

Influenza and Pertussis Vaccination Rates Among Pregnant Women in Rural and Urban Areas

Annette Regan, PhD, MPH, Ravneet Kaur, BDS, and Timothy Callaghan, PhD

Purpose

This policy brief evaluates the receipt of vaccines routinely recommended during pregnancy in rural and urban areas of the United States. Specifically, it analyzes the receipt of influenza and pertussis vaccines among pregnant women over a seven-year period from 2012-2018. It also studies whether pregnant women received an influenza vaccine recommendation from their health care provider during the same period of analysis.

Background

Immunization of women during pregnancy offers protection to mothers and their infants in the first six months of life against severe morbidity and mortality from certain vaccine-preventable diseases. In the U.S., influenza vaccination is recommended for pregnant women, as well as women planning to become pregnant, during influenza season.¹⁻³ In addition, since 2012, the U.S. Advisory Committee on Immunization Practices (ACIP) has recommended that pregnant women also be vaccinated against pertussis.⁴ During pregnancy, vaccine-induced antibodies are transferred from the mother to the fetus through the placenta, and following delivery, antibodies are passed to the infant via breast milk. This provides passive immunity to the newborn before routine childhood vaccination can be initiated.⁵ Despite these benefits, uptake of recommended vaccines remains low among U.S. pregnant women, with only 54% of pregnant women receiving an influenza vaccination before or during pregnancy, and 55% of women receiving a pertussis vaccine during pregnancy.⁶

Vaccine uptake may vary based on individual and area-level factors including differences in immunization accessibility and delivery. Previous research has shown that access to recommended vaccines among rural residents of the U.S. may be limited in comparison to urban residents.^{6,7} Women residing in rural areas may experience delays or interruptions to their prenatal care including vaccination due to hospital closures and workforce shortages⁸, lack of access to transportation that allows women to reach distant perinatal services, inability to pay for perinatal services, or a lack of health insurance coverage.⁹

One important component of promoting immunization is patient-provider interactions. Provider recommendations can play a critical role in increasing vaccine uptake among pregnant women. Compared to those who do not receive any health care provider recommendation, pregnant women who

Key Findings

- ◆ Pregnant women in rural areas were significantly less likely than pregnant women in urban areas to receive a recommendation for influenza vaccination from their health care provider and were less likely to receive an influenza vaccine during pregnancy.
- ◆ Receipt of influenza vaccine was lowest among pregnant women in rural areas who were 30 years or older, non-Hispanic White or Hispanic, those with lower educational attainment, those without health insurance coverage, and those residing in the South region of the U.S.
- ◆ Trends over time show that from 2012-2018, influenza vaccine uptake for pregnant women in rural areas was lower than for pregnant women in urban areas. This rural-urban gap in influenza vaccination was apparent for vaccination during pregnancy but not for vaccination prior to pregnancy.
- ◆ A similar proportion of pregnant women received the pertussis vaccine during pregnancy in rural and urban areas; however, pertussis vaccination was significantly lower among pregnant women in rural areas who were 35 years or older and residing in the Midwest or South region of the U.S.

report a recommendation or referral for vaccination by their health care provider during pregnancy are 12% more likely to be vaccinated for influenza and 16% more likely to be vaccinated for pertussis.⁶

Despite the possibility of place-based disparities in the uptake of vaccines and the receipt of recommended prenatal care, little is known about immunization rates for pregnant women in rural and urban areas of the U.S. This policy brief works to better understand this topic by studying influenza and pertussis vaccination rates among pregnant women in rural and urban areas. This research can be used to understand current patterns in prenatal vaccination and to inform future vaccine promotion efforts.

Methods

To study the uptake of recommended vaccines by pregnant women in rural and urban areas, the analysis used data from the 2012-2018 waves of the Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS is an ongoing state-level, population-based surveillance system implemented since 1987.¹⁰ PRAMS monitors selected maternal behaviors and experiences that occur before, during, and shortly after pregnancy through surveys conducted by state, territorial, tribal, or local health departments in partnership with the Center for Disease Control and Prevention’s (CDC) Division of Reproductive Health.¹⁰ This policy brief utilizes data from 19 states as

well as New York City (n=153,648). The study relied on this set of states because they provide data for the entire period of analysis.

