Australian Government
Department of Health

COMMUNICABLE DISEASES INTELLIGENCE

2019 Volume 43

https://doi.org/10.33321/cdi.2019.43.21

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Communicable Diseases Intelligence
ISSN: 2209-6051 Online

This journal is indexed by Index Medicus and Medline.

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http://www.health.gov.au/cdna

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Communicable Diseases Intelligence is produced by:
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Original article

Potential use of Western Australia's mandatory Midwives Notification System for routinely monitoring antenatal vaccine coverage

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Abstract

Background

Despite the maternal and infant health benefits of antenatal vaccines and availability of government-funded vaccination programs, Australia does not have a national system for routinely monitoring antenatal vaccination coverage. We evaluated the potential use of Western Australia's mandatory Midwives Notification System (MNS) as a tool for routinely monitoring antenatal vaccination coverage.

Methods

Two hundred and sixty-eight women who gave birth to a live infant between August and October 2016 participated in a telephone survey of vaccines received in their most recent pregnancy. For women who reported receiving influenza and/or pertussis vaccine and whose vaccination status was documented by their vaccine provider, MNS vaccination data were compared with the vaccine provider's record as the 'gold standard.' For women who reported receiving no vaccines, MNS vaccination data were compared with self-reported information.

Results

Influenza and pertussis vaccination status was complete (i.e. documented as either vaccinated or not vaccinated) for 66% and 63% of women, respectively. Sensitivity of MNS influenza vaccination data was 65.7% (95% CI 56.0-74.2%) and specificity was 53.0% (95% CI 42.4-63.4%). Sensitivity of MNS pertussis vaccination data was 62.5% (95% CI 53.3-70.9%) and specificity was 40.4% (95% CI 27.6-54.7%). There was no difference between vaccinated and unvaccinated women in the proportion of MNS records with missing or unknown vaccination information. When considering only MNS records with complete vaccination information, the sensitivity of the MNS influenza vaccination field was 91.8% (95% CI 83.0-96.9%) and the sensitivity of the MNS pertussis vaccination field was 88.0% (95% CI 76.7-95.5%).

Conclusion

Due to the high proportion of records with missing or unknown vaccination status, we observed low sensitivity and specificity of antenatal vaccination data in the MNS. However, given we did not observe differential ascertainment by vaccination status, MNS records with complete information may be reliable data source for routinely monitoring antenatal vaccine coverage.

Keywords: Antenatal vaccination, pregnancy, vaccine surveillance, vaccine coverage, influenza vaccine, pertussis vaccine, public health, evaluation

Article summary

We evaluated the use of Western Australia's mandatory Midwives Notification System (MNS) for routinely monitoring antenatal vaccine coverage. Despite the low proportion of completed vaccine fields, complete vaccine information in the MNS was highly reliable and is a potential source of state-wide vaccine coverage data for public health surveillance.

Introduction

Influenza and pertussis-containing vaccines are routinely recommended for pregnant women in Australia[1] and other developed countries[2-4], as seasonal influenza vaccine can prevent up to 63% of influenza infections in infants and 36% of febrile respiratory illnesses in pregnant women[5,6] and antenatal pertussis vaccination can prevent up to 91% of infections in infants <2 months of age.[7-10] Despite these benefits, uptake of influenza and pertussis vaccines by pregnant women in Australia and other countries has been suboptimal.[11-14] Recently published estimates in Western Australia suggest that fewer than 50% of pregnant women received an influenza vaccine in 2014[15] and in 2015, 62% of Aboriginal women received an influenza vaccine; 63% received a pertussis vaccine.[16]

To improve vaccine coverage in Australia, routine monitoring of vaccine coverage in pregnant women will be needed to inform targeted vaccine promotion strategies. Unfortunately, Australia does not currently have a routine national data collection for monitoring vaccine uptake in pregnancy. We investigated the potential use of the mandatory Midwives Notification System (MNS) in Western Australia as a tool for routine monitoring of antenatal influenza and pertussis vaccination coverage.

