

2016

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

Annette Regan

Donna Mak

University of Notre Dame Australia, donna.mak@nd.edu.au

Yvonne Hauck

Robyn Gibbs

Lauren Tracey

See next page for additional authors

Follow this and additional works at: https://researchonline.nd.edu.au/med_article



Part of the [Medicine and Health Sciences Commons](#)

This article was originally published as:

Regan, A., Mak, D., Hauck, Y., Gibbs, R., Tracey, L., & Effler, P. (2016). Trends in seasonal influenza vaccine uptake during pregnancy in Western Australia: Implications for midwives. *Women and Birth, Early View (Online First)*.

<http://doi.org/10.1016/j.wombi.2016.01.009>

Original article available here:

<http://www.sciencedirect.com/science/article/pii/S1871519216000330>

This article is posted on ResearchOnline@ND at
https://researchonline.nd.edu.au/med_article/738. For more
information, please contact researchonline@nd.edu.au.



Authors

Annette Regan, Donna Mak, Yvonne Hauck, Robyn Gibbs, Lauren Tracey, and Paul Effler

This is the author's post-print copy of the article published as:

Regan, Annette K., Mak, Donna B., Hauck, Yvonne L., Gibbs, Robyn., Tracey, Lauren & Effler, Paul V., (2016). Trends in seasonal influenza vaccine uptake during pregnancy in Western Australia: Implications for midwives. *Women and Birth*. doi: 10.1016/j.wombi.2016.01.009

This article has been published in final form

at <http://www.sciencedirect.com/science/article/pii/S1871519216000330>

© 2015. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

1 **ABSTRACT**

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

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

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

10 **Findings:** Between 2012 and 2014, influenza vaccine coverage increased from 22.9% to
11 41.4%. Women who reported receiving the majority of their antenatal care from a private
12 obstetrician were significantly more likely to have influenza vaccination recommended to them
13 than those receiving the majority of their care from a public antenatal hospital or **general**
14 **practitioner** ($p < 0.001$). In 2014, the most common reason women reported for accepting
15 influenza vaccination was to protect the baby (92.8%) and the most common reason for being
16 unimmunised was lack of a healthcare provider recommendation (48.5%).

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

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

24

25 **Keywords:** Influenza Vaccine; Pregnant Woman; Maternal Health; Maternal Vaccination;
26 Antenatal Vaccination

27

28 **SUMMARY OF RELEVANCE**

29 **Problem**

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

32 **What is already known**

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

36 **What this paper adds**

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

42 INTRODUCTION

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

50

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

61

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

65

66 METHODS

67 Between 2012 and 2014, WA Health conducted an annual survey of mothers who had recently
68 given birth to a live infant in Western Australia [8, 14]. A random sample of live births was

69 selected in November each year using the Western Australian Midwives Notification System,
70 which is a legally mandated state-wide data collection of attended births in Western Australia
71 [17]. The sample was randomly selected from all births using a random number generator.
72 Sample size was determined based on the number of participants required to measure vaccine
73 uptake with a precision of $\pm 1.5\%$. In 2012, mothers residing in non-metropolitan areas were
74 oversampled. In 2013, mothers from two metropolitan health services were oversampled;
75 these oversampling techniques were not repeated in 2014. Selected women were invited to
76 participate in a 10 minute telephone interview; women who declined the invitation were
77 removed from the sample. The remaining women were telephoned by trained interviewers in
78 December to March of each year.

79

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

87

88 **Data collection**

89 Women were asked to self-report whether they were immunised against influenza during their
90 most recent pregnancy. Where possible, immunisation providers were contacted to verify the
91 self-reported vaccination status. Women were considered “vaccinated” if they self-reported a
92 vaccination which was verified by their immunisation provider. For women who self-reported
93 immunisations administered by a provider without immunisation records (i.e. private
94 workplace, pharmacy), it was assumed the woman was “vaccinated.” Women who self-

95 reported not being vaccinated and those who self-reported being vaccinated but their
96 nominated provider indicated no such vaccination was given were considered “unvaccinated.”