The PRAMS survey collects information on three outcomes related to prenatal vaccination: 1) influenza vaccine uptake prior to or during pregnancy, 2) receipt of a recommendation for influenza vaccination from a health care provider during pregnancy, and 3) pertussis vaccine uptake during pregnancy.

Rurality in the analysis is based on the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme applied to the respondent’s county of residence. PRAMS provides a two-level measure of rurality – indicating whether each pregnant woman resided in an urban or rural area of the state. The analysis assessed current factors associated with each outcome using the most recent data available (2016-2018) and additionally explored trends over time (2012-2018). All available PRAMS data were used for analysis, which varied by state and year of the survey. Additional information about the data available for use from PRAMS is in **Table 1**.

The analysis estimated weighted absolute differences in the percentage of women residing in rural and urban areas vaccinated against influenza and pertussis and relied on the same procedure for the analysis of health care provider recommendations. Logistic regression was

Table 1. U.S. sites providing data for each outcome assessed

Outcome assessed	Years of data	Sites providing data
Influenza vaccine uptake & provider recommendation, by select factors	2016-2018	20 sites: Alaska, Colorado, Connecticut, Delaware, Louisiana, Massachusetts, Michigan, Missouri, New Jersey, New Mexico, Pennsylvania, Rhode Island, Utah, Virginia, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.
Trends in influenza vaccine uptake over time	2012-2018	14 sites: Alaska, Delaware, Massachusetts, Missouri, New Jersey, New Mexico, Pennsylvania, Utah, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.
Pertussis vaccine uptake, by select factors	2016-2018	12 sites: Delaware, Louisiana, Massachusetts, Michigan, Missouri, New York City, Pennsylvania, Utah, Virginia, Vermont, Washington, and Wisconsin.
Trends in pertussis vaccine uptake over time	2012-2018	4 sites: Delaware, Missouri, Pennsylvania, and Wisconsin.

used to evaluate whether differences in outcomes were significant for women residing in rural vs. urban areas.

Results

Influenza vaccination uptake

Vaccination rates for pregnant women in rural and urban areas during 2016-2018 are presented in **Table 2**. These data show that the percentage of pregnant women who received an influenza vaccine prior to or during pregnancy in rural communities was lower than in urban communities. Specifically, the percent of rural pregnant women vaccinated against influenza was 5.5% lower compared to urban pregnant women. Vaccine coverage varied across levels of rurality based on age, race, ethnicity, gender, region, and insurance status. The greatest disparities in influenza vaccination coverage between rural and urban women occurred for women 35 years of age or older, non-Hispanic White and Hispanic women, those who had less than a high school diploma or with a college degree or higher, those with no insurance coverage, and those residing in West, North-east and South U.S. Census Regions.

Table 2. Percent of mothers in rural and urban communities who received an influenza vaccine prior to or during pregnancy – 20 U.S. sites, 2016-2018*

	Rural	Urban	Rural vs. Urban
	%	%	Absolute % Difference
Overall	55.2	60.7	-5.5 [†]
By Age			
18-24 years	49.0	52.6	-3.6
25-29 years	57.3	56.6	+0.7
30-34 years	60.2	65.9	-5.7 [†]
>=35 years	54.7	66.5	-11.8 [†]
By Race/Ethnicity			
Non-Hispanic Whites	55.8	62.9	-7.1 [†]
Non-Hispanic Blacks	42.1	48.7	-6.6
Hispanics	57.4	64.3	-6.9 [†]
Other	58.4	53.1	+5.3
By Education			
9-11 years	47.8	54.9	-7.1 [†]
12 years	48.6	51.1	-2.5
13-15 years	56.7	54.6	+2.1
≥16 years	64.4	71.6	-7.2 [†]
By Insurance coverage			
Private	63.8	68.9	-5.1 [†]
Public	51.2	52.5	-1.3
Other	42.5	54.8	-12.3 [†]
None	25.5	43.5	-18.0 [†]
By U.S. Census Region			
West	56.6	66.0	-9.4 [†]
Midwest	59.9	58.8	+1.1
Northeast	47.8	60.6	-12.8 [†]
South	48.2	56.7	-8.5 [†]