Methods

The MNS is a mandated perinatal data collection system, capturing information on >99% of births in Western Australia.[17] It includes information on the health of the mother and neonate, including pregnancy and labour complications and procedures during pregnancy. The 'Notification of Case Attending' form is used to provide this information and is completed by the first medical professional attending the birth (typically a midwife). In July 2016, 4 additional variables were introduced to the 'Notification of Case Attending' form to collect influenza and pertussis vaccination status and the trimester of vaccination during pregnancy.[18] This information is now maintained as part of the MNS.

Since 2012, the Department of Health Western Australia has conducted annual surveys of antenatal vaccination coverage.[15] In brief, a random sample of women aged ≥18 years who gave birth to a live infant between April and October are selected and sent a letter describing procedures opting-out. Women who do not opt-out are contacted by telephone and asked to provide sociodemographic information, whether a provider recommended any vaccines to them, whether they received any vaccines, and reasons why they were or were not vaccinated. For vaccinated women, permission was obtained to contact their immunisation provider to verify their vaccination record.

We requested vaccination fields from the MNS for all women who participated in the survey and gave birth in August 2016 (at least one month after the introduction of the mandatory vaccination field) through October 2016. We verified the vaccination information obtained from the MNS against the woman's self-reported and medically-verified vaccination status (vaccinated women) and against the woman's self-reported vaccination status (unvaccinated women). Vaccinated women were those who self-reported receiving a vaccine during pregnancy and whose nominated vaccination provider confirmed the vaccination record. Unvaccinated women were those who self-reported receiving no vaccine during pregnancy. Using this information, we estimated the positive predictive value (PPV), negative predictive value (NPV), sensitivity and specificity of vaccination information obtained from the MNS, overall and by trimester of vaccination (influenza only) and the woman's

antenatal care provider. Supplementary analyses estimated sensitivity and specificity after excluding incomplete vaccination fields in the MNS. Women whose vaccination status in their MNS record was either 'vaccinated' or 'not vaccinated', i.e. not 'missing' or 'unknown', were considered as having complete vaccination information in the MNS. To investigate whether data recorded in the MNS as missing or unknown vaccination status were distributed randomly among vaccinated and unvaccinated women, we performed chi-square analyses comparing characteristics of women with complete vaccination information in the MNS to women with missing unknown vaccination status in the MNS. This study was approved by the WA Department of Health's Human Research Ethics Committee (approval # 2015/29).

Results

A total of 277 women completed the telephone survey. Nine women were excluded because they had missing demographic information (n=5) or did not self-report a vaccination status (n=4). Information from the remaining 268 participating women was available for the final validation analysis (Figure 1). Of the 185 women who self-reported receiving seasonal influenza vaccine, 178 gave permission to verify their vaccination details with their immunisation provider, 102 of which were successfully verified. Of the 268 women who self-reported receiving a pertussis vaccine during pregnancy, 215 gave permission to verify their vaccination record, 112 of which could be confirmed by the immunisation provider. The final sample for the validation analysis included the vaccination records of 212 women: 185 in the analysis of influenza vaccination (102 vaccinated, 83 non-vaccinated) and 159 in the analysis of pertussis vaccination (112 vaccinated, 47 unvaccinated). Of the 76 influenza and 103 pertussis vaccinations that were not verified, reasons for lack of verification included incorrect or insufficient contact details for vaccination provider, no response from vaccination provider after at least 3 contact attempts by telephone and email over at least 3 weeks, and in cases where the provider was contacted, the provider could not confirm the vaccination record. The characteristics (for which state-wide data were available) of women who completed the survey were similar to the characteristics of women who gave birth in the state during the study time period (Table 1).

Influenza vaccine

Among the 185 women included in the influenza vaccination analysis, complete information was obtained from the MNS for 123 women (66%) (73/102 [72%] vaccinated, and 50/83 [60%] unvaccinated, women), P=0.12 (Table 2). The remainder had missing or unknown vaccination status (Table 3). There was no difference in the proportion of MNS records with missing or unknown vaccination status between influenza-vaccinated and unvaccinated women (P=0.12) (Table 2). However, vaccination information in the MNS was more frequently missing for women who received most of their antenatal care from a private obstetrician or midwife (P=.001). Forty of 61 (65.6%) influenza vaccination records with gestation at time of influenza vaccination had the correct gestation recorded in the MNS.

