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Midwives' knowledge, attitudes and learning needs regarding antenatal vaccination

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ABSTRACT

Objective: To determine the knowledge, attitudes and learning needs of midwives regarding antenatal vaccination.

Design & Setting: A cross-sectional, paper-based survey of midwives employed at the only public tertiary maternity hospital in the Australian state of XX between November 2015 and July 2016.

Participants: 252 midwives providing care in antepartum, intrapartum, and/or postpartum settings.

Measurements: Self-reported responses to a 41-item survey.

Findings: The vast majority of midwives supported influenza and pertussis vaccination for pregnant women, with 90.0% and 71.7% reporting they would recommend pertussis and influenza vaccine, respectively, to a pregnant friend or family member, and almost all stating that midwives should administer vaccines to pregnant patients (94.8%). Seven out of ten midwives (68.1%) responded correctly to all knowledge items regarding vaccines recommended during pregnancy; 52.8% demonstrated correct knowledge regarding vaccine administration despite only 36.6% having attended an education session on antenatal vaccination in the previous two years. Nearly all midwives (97.3%) expressed a need for more education on vaccine administration. The most commonly reported barrier to administering influenza (61.3%) and pertussis (59.0%) vaccination was having staff available with the certification required to administer vaccines.

Key Conclusions: Midwives view antenatal vaccination as their responsibility and are interested and receptive to education.

Implications for Practice: There is an unmet need and demand among midwives for professional development that would enable them to recommend and administer vaccines to pregnant women in accordance with national immunisation guidelines and integrate vaccination into routine antenatal care.

Keywords: *midwifery, vaccination, prenatal care, preventive medicine*

Introduction

Antenatal vaccination is an important strategy for preventing serious disease in pregnant women and their infants during the first six months of life. Vaccination during pregnancy has been found to prevent 63% of influenza infections and 91% of pertussis infections among young infants (Zaman, Roy et al. 2008, Amirthalingam, Andrews et al. 2014). Due to these benefits, influenza and pertussis vaccines are routinely recommended for pregnant women in Australia, other high-income countries and the World Health Organization (World Health Organization 2012, Australian Technical Advisory Group on Immunisation (ATAGI) 2016).

Despite the substantial health benefits of antenatal vaccination, uptake of vaccines among pregnant women is low in Australia and other countries. Currently, between 40-50% of pregnant women receive an influenza vaccine in Australia (McCarthy, Pollock et al. 2015, Regan, Mak et al. 2016). These estimates are similar to those in the United States (Groom, Henninger et al. 2016), Canada (Liu, Sprague et al. 2012), and the United Kingdom (Dabrera, Zhao et al. 2014). Studies investigating reasons for these low rates have consistently identified advice by antenatal care providers as the strongest factor influencing whether a woman will accept vaccines during her pregnancy or not (Henninger, Irving et al. 2015, Mak, Regan et al. 2015, Regan, Mak et al. 2016).

Given their frequent contact with pregnant women, midwives have an important role in antenatal vaccine promotion. Previous research has shown that 70% of unvaccinated pregnant women would have received a vaccine during their most recent pregnancy had a midwife recommended it to them (Regan, Mak et al. 2016). However, less than 62% of pregnant women reported that a health professional recommended vaccination to them (Regan, Mak et al. 2016).

Despite the key role midwives have in recommending and providing vaccines to pregnant women, little is known about their knowledge and attitudes regarding antenatal vaccination. Although some surveys have suggested midwives support vaccination during pregnancy

(Ishola, Permalloo et al. 2013), several surveys in Canada and Belgium have identified knowledge gaps regarding antenatal vaccination that midwives may perceive as barrier to recommending and offering vaccine to pregnant patients. For example, less than half of midwives in Ontario reported having sufficient knowledge of immunisation (Lee, Saskin et al. 2005). A recent survey of health providers in Belgium found one-quarter of midwives recommended influenza and pertussis vaccines to their pregnant patients (Maertens, Braeckman et al. 2016), and a similar study from Canada suggested midwives take a less active role in promoting immunisation compared to other healthcare providers (Dube, Vivion et al. 2013). This study aimed to assess the knowledge, attitudes and learning needs of midwives in hospital X, the only public tertiary maternity hospital in the Australian state of XX.