*Includes data from 2016-2018 from 20 US PRAMS sites including: Alaska, Colorado, Connecticut, Delaware, Louisiana, Massachusetts, Michigan, Missouri, New Jersey, New Mexico, Pennsylvania, Rhode Island, Utah, Virginia, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

† Significant at P<.05

Table 3. Influenza vaccine uptake prior to and during pregnancy among women in rural and urban areas – 14 U.S. sites, 2012-2018*

Year	Prior to pregnancy		Rural vs. Urban	During pregnancy		Rural vs. Urban
	Rural	Urban		Rural	Urban	
	%	%	Absolute % Difference	%	%	Absolute % Difference
2012	7.5	11.2	-3.7	29.0	32.0	-3.0
2013	8.5	11.9	-3.4	41.0	39.2	+1.8
2014	8.7	10.4	-1.7	39.4	42.6	-3.2
2015	6.8	10.6	-3.8 [†]	42.9	42.3	+0.6
2016	7.4	10.4	-3.0 [†]	46.8	50.9	-4.1 [†]
2017	7.5	10.6	-3.1 [†]	47.2	50.6	-3.4
2018	9.1	10.3	-1.2	45.0	51.0	-6.0 [†]

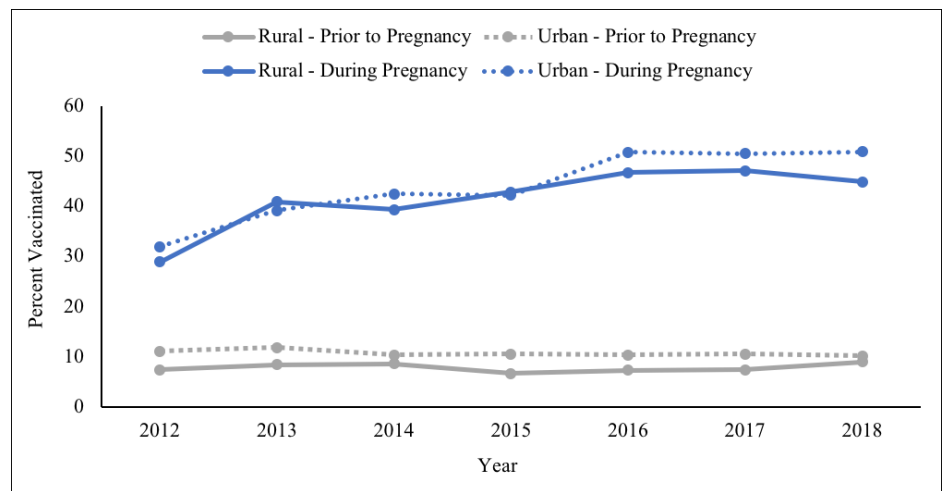
*Includes data from 2012-2018 for 14 PRAMS sites including: Alaska, Delaware, Massachusetts, Missouri, New Jersey, New Mexico, Pennsylvania, Utah, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

† Significant at P<.05

Table 3 shows trends in the percentage of influenza vaccine uptake prior to and during pregnancy from 2012 to 2018 in rural and urban areas. Influenza vaccine uptake *prior to* pregnancy in rural areas increased from 7.5% in 2012 to 9.1% in 2018. Influenza vaccine uptake prior to pregnancy in rural areas increased from 7.5% in 2012 to 9.1% in 2018. Conversely, in urban areas, influenza vaccine uptake prior to pregnancy decreased from 11.2% in 2012 to 10.3% in 2018.