The sensitivity of the MNS was 65.7% (95% CI 56.0-74.2%) and the specificity was 53.0% (95% CI 42.4-63.4%) (Table 4). Sensitivity was lower for women who received the majority of their care from a private obstetrician (43.2% [95% CI 28.7-59.1%]) compared to women who received most of their care from a public antenatal clinic (79.0% [95% CI 67.4-87.3%]). When restricted to records with complete influenza vaccination information, sensitivity was 91.8% (95% CI 83.0-96.9%) and specificity was 88.0% (95% CI 76.7-95.5) (Table 5).

Pertussis vaccine

Among the 159 women included in the pertussis vaccination analysis, complete information was obtained from the MNS for 100 women (63%) (74/112 [66%] vaccinated, and 26/47 [55%] unvaccinated, women) (Table 2). The remainder had missing or unknown vaccination status

Commun Dis Intell (2018) 2019;43(https://doi.org/10.33321/cdi.2019.43.21) Epub 17/06/2019

Figure 1. Selection of verification sample from telephone survey of new mothers – Western Australia, 2016.

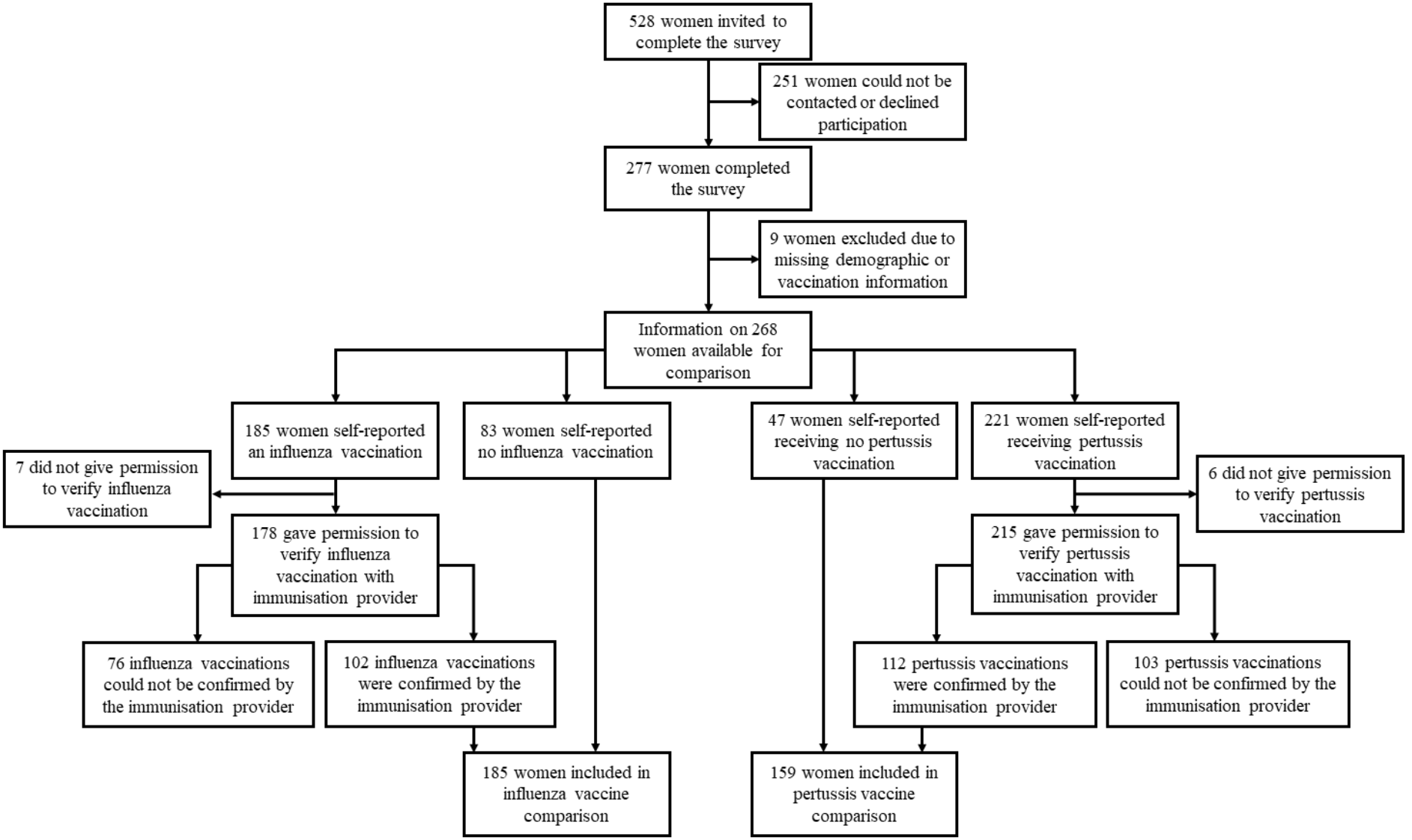

Table 1. Characteristics of pregnant women included in analysis (n=268) – Western Australia, 2016.

Characteristic	Pregnant women included in analysis		Pregnant women in state during study period	
	n	%	N	%
Age group				
18-24 years	35	13%	818	14%
25-29 years	75	28%	1,662	28%
30-34 years	103	38%	2,205	37%
35-39 years	45	16%	1,074	18%
≥40 years	10	4%	186	3%
Socioeconomic level				
Lowest 20%	21	8%	—*	—
20-39%	46	17%	—	—
40-59%	67	25%	—	—
60-79%	49	18%	—	—
Highest 20%	85	32%	—	—
Educational attainment				
≤High school	72	27%	—*	—
Technical and further education	64	24%	—	—
≥University degree	132	49%	—	—
Residence				
Metropolitan	210	78%	4,770	80%
Non-metropolitan	58	22%	1,175	20%
Chronic medical condition				
≥1 condition	38	14%	—*	—
No condition	230	86%	—	—

* Data not available

(Table 3). There was no difference in the proportion of MNS records with missing or unknown vaccination status between pertussis vaccinated and unvaccinated women (P=0.20) (Table 2). Similar to influenza vaccination, pertussis vaccination information was more frequently missing or incomplete for women who received most of their care from a private obstetrician or midwife (P<.001). Forty eight of 63 (76.2%) pertussis vaccination records with gestation at time of pertussis vaccination available had the correct gestation recorded in the MNS.