Methods

Design and aim

We conducted a cross-sectional survey of the knowledge, attitudes and learning needs for antenatal immunisation among midwives working at hospital X between November 2015 and July 2016. Midwives providing antenatal care were also asked about their current vaccination practices and perceived barriers to administration of influenza and pertussis vaccination. Surveys are ideal for gathering information about attitudes, knowledge and phenomena such as beliefs or perceptions of existing practices (Schneider, Whitehead et al. 2013, Borbasi and Jackson 2016). All midwives employed within hospital X were invited to participate in the survey reflecting convenience sampling. Approval was granted from the hospital Human Research Ethics Committee (Reference Number 2016122QK).

Survey instrument

A survey instrument was designed for the current study which incorporated items about i) attitudes on vaccination adapted from a United Kingdom survey of midwives (Ishola, Permalloo et al. 2013); ii) vaccination learning needs adapted from an Australian survey of

midwives' perinatal mental health learning needs (Hauck, Kelly et al. 2015); and iii) general knowledge items regarding vaccination during pregnancy.

The final instrument contained 41 items, which collected information on midwives' attitudes toward vaccination (eight items), vaccination history (two items), immunisation learning needs (four items), and general knowledge of influenza and pertussis vaccines (21 items). General knowledge items were grouped into three themes: evidence supporting the need for antenatal vaccination (nine items), safety of vaccination during pregnancy (five items), and appropriate administration of vaccines to pregnant women (seven items). Midwives who routinely provide antenatal care were asked four additional items, including whether influenza and pertussis vaccinations were routinely recommended and administered in their clinical area and barriers related to vaccine administration. Barriers were classified as major, minor, or not a barrier. The final two survey items collected demographic and employment information.

Prior to commencement, the survey was piloted with six midwives, who offered feedback on the clarity, content and format of the questions.

Setting

Hospital X is the only public tertiary maternity hospital in XX and has approximately 6,000 births per year. The hospital offers a variety of antenatal and postnatal services, including general antenatal clinics, specialist antenatal clinics, midwife-led care for low risk and all risk women and a Community Midwifery Program offering homebirth services.

At the time the survey was administered (November 2015 to July 2016) midwives working at Hospital X (with the exception of the Infection Control Coordinators) did not have an active role in immunising pregnant women. In October 2016, changes to XX's vaccine administration code enabled midwives with an immunisation certificate to administer pertussis and influenza vaccinations to pregnant women (Department of Health Western Australia 2016). Therefore,

our results reflect the baseline knowledge and attitudes prior to the introduction of this training course.

Recruitment and data collection

During the study period approximately 590 full-time midwives were employed at the hospital. A sample size calculator was used to determine the recommended sample of 233 participants to achieve a 5% margin of error and 95% confidence level (under assumption of 50% response distribution) (Raosoft Inc. 2004). Over a nine-month period, two clinical nurse consultants in infection prevention and management who were clinical champions for the study and a midwife employed as a research assistant visited all clinical areas where midwives were employed to advertise the survey. They provided information about the study purpose, answered queries and distributed surveys and a locked box for midwives to deposit anonymously completed surveys. Confidentiality was assured as no information was collected that could identify individual midwives. The survey cover sheet provided information regarding the study purpose and clarified that summaries of the findings would be reported. Submission of a completed survey was regarded as implied consent.

Data analysis

Survey data were analysed in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Percentages and corresponding 95% confidential intervals (CIs) were estimated based on survey responses. Comparisons in survey responses were made using one-sample t-tests ($\alpha=.05$). With regards to vaccine knowledge, we calculated the mean percent of knowledge items correctly identified. Mean percent was compared between groups using Wilcoxon Signed Rank Tests ($\alpha=.05$).