97

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

101

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

110 http://www.slp.wa.gov.au/legislation/statutes.nsf/main_mrtitle_1563_homepage.html

111 **Data analysis**

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

121

122 RESULTS

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

132

133 A total of 783 (38.8%) women self-reported a vaccination during their pregnancy and 756
134 (96.5%) of these women gave permission to verify the vaccination (Figure 1). Of these, 718
135 (91.7%) were classified as vaccinated. Records could not be located by the immunisation
136 provider for 65 (8.6%) women and these women were considered unvaccinated. A total of
137 1,278 women included in the final analysis were classified as unvaccinated.

138

139 Overall, between 2012 and 2014, 57.2% of women reported having been recommended TIV
140 during their most recent pregnancy and 35.3% of women received the vaccine (Table 1). After
141 adjusting for sociodemographic factors, women with chronic medical conditions were at higher
142 odds of receiving a recommendation for TIV from their provider (AOR: 1.39; 95% CI: 1.01-
143 1.91), while those residing outside the metropolitan area were at lower odds of receiving this
144 recommendation (AOR: 0.75; 95% CI: 0.58-0.98). Women who received the majority of care
145 from a general practitioner or public antenatal hospital clinic had lower odds of receiving a
146 recommendation for TIV as compared to women who received care from a private obstetrician
147 (AOR: 0.73; 95% CI: 0.54-0.99; AOR: 0.76; 95% CI: 0.60-0.95, respectively). Women who
148 received the majority of their care from a general practitioner or public antenatal hospital also

149 had lower odds of receiving TIV during pregnancy than women who received care from a
150 private obstetrician (AOR: 0.70; 95% CI: 0.52-0.94 and OR: 0.60; 95% CI 0.48-0.76,
151 respectively). Although not statistically significant, women who reported receiving the majority
152 of their antenatal care from a private practice midwife had the lowest odds of receiving a
153 recommendation (AOR: 0.49, 95% CI: 0.20-1.24) or receiving TIV during their pregnancy
154 (AOR: 0.50, 95% CI: 0.17-1.43).

155

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

163

164 The proportion of women who reported having been recommended influenza vaccination
165 during pregnancy increased from 37.2% in 2012 to 62.1% in 2014 ($p<0.001$) (Figure 2). The
166 proportion of unvaccinated women who would have been vaccinated if it had been
167 recommended by a HCP did not change throughout the study period, remaining between 75.2
168 and 80.5% ($p=0.63$). In 2014, 65.7% of women would have been vaccinated had a midwife
169 recommended the vaccine, 69.4% if a general practitioner had recommended the vaccine,
170 and 72.2% if an obstetrician had recommended the vaccine to them during pregnancy (Figure
171 2).

172

173 Between 2012 and 2014, the reason women most commonly cited for receiving TIV was to
174 protect the baby (89.7%), followed by receiving a recommendation from a HCP (82.5%). The
175 proportion of women who were immunised during pregnancy in order to protect the baby
176 increased from 74.7% in 2012 to 92.8% in 2014 ($p=0.002$), and the proportion immunised

177 because a provider recommended the vaccine increased from 78.8% in 2012 to 85.5% in
178 2014, although not significantly ($p=0.06$) (Table 2). The proportion of unimmunised women
179 who indicated they did not normally get an annual influenza vaccination decreased from 67.0%
180 in 2012 to 39.7% in 2014 ($p<0.001$). The percentage of women who were not vaccinated
181 because of concerns about potential harm to the baby decreased from 49.6% in 2012 to 42.9%
182 in 2014, although this decrease was only borderline significant ($p=0.05$). However, the
183 proportion of women who declined vaccination due to potential side effects to the mother did
184 not significantly change between 2012 and 2014 (46.8% to 43.3%, $p=0.22$).

