Trends in seasonal influenza vaccine uptake during pregnancy in Western Australia: Implications for midwives

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ABSTRACT

**Background:** Antenatal influenza vaccination is an important public health intervention for preventing serious illness in mothers and newborns, yet uptake remains low.

**Aim:** To evaluate trends in seasonal influenza vaccine coverage and identify determinants for vaccination among pregnant women in Western Australia.

**Methods:** We conducted an annual telephone survey in a random sample of post-partum women who delivered a baby in Western Australia between 2012 and 2014. Women were asked whether influenza vaccination was recommended and/or received during their most recent pregnancy; women were also asked why or why they were not immunised.

**Findings:** Between 2012 and 2014, influenza vaccine coverage increased from 22.9% to 41.4%. Women who reported receiving the majority of their antenatal care from a private obstetrician were significantly more likely to have influenza vaccination recommended to them than those receiving the majority of their care from a public antenatal hospital or general practitioner \( (p < 0.001) \). In 2014, the most common reason women reported for accepting influenza vaccination was to protect the baby (92.8%) and the most common reason for being unimmunised was lack of a healthcare provider recommendation (48.5%).

**Discussion:** Antenatal influenza vaccination uptake is increasing, but coverage remains below 50%. A recommendation from the principal care provider is an important predictor of maternal influenza vaccination.

**Conclusion:** Antenatal care providers, including midwives, have a key role in providing appropriate information and evidence-based recommendations to pregnant women to ensure they are making informed decisions. Consistent recommendations from antenatal care providers are critical to improving influenza vaccine coverage in pregnant women.

**Keywords:** Influenza Vaccine; Pregnant Woman; Maternal Health; Maternal Vaccination; Antenatal Vaccination
SUMMARY OF RELEVANCE

Problem
Influenza vaccination during pregnancy prevents serious morbidity in mothers and their infants; however, uptake has been suboptimal historically.

What is already known
Previous studies have shown that 60% of pregnant women are recommended to receive seasonal influenza vaccine during their pregnancy, and as a result, one in three pregnant women receives an influenza vaccine each year.

What this paper adds
Uptake improved between 2012 and 2014. Advice from an antenatal care provider was the most important motivator for influenza vaccination in pregnant women, yet 40% of pregnant women were not recommended an influenza vaccine. These results imply there is a greater role for antenatal care providers, including midwives, in encouraging antenatal vaccination and promoting the health of pregnant women and their newborns.
INTRODUCTION

Antenatal influenza vaccination has been demonstrated to reduce morbidity in both mothers and their infants [1-3]. Infection with seasonal influenza during pregnancy is associated with severe illness and increased risk of hospitalisation and adverse infant outcomes, including small for gestational age and low birth weight births [4, 5]. Influenza vaccination during pregnancy has been shown to reduce the risk of these poor neonatal health outcomes [6, 7]. Despite the known benefits of maternal influenza vaccination, historically, fewer than 50% of pregnant women in Australia receive an influenza vaccine each year [8-10].

Previous research has found that a recommendation by an antenatal care provider is the primary reason pregnant women get vaccinated against influenza, and lack of discussion with a provider remains a commonly cited reason for non-vaccination [11-13]. Protecting the infant from infection, perceiving influenza as a serious illness, and believing that the vaccine is safe and effective have also been identified as strong predictors of influenza vaccination during pregnancy [14-16]. Concerns about the safety of the vaccine for the developing fetus and potential side effects are other commonly cited reasons for non-vaccination among pregnant women [8, 11, 15, 16]. Because information on maternal influenza vaccination has generally been unavailable in Western Australia, the Western Australia Department of Health (WA Health) has conducted an annual survey in Western Australia since 2012.

It was the goal of this study to use annual survey data to assess trends in uptake of trivalent influenza vaccine (TIV) in pregnant women between 2012 and 2014, as well as factors associated with vaccination and non-vaccination.