Results

A total of 252 surveys were completed between November 2015 and July 2016. Nearly half the respondents (47.6%) had 10 years or less experience in midwifery and 43.1% worked

across antenatal, intrapartum, and postpartum services (Table 1). The majority (63.4%) had not attended an education session related to antenatal vaccination in the past two years. Three-quarters (75.0%) had been vaccinated against pertussis in the last 10 years, 62.3% against influenza in the past one year and 52.5% had been vaccinated against pertussis in the last 10 years and influenza in the past one year.

Attitudes to antenatal vaccination

In general, the majority of midwives reported influenza and pertussis vaccination during pregnancy was justified and would recommend the vaccines to a pregnant friend or family member (Table 2). While there was no difference in the percentage of midwives who would recommend influenza versus pertussis vaccines to a close friend or family member who was pregnant (71.7% [95% CI 66.1-77.3%] and 90.0% [95% CI 86.3-93.7%], respectively, $p=.53$), a significantly lower proportion of midwives reported that influenza vaccine was justified during pregnancy compared to pertussis vaccine (91.2%, [95% CI 87.7-94.7%] and 79.2% [95% CI 74.2-84.2%], respectively, $p=.02$). The majority of respondents reported it was a midwife's role to routinely advise pregnant women on vaccines (87.5%) and to administer vaccines to pregnant women (78.3%). When asked which health professional should offer advice or information about antenatal vaccines, a midwife was nominated by 72.9% compared to a general practitioner GP (58.9%) and obstetrician (57.8%).

Knowledge of antenatal vaccination

On average, respondents answered 68.1% (SE 1.3%) of general knowledge questions regarding antenatal vaccination correctly. In general, midwives answered items about administration of vaccines to pregnant women correctly least often (52.8% [SE 1.6%]) as compared to the evidence supporting vaccination (78.6% [SE 1.4%]) and the safety of vaccination during pregnancy (70.3% [SE 2.3%]). A large proportion of midwives were aware that maternal antibodies against influenza (74.1% [95% CI 68.6-79.5%]) and pertussis (85.9% [95% CI 81.5-90.2%]) protect infants after birth (Table 3). However, only half of midwives

(55.2% [95% CI 49.1-61.4%]) knew that pertussis vaccination is more effective at protecting infants when the mother is vaccinated during the second and third trimesters of pregnancy. Less than half of midwives (48.0% [95% CI 41.8-54.2%]) were aware that pertussis vaccine is recommended in every pregnancy regardless of previous pertussis vaccination. However, 83.8% (95% CI 79.2-88.4%) of midwives knew that influenza vaccine was required during the current pregnancy, even if the patient had received the vaccine in the prior year.

When we compared the percent of general knowledge items answered correctly by subgroups (Table 4), we found that midwives working in antenatal services ($p=.03$), those who had attended an education session in the last two years on antenatal vaccination ($p<.001$) and those who had received an influenza or pertussis vaccine ($p=.001$) had better overall knowledge of antenatal vaccination (Table 4). Interestingly, there was no difference observed in the percent of general knowledge items correctly identified based on whether the midwife worked in a clinical area where pregnant women were being vaccinated ($p>.05$).

Vaccine education needs

A total of 97.3% (95% CI 95.1-99.2%) of midwives reported wanting education on the following topics: evidence for antenatal pertussis (81.9% [95% CI 77.1-86.7%]) and influenza (80.7% [95% CI 75.8-85.6%]) vaccine during pregnancy; the implications of antenatal vaccination on the fetus and newborn (78.3% [95% CI 73.2-83.4%]); and the roles and expectations of health professional for advising pregnant women about vaccines (74.3% [95% CI 69.9-79.7%]) and for administering vaccines to pregnant women (68.1% [95% CI 62.3-73.9%]). When asked about the preferred format, 82.3% (95% CI 77.6-87.1%) of midwives reported preferring online packages and 61.6% (95% CI 54.6-66.7%) preferred a seminar with a guest speaker (multiple responses allowed).