185

186 **DISCUSSION**

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

194

195 Pregnant women and young infants are at high risk of severe influenza infection and
196 associated complications [4, 20, 21], and influenza immunisation during pregnancy has been
197 shown to prevent 36% of respiratory illnesses in mothers and 63% of influenza cases in infants
198 <6 months [2]. Based on the evidence supporting the benefits of seasonal influenza
199 vaccination to mother and infant, the World Health Organisation considers pregnant women
200 the highest priority group for seasonal influenza vaccination programs [22]. Results from our
201 investigation highlight potential strategies for improving maternal influenza vaccine uptake.

202

203 **More than 40% of women were not recommended TIV during pregnancy, and nearly 50% of**
204 **women who received their antenatal care from a general practitioner or at a public hospital**

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

218

219 Other studies suggest that midwives may be less likely to recommend and administer
220 influenza vaccine to pregnant patients as compared with other providers [24]. Our results
221 showed that women who received most of their care at sites where midwives provide care
222 (e.g., public hospital antenatal clinics) were less likely to receive a recommendation for TIV or
223 to receive TIV during pregnancy. Although the majority of midwives agree that vaccinating
224 pregnant women against seasonal influenza is important [25], researchers have found that
225 midwives may not recommend influenza vaccine to their patients as often as other providers
226 because they do not feel prepared for such conversations [25]. A recent study in the UK
227 suggests that just 26% of midwives feel prepared to provide immunisation advice and only
228 one-third of midwives are willing to immunise pregnant women [25]. Because midwives play
229 an important role in promoting TIV to their patients and successful antenatal and post-natal
230 immunisation programs rely on the support of midwives [26, 27], it is important to identify
231 barriers in promoting and providing TIV during pregnancy experienced by midwives,
232 particularly midwives practising in Australia. In Western Australia, influenza immunisation

233 education resources are available to healthcare professionals at no cost [28]; additional
234 immunisation education needs of midwives should be identified in order to provide targeted
235 immunisation education programs for midwives.

236

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

249

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

261 Additional research should further explore the association between **models of antenatal care**
262 and recommendations for, and receipt of, TIV during pregnancy.

263

264 **Conclusion**

265 Influenza vaccination during pregnancy is standard of care in Australia [32] and research in
266 many countries has shown that the recommendation of the antenatal care providers is an
267 important factor in a woman's decision to be vaccinated during pregnancy. Our results showed
268 that only two of every five women in Western Australia received an influenza vaccine during
269 their pregnancy in 2014. Significant improvement in antenatal influenza immunisation rates
270 are needed to ensure pregnant women and their young infants are protected against seasonal
271 influenza infection. We estimate that almost 80% coverage is achievable if all antenatal care
272 providers recommended the vaccine to their pregnant patients. With the recent introduction of
273 pertussis vaccination to antenatal vaccination programs in Australia [33], it will become
274 increasingly important for all antenatal care providers to actively promote antenatal
275 vaccination. Consistent recommendations from all antenatal care providers, **including**
276 midwives, and discussion of the safety and potential benefits are critical to improving influenza
277 vaccine coverage in pregnant women.

278 **AUTHOR ACKNOWLEDGMENTS**

279 The authors kindly acknowledge the contributions of Edith Cowan University as well as Mary
280 Barker, Sana Boutros, Joan Castenelle, and Maureen Griffiths at Integrity Staffing for
281 conducting the telephone interviews. We'd also like to acknowledge the support of Maureen
282 Hutchinson, the Midwives Notification System Data Custodian at Western Australia
283 Department of Health, for her support in selecting a random sample of mothers annually.
284 Finally, we would like to acknowledge Ali Radomiljac and Sarah Joyce at the Epidemiology
285 Branch (Western Australia Department of Health) for their assistance in preparing the survey
286 instrument. All project funds were provided by the Communicable Disease Control Directorate
287 at the Western Australia Department of Health.