The sensitivity of the MNS for measuring pertussis vaccination was 62.5% (95% CI 53.3-70.9%) and the specificity was 40.4% (95% CI 27.6-54.7%) (Table 4). Similar to influenza vaccination, sensitivity was lower for women who received most of their antenatal care from a private obstetrician (37.8% [95% CI 24.1-53.9%]) compared to women who received care from public antenatal clinics (75.3% [95% CI 64.4-83.8%]). When restricted to completed pertussis vaccination records in the MNS, the sensitivity was 94.6% (95% CI 86.7-98.5%) and the specificity was 73.1% (95% CI 52.2-88.4%) (Table 5).

Discussion

We observed low sensitivity and specificity of influenza and pertussis vaccination information obtained from the MNS as compared with self-reported information and vaccine provider records due to 28-34% of MNS vaccination fields having missing or unknown vaccination status. After excluding women with missing or

Table 2. Number and percent of women with complete vaccination information in Midwives Notification System, overall and by select characteristics– Western Australia, 2016.

	Influenza vaccination			Pertussis vaccination		
	N	%	CMH p-value*	N	%	CMH p-value*
Overall	123	66%		100	63%	
Vaccination status			.12			.20
Vaccinated	73	72%		74	66%	
Unvaccinated	50	60%		26	55%	
Residence			.25			.50
Rural/remote	26	59%		24	59%	
Metropolitan	97	69%		76	64%	
Antenatal care provider†			.001			<.001
Public hospital	91	74%		79	71%	
Private obstetrician or midwife	27	48%		18	41%	
General practitioner	5	83%		3	75%	

* CMH, Cochrane-Mantel-Hansel chi-square test for independence comparing the characteristics of women with complete information.

† The healthcare provider whom the woman reported receiving the majority of her antenatal care from.

Table 3. Agreement between immunisation medical record/self-report* and immunisation information obtained from the Midwives Notification System – Western Australia, 2016.