When examining influenza vaccine uptake *during* pregnancy in rural areas, an increase was observed from 29% in 2012 to 45% in 2018 (Table 3, Figure 1). Similarly, influenza vaccine uptake during pregnancy in urban areas progressively increased from 32% in 2012 to 51% in 2018. The percentage of women vaccinated during pregnancy was 6% lower in rural areas compared to urban areas in 2018.

Figure 1. Influenza vaccine uptake prior to and during pregnancy among women in rural and urban areas – 14 U.S. sites, 2012-2018*



*Includes data from 2012-2018 for 14 PRAMS sites including: Alaska, Delaware, Massachusetts, Missouri, New Jersey, New Mexico, Pennsylvania, Utah, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

Influenza vaccine recommendation

Table 4 presents analyses of rural and urban differences in influenza vaccine recommendations for pregnant women between 2016-2018. The percent of rural women who received an influenza vaccine recommendation during pregnancy from their health care provider was 2% lower compared to urban women. Rural pregnant women who were 35 years of age or older, non-Hispanic White, had private, other, or no health insurance coverage, and resided in the West region of the U.S. were all significantly less likely than their urban counterparts to receive an influenza immunization recommendation from their health care provider.

Table 4. Percent of women who were recommended an influenza vaccine by their health care provider during their most recent pregnancy – 20 U.S. sites, 2016-2018*

	Rural	Urban	Rural vs. Urban
	%	%	Absolute % Difference
Overall	85.6	87.6	-2.0 [†]
By Age			
18-24 years	81.6	83.0	-1.4
25-29 years	87.2	87.5	-0.3
30-34 years	88.5	89.2	-0.7
≥35 years	85.4	89.6	-4.2 [†]
By Race/Ethnicity			
Non-Hispanic Whites	86.2	89.0	-2.8 [†]
Non-Hispanic Blacks	82.9	84.6	-1.7
Hispanics	82.7	85.1	-2.4
Other	77.0	84.7	-7.7
By Education			
9-11 years	78.4	82.6	-4.2
12 years	83.6	83.4	+0.2
13-15 years	86.2	86.9	-0.7
≥16 years	90.1	91.4	-1.3
By Insurance coverage			
Private	89.3	91.0	-1.7 [†]
Public	85.0	84.8	+0.2
Other	74.3	84.8	-10.5 [†]
None	51.4	65.3	-13.9 [†]
By U.S. Census Region			
West	84.3	89.3	-5.0 [†]
Midwest	87.6	89.1	-1.5
Northeast	86.8	87.3	-0.5
South	82.2	84.4	-2.2

*Includes data from 2016-2018 from 20 US PRAMS sites including: Alaska, Colorado, Connecticut, Delaware, Louisiana, Massachusetts, Michigan, Missouri, New Jersey, New Mexico, Pennsylvania, Rhode Island, Utah, Virginia, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

[†] Significant at P<.05

When analyzing health care provider recommendations for influenza vaccine between 2012 and 2018 (Table 5, Figure 2), the percentage of women who received a recommendation from their health care provider increased from 67.7% to 87.3% in rural areas and from 69.5% to 89.3% among pregnant women who resided in urban areas.

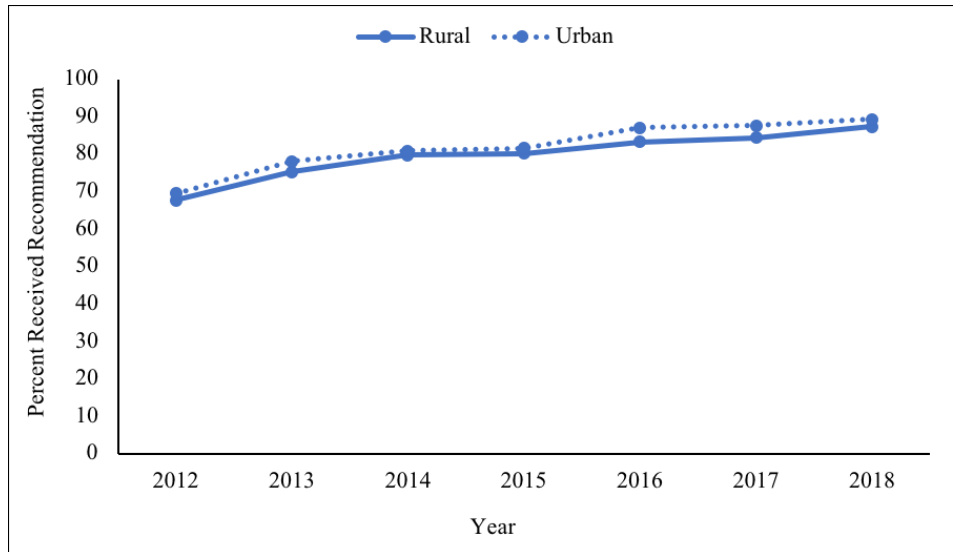
Table 5. Percent of women who were recommended an influenza vaccine by their health care provider during their most recent pregnancy – 14 U.S. sites, 2012-2018*