288 **DISCLOSURE STATEMENT**

289 The authors have no conflicts of interest to disclose.

REFERENCES

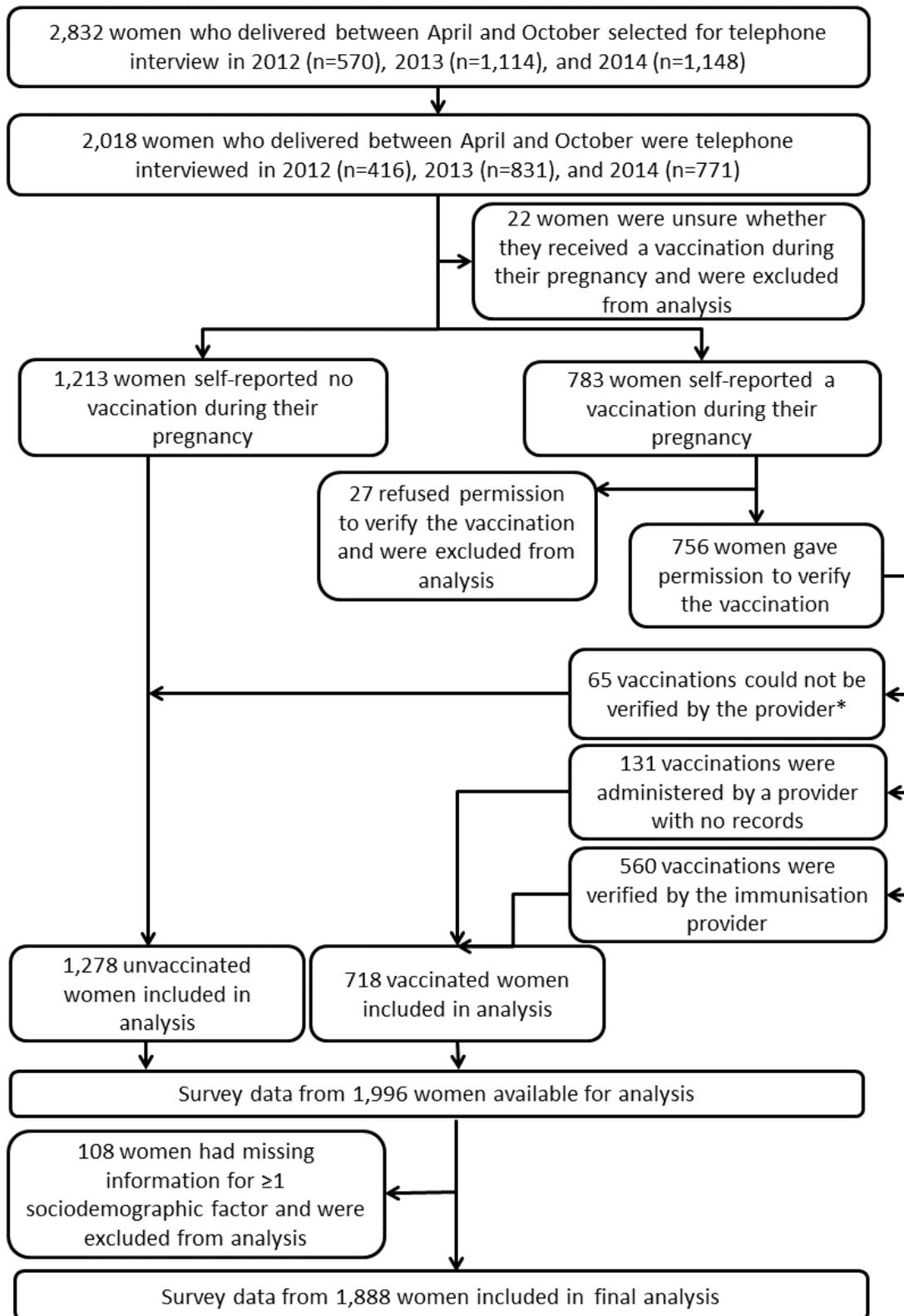
1. Manske JM. Efficacy and effectiveness of maternal influenza vaccination during pregnancy: a review of the evidence. *Matern Child Health J.* 2014 Sep;18(7):1599-609. doi: 10.1007/s10995-013-1399-2.
2. Zaman K, Roy E, Arifeen SE, Rahman M, Raqib R, Wilson E, et al. Effectiveness of maternal influenza immunization in mothers and infants. *N Engl J Med.* 2008 Oct 9;359(15):1555-64. doi: 10.1056/NEJMoa0708630.
3. Poehling KA, Szilagyi PG, Staat MA, Snively BM, Payne DC, Bridges CB, et al. Impact of maternal immunization on influenza hospitalizations in infants. *Am J Obstet Gynecol.* 2011 June;204(6):S141-8. doi: 10.1016/j.ajog.2011.02.042.
4. Dodds L, McNeil SA, Fell DB, Allen VM, Coombs A, Scott J, et al. Impact of influenza exposure on rates of hospital admissions and physician visits because of respiratory illness among pregnant women. *CMAJ.* 2007 Feb 13;176(4):463-8.
5. McNeil SA, Dodds LA, Fell DB, Allen VM, Halperin BA, Steinhoff MC, et al. Effect of respiratory hospitalization during pregnancy on infant outcomes. *Am J Obstet Gynecol.* 2011 Jun; 204(6 Suppl 1):S54-7. doi: 10.1016/j.ajog.2011.04.031.
6. Steinhoff MC, Omer SB, Roy E, El Arifeen S, Raqib R, Dodd C, et al. Neonatal outcomes after influenza immunization during pregnancy: a randomized controlled trial. *CMAJ.* 2012 Apr 3;184(6):645-53. doi: 10.1503/cmaj.110754.
7. Omer SB, Goodman D, Steinhoff MC, Rochat R, Klugman KP, Stoll BJ, et al. Maternal influenza immunization and reduced likelihood of prematurity and small for gestational age births: a retrospective cohort study. *PLoS Med.* 2011. DOI: 10.1371/journal.pmed.1000441.
8. Mak DB, Regan AK, Joyce S, Gibbs R, Effler PV. Antenatal care provider's advice is the key determinant of influenza vaccination uptake in pregnant women. *Aust N Z J Obstet Gynecol.* 2015 Apr;55(2):131-7. doi: 10.1111/ajo.12292.