METHODS

Between 2012 and 2014, WA Health conducted an annual survey of mothers who had recently given birth to a live infant in Western Australia [8, 14]. A random sample of live births was
selected in November each year using the Western Australian Midwives Notification System, which is a legally mandated state-wide data collection of attended births in Western Australia [17]. The sample was randomly selected from all births using a random number generator. Sample size was determined based on the number of participants required to measure vaccine uptake with a precision of ±1.5%. In 2012, mothers residing in non-metropolitan areas were oversampled. In 2013, mothers from two metropolitan health services were oversampled; these oversampling techniques were not repeated in 2014. Selected women were invited to participate in a 10 minute telephone interview; women who declined the invitation were removed from the sample. The remaining women were telephoned by trained interviewers in December to March of each year.

The interview included questions regarding whether the woman was advised by a healthcare provider (HCP) to be immunised against influenza, whether she had received TIV during her most recent pregnancy, and factors associated with vaccination status. The survey instrument is based on the Pregnancy Risk Assessment Monitoring Systems survey, which is a validated state-based telephone survey of pregnant women conducted by the United States Centers for Disease Control and Prevention [18]. This study was reviewed and approved by the Western Australia Department of Health Human Research Ethics Committee (Project 2014/67).

**Data collection**

Women were asked to self-report whether they were immunised against influenza during their most recent pregnancy. Where possible, immunisation providers were contacted to verify the self-reported vaccination status. Women were considered “vaccinated” if they self-reported a vaccination which was verified by their immunisation provider. For women who self-reported immunisations administered by a provider without immunisation records (i.e. private workplace, pharmacy), it was assumed the woman was “vaccinated.” Women who self-
reported not being vaccinated and those who self-reported being vaccinated but their
nominated provider indicated no such vaccination was given were considered “unvaccinated.”

Vaccinated women were asked why they chose to be vaccinated, and unvaccinated women
were asked why they were not vaccinated; reasons not listed on the survey were recorded
verbatim and coded into themes.

Demographic information was collected during the survey, including the woman’s age,
postcode of residence, highest level of education completed, presence of chronic medical
conditions, and the primary antenatal care provider for her most recent pregnancy (e.g.,
private obstetrician, general practitioner, public antenatal hospital clinic, private practice
midwife, or other). The postcode of residence provided was used to determine whether the
woman lived in a metropolitan or non-metropolitan area as well as the socioeconomic status
of the woman, as determined by the Socio-Economic Indexes for Areas (SEIFA) score [19].
Women were assigned into tertiles of socioeconomic status based on these scores.

Data analysis
To account for the oversampling strategies implemented in 2012 and 2013, annual survey
results were weighted according to the known distribution of births in the state. The odds of
receiving a recommendation for influenza vaccination and the odds of receiving an influenza
vaccine during pregnancy were examined by age group, health status, educational attainment,
socioeconomic status, area of residence and antenatal care provider using multivariate logistic
regression analyses which controlled for each of the other variables. Multivariable logistic
regression models were used to estimate influenza vaccination status by year, adjusting for
area of residence, socioeconomic status, and educational attainment. Complete-case
analyses were performed in SAS version 9.4 (SAS Institute Inc., Cary NC, USA).
RESULTS

A total of 2,828 women (2012: n=566; 2013: n=1,114; 2014: n=1,148) were telephoned, of whom 2,018 (71.3%) completed the interview (2012: n=416; 2013: n=831; 2014: n=771). Of the 814 women who did not complete an interview, 43.0% could not be contacted after 10 attempts, 41.5% had incorrect or disconnected telephone numbers, 7.2% declined participation, 6.8% were non-English speaking, and 1.5% were unavailable at the time of interview. One-half of respondents were between 30 and 45 years of age (53.6%), and two-thirds of respondents had post-secondary school qualifications (67.8%); 40.8% were in the highest socioeconomic tertile. The majority of women resided in the metropolitan area (72.9%) and reported no chronic medical conditions (86.8%).

A total of 783 (38.8%) women self-reported a vaccination during their pregnancy and 756 (96.5%) of these women gave permission to verify the vaccination (Figure 1). Of these, 718 (91.7%) were classified as vaccinated. Records could not be located by the immunisation provider for 65 (8.6%) women and these women were considered unvaccinated. A total of 1,278 women included in the final analysis were classified as unvaccinated.