Year	Rural	Urban	Absolute % Difference
	%	%	
2012	67.7	69.5	-1.8
2013	75.2	78.1	-2.9
2014	79.7	80.8	-1.1
2015	80.1	81.5	-1.4
2016	83.2	87.1	-3.9 [†]
2017	84.4	87.6	-3.2 [†]
2018	87.3	89.3	-2.0

*Includes data from 2012-2018 for 14 PRAMS sites including: Alaska, Delaware, Massachusetts, Missouri, New Jersey, New Mexico, Pennsylvania, Utah, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

[†] Significant at P<.05

Figure 2. Percent of women who were recommended an influenza vaccine by their health care provider during their most recent pregnancy – 14 U.S. sites, 2012-2018*



*Includes data from 2012-2018 for 14 PRAMS sites including: Alaska, Delaware, Massachusetts, Missouri, New Jersey, New Mexico, Pennsylvania, Utah, Vermont, Washington, Wisconsin, West Virginia, Wyoming, and New York City.

Pertussis vaccination

Overall, the percentage of women who received a pertussis vaccine in rural areas during pregnancy was similar to the percentage of pregnant women who received one in urban areas (**Table 6**). However, rural-urban differences in pertussis vaccination coverage were observed among certain subgroups. For example, pregnant women in rural areas who were at least 35 years old or lived in one of the participating sites in the Midwest or South regions were significantly less likely than pregnant women in urban areas to be vaccinated against pertussis.

Table 6. Percent of mothers in urban and rural communities who received a pertussis vaccine during pregnancy, 12 U.S. sites, 2016-2018*

	Rural	Urban	Rural vs. Urban
	%	%	Absolute % Difference
Overall	74.9	75.8	-0.9
By Age			
18-24 years	74.1	73.3	+0.8
25-29 years	76.8	74.8	+2.0
30-34 years	77.1	78.7	-1.6
≥35 years	66.3	75.0	-8.7†
By Race/Ethnicity			
Non-Hispanic Whites	76.0	77.6	-1.6
Non-Hispanic Blacks	59.7	67.7	-8.0
Hispanics	76.3	77.3	-1.0
Other	74.3	74.2	+0.1
By Education			
9-11 years	66.3	68.3	-2.0
12 years	72.9	71.4	+1.5
13-15 years	75.0	73.5	+1.5
≥16 years	80.1	81.1	-1.0
By Insurance coverage			
Private	80.3	80.9	-0.6
Public	72.9	70.9	+2.0
Other	61.8	70.7	-8.9
None	36.6	52.7	-16.1
By U.S. Census Region			
West	76.8	79.9	-3.1
Midwest	78.8	75.9	+2.9†
Northeast	74.1	76.6	-2.5
South	62.2	70.9	-8.7†

*Includes data from 2016-2018 for 12 PRAMS sites including: Delaware, Louisiana, Massachusetts, Michigan, Missouri, Pennsylvania, Utah, Virginia, Vermont, Washington, Wisconsin, and New York City.