9. Maher L, Hope K, Torvaldsen S, Lawrence G, Dawson A, Wiley K, et al. Influenza vaccination during pregnancy: coverage rates and influencing factors in two urban districts in Sydney. *Vaccine*. 2013 Nov 12;31:5557-64. doi: 10.1016/j.vaccine.2013.08.081.
10. Wiley KE, Massey PD, Cooper SC, Wood NJ, Ho J, Quinn HE, et al. Uptake of influenza vaccine by pregnant women: a cross-sectional survey. *Med J Aust*. 2013 Apr 15;198(7):373-5.
11. Yuen CY, Tarrant M. Determinants of uptake of influenza vaccination among pregnant women - A systematic review. *Vaccine*. 2014 Aug 6;32(36):4602-13. doi: 10.1016/j.vaccine.2014.06.067.
12. Takayama M, Gillespie CW, Mokdad AH. Health-care access and uptake of influenza vaccination among pregnant women in the USA: a cross-sectional survey. *Lancet*. 2013 Jun 17;381:S141. doi: 10.1016/S0140-6736(13)61395-1..
13. McCarthy EA, Pollock WE, Tapper L, Sommerville M, McDonald S. Increasing uptake of influenza vaccine by pregnant women post H1N1 pandemic: a longitudinal study in Melbourne, Australia, 2010 to 2014. *BMC Pregnancy Childbirth*. 2015 Mar 5;15:53. doi: 10.1186/s12884-015-0486-3.
14. Taksdal SE, Mak DB, Joyce S, Tomlin S, Carcione D, Armstrong PK, et al. Predictors of uptake of influenza vaccination: a survey of pregnant women in Western Australia. *Aust Fam Physician*. 2013 Aug;42(8):582-6.
15. Yuet Sheung Yuen C, Yee Tak Fong D, Lai Yin Lee I, Chu S Sau-mei Siu E, Tarrant M. Prevalence and predictors of maternal seasonal influenza vaccination in Hong Kong. *Vaccine*. 2013 Oct 25;31(45):5281-8. doi: 10.1016/j.vaccine.2013.08.063.
16. Lau JT, Yeung NC, Choi KC, Cheng MY, Tsui HY, Griffiths S. Factors in association with acceptability of A/H1N1 vaccination during the influenza A/H1N1 pandemic phase in the Hong Kong general population. *Vaccine*. 2010 Jun 23;28(29):4632-7. doi: 10.1016/j.vaccine.2010.04.076.