Overall, between 2012 and 2014, 57.2% of women reported having been recommended TIV during their most recent pregnancy and 35.3% of women received the vaccine (Table 1). After adjusting for sociodemographic factors, women with chronic medical conditions were at higher odds of receiving a recommendation for TIV from their provider (AOR: 1.39; 95% CI: 1.01-1.91), while those residing outside the metropolitan area were at lower odds of receiving this recommendation (AOR: 0.75; 95% CI: 0.58-0.98). Women who received the majority of care from a general practitioner or public antenatal hospital clinic had lower odds of receiving a recommendation for TIV as compared to women who received care from a private obstetrician (AOR: 0.73; 95% CI: 0.54-0.99; AOR: 0.76; 95% CI: 0.60-0.95, respectively). Women who received the majority of their care from a general practitioner or public antenatal hospital also
had lower odds of receiving TIV during pregnancy than women who received care from a private obstetrician (AOR: 0.70; 95% CI: 0.52-0.94 and OR: 0.60; 95% CI 0.48-0.76, respectively). Although not statistically significant, women who reported receiving the majority of their antenatal care from a private practice midwife had the lowest odds of receiving a recommendation (AOR: 0.49, 95% CI: 0.20-1.24) or receiving TIV during their pregnancy (AOR: 0.50, 95% CI: 0.17-1.43).

Between 2012 and 2014, TIV coverage increased from 22.9% to 41.4% (p<0.001). Subgroup analyses indicated that during this period uptake increased for all groups of age, socioeconomic, education and residence; however, uptake did not significantly change in mothers with at least one chronic medical condition (p=0.38). The majority of mothers were vaccinated in their second trimester (57.2%); one-third (29.1%) were vaccinated in the third trimester, and 13.7% were vaccinated in the first trimester. Most commonly, women were immunised by their general practitioner (2012: 70.3%, 2013: 60.3%, 2014: 63.1%).

The proportion of women who reported having been recommended influenza vaccination during pregnancy increased from 37.2% in 2012 to 62.1% in 2014 (p<0.001) (Figure 2). The proportion of unvaccinated women who would have been vaccinated if it had been recommended by a HCP did not change throughout the study period, remaining between 75.2 and 80.5% (p=0.63). In 2014, 65.7% of women would have been vaccinated had a midwife recommended the vaccine, 69.4% if a general practitioner had recommended the vaccine, and 72.2% if an obstetrician had recommended the vaccine to them during pregnancy (Figure 2).

Between 2012 and 2014, the reason women most commonly cited for receiving TIV was to protect the baby (89.7%), followed by receiving a recommendation from a HCP (82.5%). The proportion of women who were immunised during pregnancy in order to protect the baby increased from 74.7% in 2012 to 92.8% in 2014 (p=0.002), and the proportion immunised
because a provider recommended the vaccine increased from 78.8% in 2012 to 85.5% in 2014, although not significantly \( (p=0.06) \) (Table 2). The proportion of unimmunised women who indicated they did not normally get an annual influenza vaccination decreased from 67.0% in 2012 to 39.7% in 2014 \( (p<0.001) \). The percentage of women who were not vaccinated because of concerns about potential harm to the baby decreased from 49.6% in 2012 to 42.9% in 2014, although this decrease was only borderline significant \( (p=0.05) \). However, the proportion of women who declined vaccination due to potential side effects to the mother did not significantly change between 2012 and 2014 (46.8% to 43.3%, \( p=0.22 \)).

**DISCUSSION**

Using a state-wide survey of women who recently delivered a live baby in Western Australia, we estimated that, overall between 2012 and 2014, 57.2% of women were recommended an influenza vaccine during their pregnancy and 35.3% received a seasonal influenza vaccine. While there has been significant improvement since 2012, less than half of pregnant women currently receive an influenza vaccine during their pregnancy. These results identify a need for better promotion of influenza immunisation by antenatal care providers to their pregnant patients, particularly considering the known benefits of antenatal influenza vaccination.