Barriers to antenatal vaccination

A total of 177 midwives who worked in antenatal services answered questions related to barriers to administering vaccines to pregnant patients. The most common barrier identified

was having staff with an immunisation certificate which qualifies midwives to administer vaccines under routine standing orders (60.5% [95% CI 53.3-67.7%]) (Table 5). One-third of midwives stated staff time required to immunise was a major barrier to vaccinating pregnant women (36.2% [95% CI 29.1-43.2%]). Midwives also stated obtaining a medication order (22.6% [95% CI 16.4-28.8%]), uncertain evidence supporting the need for vaccination (23.2% [95% CI 16.9-29.4%]), and concern about the safety of vaccination for the fetus (19.2% [95% CI 13.4-25.0%]) were major barriers to antenatal vaccination. Other barriers were less frequently reported.

Discussion

To our knowledge this is the first survey in Australia of midwives' attitudes, knowledge and learning needs regarding antenatal vaccination. Similar to surveys of other healthcare providers (Healy, Rench et al. 2015, MacDougall, Halperin et al. 2015), our results indicate that midwives strongly support vaccination against both influenza and pertussis. The majority of midwives also reported believing that antenatal immunisation should be provided by midwives. Our results indicate that midwives are willing to advise and administer vaccines for pregnant women and their role could be supported through targeted vaccine education and support to obtain the required immunisation certification. Uncertainty about who is responsible for discussing, recommending, and providing vaccines to pregnant women has been identified in other settings as a barrier to antenatal vaccination (Tong, Biringer et al. 2008), but this is unlikely to apply to hospital X given that 87.5% of midwives at the hospital given agreed that midwives should routinely advise pregnant women about vaccination and 78.3% agreed that midwives should be expected to vaccinate pregnant women.

We identified key areas for improvement of vaccine knowledge among midwives, particularly related to the optimal timing of pertussis vaccine administration during pregnancy. Knowledge of vaccines reported by midwives in our survey was lower compared to surveys of other providers. An American survey of antenatal care providers showed that 84% of providers were

aware that influenza vaccine was recommended during any trimester and 79% of providers were aware pertussis vaccine was recommended in third trimester (Healy, Rench et al. 2015). In contrast, less than half of midwives who participated in our survey were aware that pertussis vaccination was recommended for every pregnancy or that influenza vaccine could be given in any trimester. Furthermore, few midwives correctly identified contraindications for administering vaccines during pregnancy. Just 21-22% of midwives knew that mild concurrent illness was not a contraindication to vaccination. In contrast, a survey of 133 obstetric providers in New York showed that 92% of providers were aware of vaccine recommendations and more than 90% of nurses were aware of the recommended gestation for pertussis and influenza vaccination (Bonville, Cibula et al. 2015). These results suggest midwives could benefit from additional opportunities for vaccine education.

Nearly all midwives wanted additional education on antenatal vaccination and expressed a preference for receiving this education through online education; these results indicate educational programs for midwives in this area should address these issues, with an emphasis on education of routine recommendations for vaccination during pregnancy and contraindications. Programs which can provide vaccine education using online settings, such as webinars, would be ideal. Given attendance at an education session in the last two years was associated with greater knowledge of antenatal vaccines in our study results, supporting vaccine education is likely to result in improved knowledge in these areas. Previous research has shown that midwives who have confidence in their ability to advise and provide on vaccinations are more likely to provide vaccines to pregnant women (Robbins, Leask et al. 2011).

We identified several factors associated with lower vaccine knowledge, including not having received a seasonal influenza vaccine or booster dose of pertussis vaccine and working outside antenatal services. In some settings midwives are cited as the primary source of vaccine information for pregnant women (Vila-Candel, Navarro-Illana et al. 2016). Because midwives have an important role in providing information about vaccination to pregnant women

and their families, it is crucial that midwives have adequate knowledge of vaccination evidence and recommendations, regardless of their clinical area. Educational interventions should target all midwives to improve their knowledge and competency about vaccines.

Barriers cited by midwives in our survey were similar to those in other countries, including staff time and having appropriate certification (Healy, Rensch et al. 2015). Other barriers cited in the literature include the cost of vaccine, concerns about vaccine safety, inadequate reimbursement, vaccine storage, or belief that vaccine should be administered by another provider were common barriers to vaccination (Kissin, Power et al. 2011, Bonville, Cibula et al. 2015). These barriers were mentioned by less than 20% of midwives in our survey.