17. Western Australia Department of Health [internet]. Midwives Notification System [cited 1 August 2015]. Available from: <http://www.health.wa.gov.au/healthdata/statewide/midwives.cfm>.
18. Centers for Disease Control and Prevention [internet]. What is PRAMS? [last updated 14 May 2015; cited 21 July 2015]. Available from: <http://www.cdc.gov/prams/>.
19. Australian Bureau of Statistics [internet]. 2033.0.55.001 - Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia 2011 [last updated 28 Mar 2013; cited 1 June 2015]. Available at: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001/>.
20. Cox S, Posner SF, McPheeters M, Jamieson DJ, Kourtis AP, Meikle S. Hospitalizations with respiratory illness among pregnant women during influenza season. *Obstet Gynecol*. 2006 Jun;107(6):1315-22.
21. Nelson EA, Ip M, Tam JS, Mounts AW, Chau SL, Law SK, et al. Burden of influenza infection in hospitalised children below 6 months of age and above in Hong Kong from 2005 to 2011. *Vaccine*. 2014 Nov 20;32(49):6692-8. doi: 10.1016/j.vaccine.2014.04.063.
22. World Health Organisation. Vaccines against influenza WHO position paper – November 2012. *Wkly Epidemiol Rec*. 2012 Nov 23;87(47):461-76.
23. Soltani H, Dickinson F. Exploring women's views on information provided during pregnancy. *Br J Midwifery*. 2005;13(10):633-6.
24. Kay MK, Koelemay KG, Kwan-Gett TS, Cadwell BL, Duchin JS. 2009 pandemic influenza A vaccination of pregnant women: King County, Washington State, 2009-2010. *Am J Prev Med*. 2012 Jun;42(6 Suppl 2):S172-9. doi: 10.1016/j.amepre.2012.04.003.
25. Ishola DA Jr, Permalloo N, Cordery RJ, Anderson SR. Midwives' influenza vaccine uptake and their views on vaccination of pregnant women. *J Public Health*. 2013 Dec;35(4):570-7. doi: 10.1093/pubmed/fds109.

26. Lee T, Saskin R, McArthur M, McGeer A. Beliefs and practices of Ontario midwives about influenza immunization. *Vaccine*. 2005 Feb 18;23(13):1574-8.
27. Robbins SC, Leask J, Hayles EH, Sinn JK. Midwife attitudes: an important determinant of maternal postpartum pertussis booster vaccination. *Vaccine*. 2011 Aug 5;29(34):5591-4. doi: 10.1016/j.vaccine.2011.05.049.
28. Western Australia Department of Health [internet]. WA Health influenza immunisation module [cited 21 August 2015]. Available at: <http://cdcd.articulate-online.com/p/0477437345>.
29. Regan AK, Blyth CC, Mak DB, Richmond PC, Effler PV. Using SMS to monitor adverse events following trivalent influenza vaccination in pregnant women. *Aust NZ J Obstet Gynaecol*. 2014 Dec; 54(6):522-8. doi: 10.1111/ajo.12266.
30. Kharbanda EO, Vazquez-Benitez G, Shi WX, Lipkind H, Naleway A, Molitor B, et al. Assessing the safety of influenza immunization during pregnancy: the Vaccine Safety Datalink. *Am J Obstet Gynecol*. 2012 Sep;207(3):S47-51. doi: 10.1016/j.ajog.2012.06.073.
31. Bednarczyk RA, Adjay-Gbewonyo D, Omer S. Safety of influenza immunization during pregnancy for the fetus and the neonate. *Am J Obstet Gynecol*. 2012 Sep;207(3 Suppl):S38-46. doi: 10.1016/j.ajog.2012.07.002.
32. Royal Australian and New Zealand College of Obstetricians and Gynecologists [internet]. Influenza vaccination during pregnancy (and in women planning pregnancy) [last updated Jul 2013; cited 1 June 2015]. Available at: <http://www.ranzcog.edu.au/womens-health/resources-for-women-a-practitioners/pregnancy-and-influenza.html>.
33. Western Australia Department of Health [internet]. Influenza and pertussis vaccinations for pregnant women [last updated 13 May 2015; cited 20 August 2015]. Available at: <http://www.health.wa.gov.au/circularsNew/attachments/1042.pdf>.

