></td>
<td>4.0</td>
<td>1.7</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seropositive: 0</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
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<tr>
<td>Studies of children</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vesikari et al.(^8)</td>
<td>8–36 mo</td>
<td>TV</td>
<td>Not noted</td>
<td>Yes</td>
<td>98</td>
<td>Approximately 3 times/wk for 3 wk</td>
<td>80</td>
<td>21</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>King et al.(^25)</td>
<td>1–7 y</td>
<td>TV</td>
<td>7.0</td>
<td>No</td>
<td>HIV positive: 24</td>
<td>3–5, 7–10, 28–35</td>
<td>HIV positive: 13</td>
<td>10</td>
<td>Not measured</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HIV negative: 25</td>
<td></td>
<td>HIV negative: 28</td>
<td></td>
<td>2.7</td>
</tr>
<tr>
<td>Gruber et al.(^26)</td>
<td>6–18 mo</td>
<td>a) MV H1N1A</td>
<td>6.2</td>
<td>Yes</td>
<td>a) 44</td>
<td>6, 11</td>
<td>a) 16</td>
<td>11</td>
<td>Not measured</td>
<td>Not measured</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) MV H3N2A</td>
<td></td>
<td>b) 45</td>
<td></td>
<td>b) 36</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>c) BVA</td>
<td></td>
<td>c) 47</td>
<td></td>
<td>c) 55</td>
<td></td>
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</tr>
</tbody>
</table>
monoclonal antibodies specific for the hemagglutinin of the H1N1 influenza A, H3N2 influenza A, and B influenza viruses to further characterize the specific influenza strains shed.\textsuperscript{10,11} Viral quantification was also performed using serial 1:10 dilutions of aliquots of positive samples that had been frozen directly in the lactated Ringer’s solution, as described previously.\textsuperscript{12}

**Immunity Assays**

Hemagglutination inhibition antibody titers to each of the three influenza strains included in the live attenuated influenza vaccine were determined at baseline prior to vaccination and between days 17 and 21 after vaccination, as described previously.\textsuperscript{13-16} Mucosal and serum IgA antibodies were detected using a kinetic enzyme-linked immunosorbent assay run in triplicate, as described previously.\textsuperscript{17} Those subjects with a hemagglutination inhibition titer greater than 1:32 or the presence of detectable serum or mucosal IgA prior to vaccination were noted and correlations with vaccine shedding were evaluated.\textsuperscript{18,19} Cell-mediated immunity assays were not performed.

**Analysis**

Comparisons between subjects with and without evidence of nasal shedding were made using Fisher’s exact test for categorical data and the Mann–Whitney U test for nonparametric continuous data. Analyses were conducted using Stata software (version 7.0; StataCorp, College Station, TX).

**RESULTS**

Twenty subjects underwent live attenuated influenza vaccine vaccination. The mean age of the cohort was 31.6 years (standard deviation, ± 8.9 years; range, 19 to 49 years). The majority of the subjects were women (11 of 20; 55%) and white (18 of 20; 90%). All subjects completed the study, although three missed one of the four scheduled follow-up visits (two subjects missed the day 7 visit and one missed the day 10 visit).

Influenza was not detected in any of the nasal wash specimens obtained at baseline (0 of 20; 95% confidence interval, 0 to 16.8%; Table 1). In contrast, half of the specimens obtained on day 3 after vaccination (10 of 20; 95% confidence interval, 27.2% to 72.8%) were positive for influenza virus. By day 7 after vaccination, the degree of mucosal shedding had markedly declined, with only 1 of 18 nasal wash specimens obtained (5.5%; 95% confidence interval, 0.1% to 27.3%) being culture positive for influenza virus. By day 7 after vaccination, the degree of mucosal shedding had markedly declined, with only 1 of 18 nasal wash specimens obtained (5.5%; 95% confidence interval, 0.1% to 27.3%) being culture positive for influenza virus. Influenza was not recovered from any of the subjects on days 10 (95% confidence interval, 0 to 17.6%) or 17 to 21 (95% confidence interval, 0 to 16.8%) after vaccination. In total, virus was recovered from 10 subjects; 1 subject shed on day 3 and day 7 after vaccination.