There are some limitations to our study. Although this was the first survey of midwives in our area, these data were self-reported by a relatively small sample of midwives at the only public tertiary maternity hospital in XX and may not necessarily be generalizable to the wider population of midwives or to midwives who practice privately or those who work in secondary maternity hospitals and rural and remote areas. Although surveys were anonymous and confidential and could not be linked to participating midwives, it is also possible there was some response bias, particularly with regards to health behaviours. However, it should be noted that the percent of midwives immunised against influenza in this survey is similar to public hospital employees in the state (author unpublished data), suggesting, if present, this bias may not be large.

Midwives are interested in learning more about antenatal vaccination. Increased knowledge of vaccination is associated with improved vaccine uptake in pregnant women (Eppes, Wu et al. 2012). Uptake of antenatal influenza and pertussis vaccination is sub-optimal in pregnant women in Australia and other parts of the world, and this has largely been attributed to poor knowledge around the importance of vaccination during pregnancy (Groom, Henninger et al. 2016, Regan, Mak et al. 2016). Given their frequent contact with pregnant women, education

programs for midwives related to vaccines recommended during pregnancy could help to improve vaccine coverage in pregnant women.

Conclusions

Our results show that midwives support the provision of vaccines to pregnant women, view vaccination as their responsibility, and are interested in learning more about antenatal vaccination. Informed discussion of the importance of antenatal vaccination and provision of vaccines by midwives has the potential to improve vaccine coverage in pregnant women. Provision of vaccine education for midwives, through formal education and continuing professional development, should be a priority for midwifery professional development and antenatal vaccine programs.

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Table 1. Characteristics of midwives participating in antenatal vaccination survey (n=252), Hospital X, Australia, 2015-16.

Variable	No. of survey participants	%
<i>Years of midwifery clinical experience (n=244)</i>		
0-4 years	59	24.2
5-10 years	57	23.4
11-15 years	32	13.1
16-25 years	46	18.9
≥26 years	50	20.5
<i>Clinical area of midwifery (n=241)</i>		
Antepartum only	25	10.4
Intrapartum only	27	11.2
Postpartum only	32	13.3
Antepartum and intrapartum	6	2.5
Antepartum and postpartum	42	17.4
Intrapartum and postpartum	5	2.1
Antepartum, intrapartum and postpartum	104	43.1
<i>Attended education session in last two years on topic of vaccination in pregnancy (n=246)</i>		
Yes	90	36.6
No	156	63.4
<i>Received an influenza vaccine in last year (n=247)</i>		
Yes	154	62.3
No	92	37.3
Unsure	1	0.4
<i>Received a pertussis vaccine in last 10 years (n=248)</i>		
Yes	186	75.0
No	51	20.6
Unsure	11	4.4
<i>Worked in a clinical area that provided vaccinations (n=251)</i>		
Yes	168	66.9
No	83	33.1

Table 2. Midwives' self-reported attitudes regarding antenatal vaccination (n=252), Hospital X, Australia, 2015-16.

Agreement with statement (N responses)	n	% (95% CI)
Giving pertussis vaccine to pregnant women is justified (n=250)	228	91.2 (87.7-94.7)
I would recommend pertussis vaccine to friend or family member who was pregnant (n=250)	225	90.0 (86.3-93.7)
Midwives should be routinely expected to give advice to pregnant women on vaccines (n=249)	218	87.5 (83.5-91.7)
Giving influenza vaccine to pregnant women is justified (n=250)	198	79.2 (74.2-84.2)
Midwives should be routinely expected to vaccinate pregnant women (n=249)	195	78.3 (73.2-83.4)
A midwife should give advice or information about vaccines to pregnant women (n=251)	183	72.9 (67.4-78.4)
I would recommend influenza vaccine to friend or family member who was pregnant (n=251)	180	71.7 (66.1-77.3)
A midwife should administer vaccines to pregnant women (n=249)	160	64.3 (58.3-70.2)
A general practitioner should give advice or information about vaccines to pregnant women (n=251)	150	58.9 (53.7-65.8)
An obstetrician should give advice or information about vaccines to pregnant women (n=251)	145	57.8 (51.7-63.9)
A general practitioner should administer vaccines to pregnant women (n=249)	112	45.0 (38.8-51.2)
An obstetrician should administer vaccines to pregnant women (n=249)	104	41.8 (35.6-47.8)

Table 3. Knowledge of antenatal vaccination by themes of evidence, safety and administration self-reported by midwives (n=252), Hospital X, Australia, 2015-16.