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



290
291
292

*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.

	Total	Recommended vaccine ^a		Received vaccine ^b	
	n (weighted %)	n (weighted %)	AOR ^c (95% CI)	n (weighted %)	AOR* (95% CI)
OVERALL	1,888 (100)	1,062 (57.2)	---	686 (35.3)	---
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					
≥1 medical condition ^d	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

By educational attainment

≤High school	563 (32.2)	306 (56.2)	1.11 (0.82-1.52)	180 (31.1)	0.72 (0.53-0.98)*
TAFE/some university	986 (51.6)	560 (57.5)	1.06 (0.81-1.38)	356 (35.3)	0.77 (0.59-1.00)
≥University graduate	339 (16.2)	196 (58.0)	Ref	150 (43.6)	Ref

By socioeconomic status

Tertile 1 (Most disadvantaged)	504 (27.9)	264 (55.0)	1.01 (0.76-1.34)	182 (35.3)	1.16 (0.88-1.52)
Tertile 2	586 (31.3)	325 (56.0)	0.99 (0.76-1.34)	200 (33.4)	1.00 (0.78-1.28)
Tertile 3 (Least disadvantaged)	798 (40.8)	473 (59.6)	Ref	304 (36.7)	Ref

By residence

Non-metropolitan	498 (27.0)	244 (51.1)	0.75 (0.58-0.98)*	159 (32.4)	0.90 (0.69-1.17)
Metropolitan	1,390 (72.9)	818 (59.5)	Ref	527 (36.3)	Ref

ANTENATAL CARE**CHARACTERISTICS**

Location of majority of antenatal care					
Private obstetrician	702 (34.9)	441 (62.8)	Ref	314 (43.6)	Ref
General practitioner	379 (20.0)	187 (51.7)	0.73 (0.54-0.99)*	123 (32.7)	0.70 (0.52-0.94)*
Public antenatal hospital	786 (43.7)	426 (55.5)	0.76 (0.60-0.95)*	244 (30.1)	0.60 (0.48-0.76)*
Private practice midwife	21 (1.2)	8 (42.3)	0.49 (0.20-1.24)	5 (24.3)	0.50 (0.17-1.43)

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

^bReceived 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.

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

^dPre-existing medical conditions included asthma, heart disease, or chronic lung disease.

Figure 2. Provider recommendations for influenza vaccination during pregnancy – 2012-14, Western Australia