† Significant at P<.05

Overall, there was a substantial increase in the uptake of pertussis vaccine during pregnancy in rural areas from 15.7% in 2012 to 80.5% in 2018 (Table 7, Figure 3). A similar increase was seen in the uptake of pertussis vaccine during pregnancy in urban areas from 15.2% in 2012 to 79.3% in 2018.

Table 7. Percent of women in rural and urban communities who received a pertussis vaccine during their most recent pregnancy, Four U.S. sites, 2012-2018*

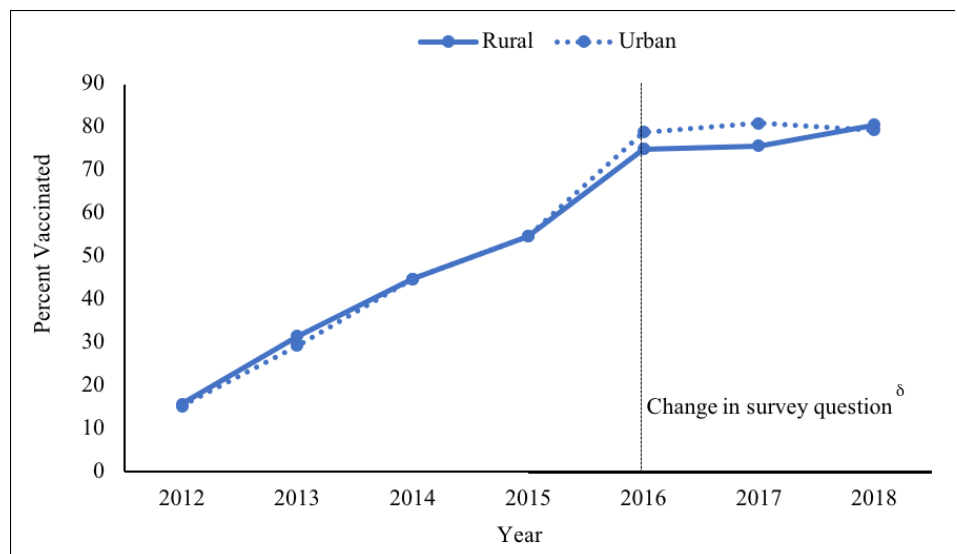
Year	Rural	Urban	Absolute % Difference
	%	%	
2012	15.7	15.2	+0.5
2013	31.5	29.3	+2.2
2014	44.8	44.8	0
2015	54.7	54.7	0
2016 ^δ	75.0	78.8	-3.8
2017	75.7	80.9	-5.2 [†]
2018	80.5	79.3	+1.2

*Vaccination in either the year preceding pregnancy or during pregnancy; Includes data from 2012-2018 for four PRAMS sites including: Delaware, Missouri, Pennsylvania, and Wisconsin.

^δChange in the survey question occurred: Prior to 2016, the PRAMS survey collected information on pertussis vaccination prior to, during, and after pregnancy. In 2016, the survey question only collected information on pertussis vaccination during pregnancy. For comparability with 2016-2018 data, we have categorized women who received a pertussis vaccine prior to or after pregnancy between 2012 and 2015 as not vaccinated.

[†]Significant at P<.05

Figure 3. Pertussis vaccine uptake among pregnant women in rural and urban communities, four U.S. sites, 2012-2018*



*Includes data for 2012-2018 from four PRAMS sites including: Delaware, Missouri, Pennsylvania, Wisconsin.

Discussion

Through a detailed analysis of data from PRAMS, this brief has illustrated important differences in maternal vaccination across the rural-urban continuum. When analyzing vaccination against influenza, the study finds consistent evidence that pregnant women in rural areas are less likely to be vaccinated than pregnant women in urban areas. This finding holds when analyzing vaccination in the 12 months prior to delivery and during pregnancy. While the difference between rural and urban areas is not statistically significant in every year, it is significant in several years of the analysis, and suggests that pregnant women in rural areas have been consistently less likely to get this important vaccination over time.