General knowledge statement (N responses, correct answer)	Total correct responses	
	N	% (95% CI)
<i>THEME 1: evidence for vaccination during pregnancy</i>		
Pertussis vaccination is important to protect babies (246, true)	222	90.2 (86.5-93.9)
Pregnant women are at a higher risk of complications from influenza than the general population (248, true)	217	87.5 (83.4-91.6)
Influenza vaccine is important to protect mothers (248, true)	213	85.9 (81.5-90.2)
Antibodies against pertussis can cross the placenta offering infants some protection after birth (248, true)	213	85.9 (81.5-90.2)
Pertussis vaccination is important to protect mothers (246, true)	206	83.7 (79.1-88.3)
Antibodies against influenza can cross the placenta offering infants some protection after birth (247, true)	183	74.1 (68.6-79.5)
Influenza vaccine is important to protect babies (248, true)	181	73.0 (67.5-78.5)
Pertussis vaccination during pregnancy is more effective at protecting babies than post-natal vaccination of parents/carers (249, true)	164	65.9 (60.0-71.7)
Pertussis vaccination is equally effective in all trimesters (248, false)	137	55.2 (49.1-61.4)
<i>THEME 2: vaccine safety</i>		
Influenza vaccination in pregnancy may be harmful to mothers (248, false)	191	77.0 (71.8-82.3)

Midwives knowledge of antenatal vaccination

Pertussis vaccination in pregnancy may be harmful to babies (247, false)	184	74.5 (69.1-79.9)
Influenza vaccination in pregnancy may be harmful to babies (248, false)	190	71.4 (65.7-77.0)
The safety profile of pertussis vaccination during pregnancy has been well established (248, true)	163	65.7 (59.8-71.6)
The safety profile of influenza vaccination during pregnancy has been well established (246, true)	151	61.4 (55.3-67.5)

THEME 3: vaccine administration

Administration of influenza vaccine in a current pregnancy is not required if patient received it last year (247, false)	207	83.8 (79.2-88.4)
Influenza vaccination in pregnancy is contraindicated in breastfeeding mothers (249, false)	186	74.7 (69.3-80.1)
Pertussis vaccination in pregnancy is contraindicated in breastfeeding mothers (245, false)	183	74.7 (69.3-80.1)
Administration of pertussis vaccine in subsequent pregnancies is not required if administered within the last 10 years (248, false)	119	48.0 (41.8-54.2)
Influenza vaccine may be given in any trimester (246, true)	110	44.7 (38.5-50.9)
Pertussis vaccination in pregnancy is contraindicated if the patient has a mild concurrent illness (247, false)	55	22.3 (17.1-27.5)
Influenza vaccination in pregnancy is contraindicated if the patient has a mild concurrent illness (248, false)	52	21.0 (15.9-26.0)

Table 4. Mean percentage of correct vaccine knowledge, by midwifery expertise and health behaviour, Hospital X, Australia, 2015-16.