The specific influenza strain shed varied: one subject shed influenza A H1N1 alone, one shed influenza A H3N2 alone, one shed both influenza A strains, six shed influenza B alone, and one shed all three strains (Table 1). The subject who shed on multiple visits had influenza B isolated...
on day 3 and day 7 after vaccination. Characterization of preimmunization status in that subject revealed a baseline hemagglutination inhibition titer to influenza B of 1:64, suggesting exposure to that strain through previous influenza vaccination. However, she did not have any detectable mucosal IgA to influenza B at baseline. Quantitative titrations were performed on all positive specimens. Only 1 of the 11 positive samples contained a detectable quantity of virus with a peak titer of $5 \times 10^6$ plaque-forming units (PFU)/mL (the lowest level of detection).

Shedding of vaccine virus was significantly associated with younger age (mean age, 26.4 years for those with shedding vs 38.6 years for those without; $P < .01$). Although those who did not shed vaccine virus were more likely to report prior influenza vaccination (8 of 10) than those who did (3 of 10), this did not achieve statistical significance ($P = .07$). Absence of shedding of influenza B vaccine virus was significantly associated with influenza B–specific mucosal IgA antibody at baseline (Figure; $P = .03$). However, no associations were noted between the shedding of influenza A vaccine virus and baseline mucosal IgA antibody titers nor with any baseline strain-specific serum IgG or IgA antibody titers to any of the vaccine strains (data not shown).

**DISCUSSION**

The licensure of trivalent live attenuated influenza vaccine has raised questions and concerns regarding the use of this vaccine in some populations. In particular, the potential for inadvertent secondary transmission of vaccine virus led to an initial advisory in the package insert that individuals recently vaccinated with live attenuated influenza vaccine avoid close contact with immunocompromised individuals for at least 21 days after vaccination, a duration based on the recovery of influenza in one transmission study from a single child 21 days after vaccination. However, data regarding mucosal shedding after live attenuated influenza vaccine vaccination in adults have been limited, with investigations rarely assessing shedding past the first week after vaccination. The current study clearly demonstrated that the degree and duration of viral shedding in adults markedly declined within the first week after live attenuated influenza vaccine vaccination and that shedding could not be documented after that time.

Previous studies of nasal shedding of vaccine virus after administration of live attenuated influenza vaccine are summarized in Table 2. These studies vary regarding type of live attenuated influenza vaccine studied (monovalent or bivalent influenza A, monovalent influenza B, or trivalent vaccines), study population (adults or children), and number of specimens collected and the timing of that collection after vaccination, impeding inter-trial comparisons. In general, the duration of shedding after vaccination has been greater in children compared with adults (range of duration in children, 5.0 to 9.8 days; range of duration in adults, 0 to 4.0 days). In addition, prior serologic immunity to the vaccine strains was associated with a reduced frequency and duration of viral shedding. In the current study, the finding of an association between baseline mucosal immunity to influenza B and the shedding of influenza B after vaccination and the absence of baseline nasal IgA in the one subject who shed virus on two visits further support the importance of prior mucosal immunity for shedding risk. Although no correlation between baseline serum immunity and detection of shedding was found in the current investigation, such analyses may have been limited by our small sample size.

Studies specifically investigating the degree of mucosal shedding after use of the newly licensed trivalent live attenuated influenza vaccine are limited. In one study of human immunodeficiency virus–infected and healthy adults, only one human immunodeficiency virus–positive subject (1 of 28; 3.6%) shed influenza virus, detected on day 5 after vaccination. Shedding was not documented in any human immunodeficiency virus–negative subjects. A similar study of children 1 to 7 years old noted a greater duration (up to 10 days after vaccination) and frequency (13% to 28%) of shedding. In contrast, all 11 healthy adults vaccinated with the trivalent live attenuated influenza vaccine in another study shed virus during the first week after vaccination, with an average of shedding of 3.4 days. In the largest investigation of shedding after trivalent live attenuated influenza vaccine vaccination, a randomized, placebo-controlled trial conducted in Finland using a cohort of 197 day care attendees, 78% (76 of 98) of vaccinated children shed virus for an average of 7.6 days. Shedding was detected up to 21 days after vaccination in one child.

Even fewer studies have directly examined the transmission of vaccine-based virus from vaccinated subjects. In the Finnish day care trial mentioned above, transmission of a vaccine-type influenza B virus from a vaccinee to one of 99 placebo recipients was documented. Four other subjects receiving placebo shed influenza A, but these isolates could not be characterized further to determine their origin (wild type vs vaccine). In this study, the probability of acquiring vaccine virus after close contact with a single live attenuated influenza vaccine vaccinee was estimated to be between 0.58% and 2.4%. Despite the transmission to one unvaccinated subject in the Finnish study, the transmitted virus retained the attenuated phenotype and did not lead to clinical disease. In another study in which 31 adult subjects recently vaccinated with monovalent avian–human influenza A H3N2 live attenuated influenza virus were housed for 7 to 9 days after vaccination with 6 placebo recipients, no episodes of transmission were detected.