Pregnant women and young infants are at high risk of severe influenza infection and associated complications [4, 20, 21], and influenza immunisation during pregnancy has been shown to prevent 36% of respiratory illnesses in mothers and 63% of influenza cases in infants <6 months [2]. Based on the evidence supporting the benefits of seasonal influenza vaccination to mother and infant, the World Health Organisation considers pregnant women the highest priority group for seasonal influenza vaccination programs [22]. Results from our investigation highlight potential strategies for improving maternal influenza vaccine uptake.

More than 40% of women were not recommended TIV during pregnancy, and nearly 50% of women who received their antenatal care from a general practitioner or at a public hospital
Trends in antenatal influenza vaccine uptake, 9

antenatal clinic, where midwives have extensive access to women in Western Australia, were not recommended TIV. These results suggest that general practitioners, midwives and other antenatal care providers have an important role in protecting their antenatal patients and newborn infants against influenza infection. Considering a provider recommendation for vaccination is the strongest predictor of antenatal vaccination [8] and the majority of women in our study stated they would have been vaccinated had a general practitioner or midwife recommended it to them, general practitioners and midwives could embrace a more active role in the promotion of antenatal immunisation services. Pregnant women view midwives as a trusted source of health information [23] and midwives, both publicly and privately practising, are ideally placed to provide antenatal immunisation information and recommendations during antenatal care visits and parent education sessions. In theory, based on our findings, if 100% of antenatal care providers recommended the vaccine to their pregnant patients, immunisation coverage rates up to 79% would be achievable.

Other studies suggest that midwives may be less likely to recommend and administer influenza vaccine to pregnant patients as compared with other providers [24]. Our results showed that women who received most of their care at sites where midwives provide care (e.g., public hospital antenatal clinics) were less likely to receive a recommendation for TIV or to receive TIV during pregnancy. Although the majority of midwives agree that vaccinating pregnant women against seasonal influenza is important [25], researchers have found that midwives may not recommend influenza vaccine to their patients as often as other providers because they do not feel prepared for such conversations [25]. A recent study in the UK suggests that just 26% of midwives feel prepared to provide immunisation advice and only one-third of midwives are willing to immunise pregnant women [25]. Because midwives play an important role in promoting TIV to their patients and successful antenatal and post-natal immunisation programs rely on the support of midwives [26, 27], it is important to identify barriers in promoting and providing TIV during pregnancy experienced by midwives, particularly midwives practising in Australia. In Western Australia, influenza immunisation
education resources are available to healthcare professionals at no cost [28]; additional immunisation education needs of midwives should be identified in order to provide targeted immunisation education programs for midwives.

Results from this survey can assist antenatal care providers, including general practitioners, obstetricians, and midwives, to effectively communicate with their pregnant patients for discussing antenatal immunisation. More than 90% of the vaccinated women in our survey reported being immunised to protect their baby. These results are consistent with those from other national and international research efforts [8, 11, 13] indicating this is an important message to convey to pregnant women when discussing immunisation. Unvaccinated women commonly cited concerns about the safety of the vaccine as a reason for remaining unvaccinated. Vaccine safety has been well demonstrated for both mothers and their infants in Australia and internationally [29-31]. Providers should discuss the demonstrated safety of influenza vaccination during pregnancy when recommending TIV to pregnant patients. The themes identified in this study could be used to develop effective communication materials summarising immunisation information for pregnant women.

Our study has several limitations which should be considered. First, most of the data were self-reported and, as a result, are subject to reporting bias. Second, 15% of vaccinated women received their vaccination from a provider for whom we could not access the patient’s medical record (i.e. immunisations that were provided in a private workplace). It is therefore possible that a portion of these reported vaccination events were errors and these women were in fact unvaccinated; however, given that the proportion of vaccines reportedly administered by providers without access to medical records did not vary over time, it is unlikely that this would explain the trends we observed during the study period. Furthermore, 91% of self-reported vaccinations administered by a provider with immunisation records could be verified, indicating self-report is a valid measure of vaccination status. Finally, some sub-analyses, particularly analyses by primary antenatal care provider, relied on small sample sizes for some groups.
Additional research should further explore the association between models of antenatal care and recommendations for, and receipt of, TIV during pregnancy.