Learning needs identified (n responses)	Total		Evidence		Safety		Administration	
	Mean (SE)	p-value*	Mean (SE)	p-value*	Mean (SE)	p-value*	Mean (SE)	p-value*
Years of experience								
0-4 years (n=59)	66.2 (2.1)		80.9 (2.3)		63.1 (4.4)		48.2 (3.0)	
5-10 years (n=57)	67.4 (3.2)		79.0 (2.9)		66.7 (4.9)		51.8 (3.8)	
11-15 years (n=32)	65.0 (4.2)		69.9 (5.2)		68.1 (6.8)		57.1 (4.0)	
16-25 years (n=46)	72.8 (2.9)		81.4 (3.2)		82.7 (4.3)		54.8 (3.5)	
≥26 years (n=50)	71.6 (2.2)	.23	80.1 (2.3)	.43	77.4 (4.6)	.01	56.8 (3.1)	.64
Clinical area of midwifery								
Antepartum only (n=25)	79.1 (2.4)		88.9 (2.3)		78.4 (5.6)		64.6 (3.9)	
Intrapartum only (n=27)	61.5 (4.7)		69.6 (5.6)		74.1 (7.1)		42.3 (4.4)	
Postpartum only (n=32)	63.5 (3.8)		77.1 (3.9)		61.9 (7.3)		48.1 (3.9)	
Antepartum and postpartum (n=42)	70.5 (3.1)		82.1 (3.1)		81.5 (4.1)		49.6 (4.3)	
Antepartum, intrapartum and postpartum (n=104)	67.5 (1.9)	.03	78.1 (2.1)	.07	64.7 (3.6)	.08	54.6 (2.5)	.01
Attended education session in last two years on topic of vaccination in pregnancy								
Yes (n=90)	77.0 (1.9)		85.9 (2.0)		78.8 (3.4)		62.7 (2.4)	
No (n=156)	63.4 (1.6)	<.001	74.6 (1.8)	<.001	65.8 (2.9)	.003	47.5 (1.9)	<.001
Received an influenza vaccine in last year								
Yes (n=154)	72.4 (1.4)		82.9 (1.3)		78.0 (2.2)		55.1 (2.0)	
No (n=92)	61.8 (2.4)	.001	72.5 (2.7)	.01	59.1 (4.3)	.001	48.9 (2.5)	.14

Midwives knowledge of antenatal vaccination

Received a pertussis vaccine in last 10 years

Yes (n=186)	70.8 (1.4)		80.4 (1.4)		74.4 (2.4)		55.7 (1.8)	
No (n=51)	60.0 (3.3)	.001	72.2 (4.0)	.12	57.2 (5.7)	.01	42.9 (3.2)	.001

Works in clinical area actively vaccinating

Yes (n=168)	67.4 (1.6)		78.3 (1.7)		67.9 (2.8)		52.5 (1.9)	
No (n=83)	69.5 (2.2)	.50	79.3 (2.2)	.92	75.3 (3.5)	.14	53.4 (2.8)	.96

*p-value for Wilson Rank Sum Test

Table 5. Barriers to providing vaccines to pregnant women, as self-reported by midwives (n=177), Hospital X, Australia, 2015-16.

Barriers to vaccination (N answered)	Influenza vaccines		Pertussis vaccines	
	n	% (95% CI)	n	% (95% CI)
Having staff with appropriate immunisation training* (n=173)	106	61.3 (54.0-68.5)	102	59.0 (51.6-66.3)
Staff time (n=172)	59	34.3 (27.2-41.4)	61	35.5 (28.3-42.6%)
Obtaining a medication order (n=171)	37	21.6 (15.5-27.8)	40	23.4 (17.1-29.7)
Uncertain evidence supporting the need for vaccination (n=172)	38	22.1 (15.9-28.3)	26	15.1 (9.8-20.5)
Concern about safety of vaccination to fetus (n=171)	32	18.7 (12.9-24.6)	26	15.2 (9.8-20.6)
Concerns about adverse events following immunisation (n=169)	23	13.6 (8.4-18.8)	23	13.6 (8.4-18.8)
Low demand for vaccine (n=168)	27	16.1 (10.5-21.6)	21	12.5 (7.5-17.5)
Obtaining consent (n=171)	21	12.3 (7.4-17.2)	20	11.7 (6.9-16.5)
Supply and cost of vaccine (n=172)	14	8.1 (4.1-12.2)	17	9.9 (5.4-14.3)
Billing for vaccines (n=167)	15	9.0 (4.7-13.3)	13	7.8 (3.7-11.9)
Storage of vaccines (n=172)	14	8.1 (4.1-12.2)	11	6.4 (2.7-10.1)

*In XX, an immunisation certificate is required to administer vaccines to pregnant women under routine standing orders. This certificate is obtained after completing an immunisation education course.