A larger issue regarding secondary transmission of vaccine-based influenza virus is whether such transmission is harmful to the exposed individual. Modification of the vaccine virus to restrict replication above 37°C (similar to the temperature of the lower airways) as well as attenuation to non-virulent viral reassortants markedly restricts the potential for clinical infection following inadvertent transmission of vaccine virus. Although reversion of the vaccine virus to a wild genotype is a concern, an investigation of individuals vaccinated with a trivalent live attenuated influenza vaccine who exhibited mucosal shedding after vaccination found that the shed viruses were genotypically stable.
retaining the attenuated vaccine genotype in all instances.\textsuperscript{31} Transmission of vaccine virus may, in fact, be beneficial, as transmission of the attenuated strain of influenza may result in a de facto vaccination of the exposed subject, providing protection from circulating wild-type influenza.

Effective secondary transmission of vaccine virus from vaccinees also requires a significant quantity of virus to be shed from the nasal mucosa. Based on prior investigations with live attenuated influenza vaccine, the dose of vaccine virus required to effectively infect an individual is approximately $10^5$ to $10^7$ PFU/mL.\textsuperscript{21,22,32} From our investigation and from other studies of mucosal shedding after live attenuated influenza vaccine use, the quantity of virus shed after live attenuated influenza vaccine vaccination was exponentially lower (from $10^5$ to $10^2$ PFU/mL) and likely would not have been able to infect other individuals. In our study, although 50\% of subjects shed at day 3 after vaccination, only one subject shed virus above the lower limit of quantification. Studies further evaluating the magnitude of shedding after live attenuated influenza vaccine vaccination are now needed to assist with assessment of the risk of secondary transmission of the vaccine virus.

Healthcare workers have been among those most affected by the recommendations restricting contact with immunocompromised individuals following live attenuated influenza vaccine vaccination. Following live attenuated influenza vaccine licensure, some facilities instituted policies requiring a 21-day furlough of any healthcare worker vaccinated with live attenuated influenza vaccine.\textsuperscript{7} Such restrictions created staffing shortages during influenza season, a time of year typically associated with high patient volume. Some vaccine experts speculate that intranasal live attenuated influenza vaccine is a more acceptable method of delivery than the intramuscular vaccine, an idea supported by recent investigations.\textsuperscript{33,34} Although annual influenza vaccination is recommended for all healthcare workers to reduce work absenteeism and prevent the nosocomial transmission of influenza, only 37\% of surveyed healthcare workers reported having received influenza vaccination in 2001.\textsuperscript{1} Expanding the use of live attenuated influenza vaccine to healthcare workers and reducing or removing post-vaccination work restrictions may improve vaccine acceptance and coverage, limiting the risk of nosocomial transmission of wild influenza.

The licensure of the live attenuated influenza vaccine provides an additional tool in the armamentarium against influenza infection. As with other live viral vaccines, secondary transmission to those at risk for clinical infection from transmitted virus is a concern; however, previous guidelines on restriction of contacts after live attenuated influenza vaccine vaccination were too restrictive. In this investigation, we found that mucosal shedding in 20 adults vaccinated with the trivalent live attenuated influenza vaccine was markedly diminished within 1 week after vaccination.

Although the sample size of this investigation was small, such results have provided a more detailed description of the duration of shedding after vaccination, leading to a modification of recommendations for live attenuated influenza vaccine use in healthcare workers that reduces the period of separation from patients after live attenuated influenza vaccine vaccination to at most 7 days.\textsuperscript{35} In addition, the amount of virus shed was much lower than the estimated dose needed for effective infection with vaccine virus in immunocompetent individuals, suggesting that the risk of infection from secondary transmission of vaccine virus is low. Additional studies refining estimates of the degree of mucosal shedding after live attenuated influenza vaccine vaccination and the risk of secondary transmission of the attenuated vaccine virus to immunocompromised individuals are needed to further explore the necessity for healthcare workers to be restricted from patients after live attenuated influenza vaccine vaccination.

\textbf{REFERENCES}


6. MedImmune Vaccines, Inc. 


16. Hierholzer JC, Suggs MT, Hall EC. Standardized viral hemagglutina-