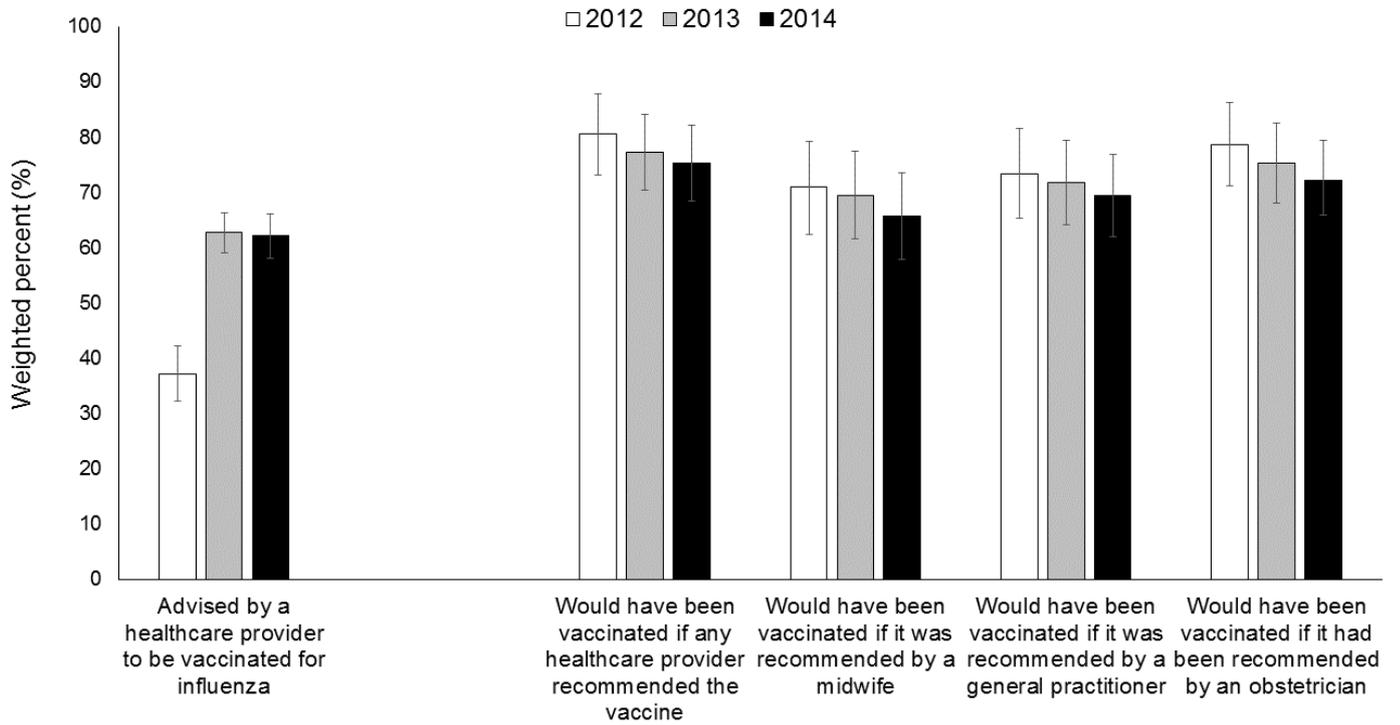


Table 2. Reasons for influenza vaccination or non-vaccination during pregnancy – 2012-14, Western Australia.

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

Reasons for non-vaccination

Don't normally get a flu vaccine	188	67.0 (61.4-72.6)	298	68.1 (63.6-72.6)	167	39.7 (34.5-45.0)	<0.001
Concerned about harm to baby	139	49.6 (43.6-55.6)	191	41.9 (37.1-46.6)	175	42.9 (37.4-48.4)	0.05
Was not recommended by any HCP	132	47.9 (41.9-53.9)	157	36.7 (32.0-41.4)	186	48.5 (42.8-54.1)	0.73
Worried about side effects	142	46.8 (41.0-52.6)	194	43.1 (38.3-47.8)	175	43.3 (37.8-48.9)	0.22
Did not think was necessary	29	10.5 (6.8-14.2)	32	7.1 (4.7-9.5)	7	1.5 (0.4-2.6)	<0.001
Advised against vaccination by provider	14	5.4 (2.6-8.1)	20	4.8 (2.7-6.9)	14	4.9 (1.4-8.4)	0.74
Accessibility of vaccine ^c	12	3.8 (1.7-6.0)	13	3.0 (1.3-4.6)	11	2.4 (0.9-3.9)	0.35

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

^b†HCP, healthcare provider.

^aAccessibility of vaccine included issues with accessing a healthcare provider to administer the vaccine.