Notably, this difference between rural and urban areas is also seen when exploring subgroups of pregnant women. It is particularly pronounced among older pregnant women, White and Hispanic mothers but not Black mothers, mothers with all insurance types except public insurance, and mothers in all regions except the Midwest. These differences across subgroups could result from differences in recommendations from medical providers to different groups of pregnant mothers, differences in the acceptance of vaccine recommendations across regions, states, and types of providers, or other barriers to health care access. Exploring the origins of these differences is an important direction for future research.

The analysis also showed statistically significant differences in influenza vaccine recommendations from health care providers across rural and urban areas. Specifically, the results showed that rural pregnant mothers were less likely to have a health care provider recommend influenza vaccination than urban pregnant mothers. While this difference between urban and rural areas was small across years – never surpassing 3.9% - it was often statistically significant. Importantly, across rural and urban areas these recommendations appeared to be getting more common – increasing 19.6% in rural areas and 19.8% in urban areas during the period of analysis.

Lastly, when examining pertussis vaccination for pregnant women, the analysis found that while vaccination rates were slightly lower in rural areas, the difference was not statistically significant. Despite this, there were some rural-urban differences across subgroups. Rural pregnant women over the age of 35 and living in the South were less likely than urban pregnant women to be vaccinated against pertussis, but rural pregnant women were more likely to be vaccinated than their urban counterparts in the Midwest. The results also suggest that ACIP's recommendation that all women be vaccinated against pertussis in 2012 has been effective – increasing pertussis vaccination for pregnant women by 64.8% in rural areas and 64.1% in urban areas in just seven years.

Implications

This research suggests that while important gains have been made in maternal vaccination, significant differences persist across the rural-urban continuum. Specifically, there is evidence that rural pregnant women were less likely to be vaccinated for influenza or to receive a recommendation from their health care provider to get an influenza vaccination. Notably however, the same cannot be said for pertussis. While rates of pertussis vaccination among pregnant women were slightly lower in rural areas, the difference was not large enough to be statistically significant in the most recent three year period of data available.

Despite these findings, it is important to note that this analysis was restricted to participating PRAMS sites, which did not encompass the entire U.S. Notably, few sites incorporated pertussis vaccination questions into their survey from 2012 through 2018, limiting the geographic representation in these analyses. Using national data would improve the generalizability of this analysis.

The findings point to several directions for possible interventions to improve maternal health. First, efforts should be made to increase maternal vaccination against influenza in rural areas. These efforts could include health promotion efforts to inform rural patients and their providers about the importance of maternal vaccination for

influenza, as well as increasing access to prenatal care for pregnant women in rural areas. Based on the results, it would appear that important gains could also be made by focusing on disparities across urban and rural areas for some sub-populations. For example, by developing interventions designed specifically to target older pregnant women and women with no health insurance in rural areas, the current disparity in immunization could be reduced considerably.

Additionally, this policy brief points to several directions for future research. First, more research is needed to understand why there is a larger gap in immunization across the rural-urban continuum for influenza than pertussis. This could result from the fact that recommendations for pertussis vaccination during pregnancy were more recently introduced and may be more favorably received by parents and providers; however, exploring this relationship will be vital to resolving differences in influenza vaccination between rural and urban areas. Second, more work is needed to understand why rural pregnant women in some subgroups are more likely to be vaccinated than others. Understanding why older women, non-Hispanic White and Hispanic women, women with all insurance types except public insurance, and women from certain census regions are less likely to be vaccinated in rural areas will be important to eliminating these disparities.

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Annette Regan^{1,2}, Ravneet Kaur², and Timothy Callaghan³

- ¹ School of Nursing and Health Professions, University of San Francisco
² Department of Epidemiology & Biostatistics, School of Public Health, Texas A&M
³ Department of Health Policy & Management, School of Public Health, Texas A&M

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Southwest Rural Health Research Center
 Texas A&M School of Public Health
 212 Adriance Lab Road
 MS 1266
 College Station, TX 77843

For more information, contact Natasha Johnson:
 Phone | 979.436.9512
 Email | nyjohnson@tamu.edu



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