	Influenza vaccination status according to medical record		Pertussis vaccination according to medical record	
Vaccination record in Midwives Notification System	**Vaccinated** n (%)	**Unvaccinated** n (%)	**Vaccinated** n (%)	**Unvaccinated** n (%)
Vaccinated	67 (66%)	6 (7%)	70 (63%)	7 (15%)
Unvaccinated	6 (6%)	44 (53%)	4 (3%)	19 (40%)
Missing	16 (16%)	12 (14%)	16 (14%)	4 (9%)
Unknown	13 (13%)	21 (25%)	22 (20%)	17 (36%)

* Vaccination status of participating women who reported vaccination were verified with their immunisation provider's medical records. Vaccination status of participating women who reported they had not been vaccinated was not verified against medical records as this would have been impractical because women can access vaccination at multiple health services including her antenatal care provider, a hospital antenatal clinic, any general practitioner, workplace vaccination providers and pharmacies.

Commun Dis Intell (2018) 2019;43(https://doi.org/10.33321/cdi.2019.43.21) Epub 17/06/2019

Table 4. Sensitivity and specificity of vaccination information collected in the Midwives Notification System – Western Australia, 2016.

	Sensitivity		Specificity		Positive predictive value		Negative predictive value	
	%	(95% CI)*	%	(95% CI)*	%	(95% CI)*	%	(95% CI)*
Influenza vaccination								
Overall	65.7	56.0-74.2	53.0	42.4-63.4	91.8	83.2-96.2	88.0	76.2-94.4
By antenatal care provider†								
Public hospital clinic	79.0	67.4-87.3	53.3	40.9-65.4	90.7	80.1-96.0	88.9	74.7-95.6
Private obstetrician	43.2	28.7-59.1	44.4	24.6-66.3	94.1	73.0-99.0	88.9	56.5-98.0
By trimester of vaccination								
First or second	60.8	49.4-71.1	53.0	42.4-63.4	88.2	76.6-94.5	89.8	78.2-95.6
Third	77.8	59.2-89.4	53.0	42.4-63.4	77.8	59.2-89.4	97.8	88.4-99.6
Pertussis vaccination								
Overall	62.5	53.3-70.9	40.4	27.6-54.7	90.9	82.4-95.5	82.6	62.9-93.0
By antenatal provider†								
Public hospital clinic	75.3	64.4-83.8	42.1	27.9-57.8	90.2	80.2-95.4	88.9	67.2-96.9
Private obstetrician	37.8	24.1-53.9	28.6	8.2-64.1	93.3	70.2-98.8	66.7	20.8-93.9

* 95% confidence interval
† The healthcare provider from whom the woman reported receiving the majority of her antenatal care from.

Table 5. Sensitivity and specificity of vaccination information excluding records with incomplete or blank vaccination information in the Midwives Notification System – Western Australia, 2016.

	Sensitivity		Specificity	
	%	(95% CI)*	%	(95% CI)*
Influenza vaccination				
Overall	91.8	(83.0-96.9)	88.0	(76.7-95.5)
By antenatal care provider†				
Hospital clinic	92.6	(82.1-97.9)	86.5	(71.2-95.5)
General practitioner	94.1	(71.3-99.8)	88.9	(51.7-99.7)
By trimester of vaccination				
First or second	90.2	(78.6-96.7)	88.0	(76.7-95.5)
Third	95.5	(77.2-99.9)	88.0	(76.7-95.5)
Pertussis vaccination				
Overall	94.6	(86.7-98.5)	73.1	(52.2-88.4)
By antenatal provider†				
Hospital clinic	96.5	(87.9-99.6)	72.7	(49.8-89.3)
Private obstetrician	93.3	(68.1-99.8)	66.7	(9.4-99.2)

* 95% confidence interval

† The healthcare provider whom the woman reported receiving the majority of her antenatal care from.

unknown vaccination status in the MNS, we observed high sensitivity and specificity. Given MNS vaccination fields were not differentially missing or unknown for vaccinated women compared to unvaccinated, vaccination data from complete records in the MNS are a potential data source for routinely monitoring antenatal vaccine coverage. However, more complete documentation of MNS vaccination fields would facilitate improved use of these MNS data for monitoring antenatal vaccine coverage.