Conclusion

Influenza vaccination during pregnancy is standard of care in Australia [32] and research in many countries has shown that the recommendation of the antenatal care providers is an important factor in a woman’s decision to be vaccinated during pregnancy. Our results showed that only two of every five women in Western Australia received an influenza vaccine during their pregnancy in 2014. Significant improvement in antenatal influenza immunisation rates are needed to ensure pregnant women and their young infants are protected against seasonal influenza infection. We estimate that almost 80% coverage is achievable if all antenatal care providers recommended the vaccine to their pregnant patients. With the recent introduction of pertussis vaccination to antenatal vaccination programs in Australia [33], it will become increasingly important for all antenatal care providers to actively promote antenatal vaccination. Consistent recommendations from all antenatal care providers, including midwives, and discussion of the safety and potential benefits are critical to improving influenza vaccine coverage in pregnant women.
The authors kindly acknowledge the contributions of Edith Cowan University as well as Mary Barker, Sana Boutros, Joan Castenelle, and Maureen Griffiths at Integrity Staffing for conducting the telephone interviews. We’d also like to acknowledge the support of Maureen Hutchinson, the Midwives Notification System Data Custodian at Western Australia Department of Health, for her support in selecting a random sample of mothers annually. Finally, we would like to acknowledge Ali Radomiljac and Sarah Joyce at the Epidemiology Branch (Western Australia Department of Health) for their assistance in preparing the survey instrument. All project funds were provided by the Communicable Disease Control Directorate at the Western Australia Department of Health.

The authors have no conflicts of interest to disclose.
REFERENCES


Figure 1. Verification of influenza vaccination records in pregnant women – Western Australia, 2012-14.

2,832 women who delivered between April and October selected for telephone interview in 2012 (n=570), 2013 (n=1,114), and 2014 (n=1,148)

- 2,018 women who delivered between April and October were telephone interviewed in 2012 (n=416), 2013 (n=831), and 2014 (n=771)
  - 22 women were unsure whether they received a vaccination during their pregnancy and were excluded from analysis

- 1,213 women self-reported no vaccination during their pregnancy
  - 27 refused permission to verify the vaccination and were excluded from analysis

- 783 women self-reported a vaccination during their pregnancy
  - 756 women gave permission to verify the vaccination

  - 65 vaccinations could not be verified by the provider*
  - 131 vaccinations were administered by a provider with no records
  - 560 vaccinations were verified by the immunisation provider

- 1,278 unvaccinated women included in analysis
- 718 vaccinated women included in analysis

Survey data from 1,996 women available for analysis

- 108 women had missing information for ≥1 sociodemographic factor and were excluded from analysis

Survey data from 1,888 women included in final analysis

*65 vaccinations were administered by an immunisation provider who maintained vaccination records, could confirm the woman was a patient, but could not locate a vaccination record for the woman.
Table 1. Percentage of women recommended and/or receiving a seasonal trivalent influenza vaccine during pregnancy – Western Australia, 2012-14.

<table>
<thead>
<tr>
<th>Total</th>
<th>Recommended vaccine&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Received vaccine&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (weighted %)</td>
<td>n (weighted %)</td>
</tr>
<tr>
<td>OVERALL</td>
<td>1,888 (100)</td>
<td>1,062 (57.2)</td>
</tr>
</tbody>
</table>

**MATERNAL CHARACTERISTICS**

**By age group**

| 18-24y | 229 (17.2) | 118 (52.0) | 0.83 (0.57-1.20) | 67 (27.1) | 0.76 (0.52-1.10) |
| 25-29y | 499 (29.2) | 270 (56.8) | 0.98 (0.75-1.30) | 166 (34.2) | 0.96 (0.73-1.27) |
| 30-34y | 677 (33.1) | 393 (59.2) | 1.04 (0.81-1.33) | 266 (38.7) | 1.09 (0.85-1.39) |
| 35-45y | 483 (20.5) | 281 (58.9) | Ref | 187 (38.1) | Ref |