The proportion of women giving birth in Western Australia with complete antenatal influenza and pertussis vaccination information in the MNS has increased since these data fields were introduced in July 2016. Between September 2016 and September 2018, completeness increased from 65% to 84% for the influenza vaccination field[19] and from 66% to 84% for the pertussis vaccination field[20]; this may be due to better data recording and/or improvements to data entry processes. Although vaccination status was a mandated field at the time of this study, since this study's completion, the MNS system has been reconfigured to prevent blank vaccination fields, i.e. antenatal influenza and pertussis vaccination status must be recorded as 'vaccinated', 'not-vaccinated' or 'unknown'. Further improvement in the completeness of reporting the MNS vaccination fields (i.e. reducing the 'unknowns') is still possible and should be encouraged.

Findings from this study suggest a mandatory vaccination field in the MNS would offer better sensitivity and specificity compared to non-mandatory, purpose-built antenatal vaccination data collections.[21] The Western Australian Antenatal Vaccination Database relied on passive reporting by immunisation providers of vaccines administered to pregnant women to the Western Australia Department of Health. A previous evaluation of this database found that although the specificity of this system exceeded 99%, its sensitivity was low (48%).[21] In contrast to non-mandatory, purpose-built antenatal

vaccination data collections, a mandatory vaccination field in the MNS and equivalent data collection systems in other jurisdictions could allow for surveillance of antenatal vaccination nationally. However, given that sensitivity has been consistently lowest for women who receive private antenatal care as measured by both non-mandatory database and the MNS data capture may be poorer for some groups of women.

Vaccination fields in the MNS are completed at, or soon after, birth so the quality of the vaccination information in a perinatal data collection is likely to depend on access to the woman's vaccination records and ability/willingness to obtain self-reported vaccination status from recently-delivered mothers. Given this, there are several opportunities to further improve the quality and usability of vaccination information in perinatal data collections. First, the National Handheld Pregnancy Record provides a paper-based record of vaccines received during pregnancy.[22] Promoting use of this record may allow medical professionals completing vaccination fields in perinatal data collections to more readily complete this information. Second, retrievable electronic records which maintain vaccination information are useful for providing vaccination information. These are available in cases when the woman is delivering in the hospital where she received the majority of her care, but may not necessarily be available in other settings. Third, promoting entry of antenatal vaccinations by all immunisation providers (both public and private) on the Australian Immunisation Register (AIR) and ensuring medical professionals can access these records would allow consistent electronic recording of antenatal vaccination.[23] Recording in AIR offers several advantages, including: 1) it is a national register; 2) the records are retrievable by multiple health providers; and 3) it is the system currently used to routinely monitor coverage for most government-funded vaccines. Providing training to midwives who complete perinatal data collection records on additional sources of vaccine information for pregnant women, such as AIR and the National Handheld Pregnancy Record, is likely to be helpful. However, it needs to be remembered that AIR neither records pregnancy status at the time of vaccination nor provides denominator data about the total number of pregnant women eligible for antenatal vaccination, so it cannot be used alone to monitor antenatal vaccination coverage. Fourth, midwives should be made aware that self-report has been shown to be an accurate and valid method of ascertaining antenatal vaccination status, in both Aboriginal[16] and non-Aboriginal[15,24] women, so it is reasonable to record a woman's self-reported vaccination status in the MNS without seeking confirmation from a medical record or AIR. Fifth, enabling midwives to enter antenatal vaccinations into the MNS throughout pregnancy could improve data quality. A recent Australian study has suggested this could improve the completeness of antenatal vaccination records.[25]

At time of writing, 4 Australian states collect antenatal vaccination information as part of the state perinatal data collection: Queensland, Victoria, New South Wales, and Western Australia.[26,27] However, each jurisdiction collects the data slightly differently and antenatal vaccination is not included in the national perinatal data collection.[28] Currently, there remain substantial gaps in routinely available information on national antenatal vaccine coverage which should be addressed because these data could be used to inform current antenatal vaccination programs and, given the apparent safety and immunogenicity of pertussis vaccination at birth[29], to identify babies who could benefit from this intervention. In view of the benefits of antenatal vaccination to both mothers and infants and the currently suboptimal uptake of these vaccines among pregnant women, routine monitoring of antenatal vaccination is essential for promoting maternal and infant health in Australia.

Acknowledgements

The authors would like to acknowledge Maureen Hutchinson, Belinda Jennings and

the staff at the Maternal and Child Health Unit supporting the Midwives Notification System for their assistance in providing project data.

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