**By health status**

<p>| ≥1 medical condition&lt;sup&gt;d&lt;/sup&gt; | 244 (13.2) | 156 (63.5) | 1.39 (1.01-1.91)* | 95 (37.5) | 1.16 (0.86-1.55) |
| No medical conditions | 1,644 (86.8) | 906 (56.2) | Ref | 591 (34.9) | Ref |</p>
<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>OR (95% CI)</th>
<th>SE (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By educational attainment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤High school</td>
<td>563</td>
<td>306</td>
<td>1.11</td>
<td>1.08-1.52</td>
<td>0.72</td>
</tr>
<tr>
<td>TAFE/some university</td>
<td>986</td>
<td>560</td>
<td>1.06</td>
<td>0.81-1.38</td>
<td>0.77</td>
</tr>
<tr>
<td>≥University graduate</td>
<td>339</td>
<td>196</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td><strong>By socioeconomic status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertile 1 (Most disadvantaged)</td>
<td>504</td>
<td>264</td>
<td>1.01</td>
<td>0.76-1.34</td>
<td>1.16</td>
</tr>
<tr>
<td>Tertile 2</td>
<td>586</td>
<td>325</td>
<td>0.99</td>
<td>0.76-1.34</td>
<td>1.00</td>
</tr>
<tr>
<td>Tertile 3 (Least disadvantaged)</td>
<td>798</td>
<td>473</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td><strong>By residence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-metropolitan</td>
<td>498</td>
<td>244</td>
<td>0.75</td>
<td>0.58-0.98</td>
<td>0.90</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>1,390</td>
<td>818</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
</tr>
</tbody>
</table>

**ANTENATAL CARE CHARACTERISTICS**
### Location of majority of antenatal care

<table>
<thead>
<tr>
<th>Location</th>
<th>Recommended</th>
<th>Received</th>
<th>Ref</th>
<th>Received</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private obstetrician</td>
<td>702 (34.9)</td>
<td>441 (62.8)</td>
<td>Ref</td>
<td>314 (43.6)</td>
<td>Ref</td>
</tr>
<tr>
<td>General practitioner</td>
<td>379 (20.0)</td>
<td>187 (51.7)</td>
<td>0.73 (0.54-0.99)*</td>
<td>123 (32.7)</td>
<td>0.70 (0.52-0.94)*</td>
</tr>
<tr>
<td>Public antenatal hospital</td>
<td>786 (43.7)</td>
<td>426 (55.5)</td>
<td>0.76 (0.60-0.95)*</td>
<td>244 (30.1)</td>
<td>0.60 (0.48-0.76)*</td>
</tr>
<tr>
<td>Private practice midwife</td>
<td>21 (1.2)</td>
<td>8 (42.3)</td>
<td>0.49 (0.20-1.24)</td>
<td>5 (24.3)</td>
<td>0.50 (0.17-1.43)</td>
</tr>
</tbody>
</table>

*Recommended vaccine was defined as women who self-reported a healthcare provider recommended influenza vaccination during their most recent pregnancy.

*Received vaccine was defined as women who self-reported receiving an influenza vaccine during their most recent pregnancy and the vaccination was either verified by their immunisation provider or was administered by a provider with no immunisation records.

*AOR, odds ratio adjusted for maternal age group, pre-existing medical conditions, socioeconomic status, educational attainment, residence and antenatal care provider.

*Pre-existing medical conditions included asthma, heart disease, or chronic lung disease.
Figure 2. Provider recommendations for influenza vaccination during pregnancy – 2012-14, Western Australia
Table 2. Reasons for influenza vaccination or non-vaccination during pregnancy – 2012-14, Western Australia.

<table>
<thead>
<tr>
<th>Reasons for vaccination</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>p-value^a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (weighted %)</td>
<td>n (weighted %)</td>
<td>n (weighted %)</td>
<td></td>
</tr>
<tr>
<td>To protect the baby</td>
<td>65 74.7 (64.9-84.5)</td>
<td>250 91.0 (87.7-94.2)</td>
<td>289 92.8 (89.9-95.7)</td>
<td>0.002</td>
</tr>
<tr>
<td>A HCP^b recommended it</td>
<td>70 78.8 (69.8-87.7)</td>
<td>221 80.2 (75.4-84.9)</td>
<td>262 85.5 (81.5-89.4)</td>
<td>0.06</td>
</tr>
<tr>
<td>General practitioner recommended it</td>
<td>57 65.1 (54.8-75.4)</td>
<td>150 55.7 (49.7-61.8)</td>
<td>172 57.6 (51.8-63.4)</td>
<td>0.86</td>
</tr>
<tr>
<td>Obstetrician recommended it</td>
<td>50 56.1 (45.3-66.9)</td>
<td>137 48.3 (42.3-54.4)</td>
<td>146 47.7 (41.8-53.6)</td>
<td>0.26</td>
</tr>
<tr>
<td>Midwife recommended it</td>
<td>26 29.9 (19.9-39.9)</td>
<td>100 37.1 (31.2-43.0)</td>
<td>112 35.3 (29.8-40.9)</td>
<td>0.84</td>
</tr>
<tr>
<td>Worried about influenza infection</td>
<td>57 63.9 (53.4-74.3)</td>
<td>163 57.8 (51.8-63.8)</td>
<td>179 56.5 (50.7-62.3)</td>
<td>0.07</td>
</tr>
<tr>
<td>Normally get seasonal vaccine</td>
<td>37 40.7 (30.1-51.3)</td>
<td>99 35.2 (29.4-41.0)</td>
<td>156 47.3 (41.5-53.1)</td>
<td>0.27</td>
</tr>
<tr>
<td>Have an at-risk medical condition</td>
<td>12 13.2 (6.0-20.3)</td>
<td>18 5.8 (3.1-8.5)</td>
<td>31 9.9 (6.5-13.3)</td>
<td>0.92</td>
</tr>
<tr>
<td>Offered at workplace</td>
<td>9  9.1 (3.2-15.0)</td>
<td>12 4.2 (1.8-6.6)</td>
<td>21 6.0 (2.5-8.5)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

^a p-value for test of trend for 2012-2014.
**Reasons for non-vaccination**

<table>
<thead>
<tr>
<th>Reason</th>
<th>No vaccinated</th>
<th>Yes vaccinated</th>
<th>Missing</th>
<th>Trend (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t normally get a flu vaccine</td>
<td>188</td>
<td>298</td>
<td>167</td>
<td>67.0 (61.4-72.6)</td>
</tr>
<tr>
<td>Concerned about harm to baby</td>
<td>139</td>
<td>191</td>
<td>175</td>
<td>49.6 (43.6-55.6)</td>
</tr>
<tr>
<td>Was not recommended by any HCP</td>
<td>132</td>
<td>157</td>
<td>186</td>
<td>47.9 (41.9-53.9)</td>
</tr>
<tr>
<td>Worried about side effects</td>
<td>142</td>
<td>194</td>
<td>175</td>
<td>46.8 (41.0-52.6)</td>
</tr>
<tr>
<td>Did not think was necessary</td>
<td>29</td>
<td>32</td>
<td>7</td>
<td>10.5 (6.8-14.2)</td>
</tr>
<tr>
<td>Advised against vaccination by provider</td>
<td>14</td>
<td>20</td>
<td>14</td>
<td>5.4 (2.6-8.1)</td>
</tr>
<tr>
<td>Accessibility of vaccine[c]</td>
<td>12</td>
<td>13</td>
<td>11</td>
<td>3.8 (1.7-6.0)</td>
</tr>
</tbody>
</table>

*p*-value of logistic regression assessing trend and adjusting for socioeconomic status, educational attainment and residence.

bHCP, healthcare provider.

*a*Accessibility of vaccine included issues with accessing a healthcare provider to administer the vaccine.