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Brief Original Report

# Receipt of pertussis vaccine during pregnancy across 7 Vaccine Safety Datalink Sites

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ABSTRACT

*Objective.* In response to widespread pertussis outbreaks and infant deaths, in 2010, the California Department of Health (CDPH) and in 2011 the Advisory Committee on Immunization Practices (ACIP) advised that the tetanus toxoid, reduced diphtheria toxoid and acellular pertussis (Tdap) vaccine be administered during pregnancy. The goals of this study were to describe Tdap coverage among pregnant women following these recommendations.

*Methods.* In this observational cohort study, we utilized electronic medical record and claims data from seven Vaccine Safety Datalink sites to identify pregnancies and Tdap administrations. All Tdap doses were classified as pre-pregnancy, during pregnancy or post-pregnancy/postpartum. For pregnancies ending in a live birth, we evaluated factors associated with Tdap vaccination.

*Results.* Among 289,141 live births at the California VSD sites, receipt of Tdap during pregnancy increased substantially in the years 2010, 2011, and 2012, when coverage was 15.9, 30.0 and 19.5%, respectively. Among 82,398 women with live births at the Oregon, Washington, Colorado, Wisconsin and Minnesota VSD sites, receipt of Tdap during pregnancy first increased in 2012, at 16.0%. Women receiving early prenatal care and other vaccine(s) during pregnancy had higher Tdap coverage.

*Conclusion.* We observed substantial increases in Tdap coverage during pregnancy following CDPH and ACIP recommendations.



## Introduction

*Bordetella pertussis* is a highly contagious bacterium that infects the human respiratory tract. While most pertussis infections in children and adults are asymptomatic or result in mild illness, infants with pertussis can experience apnea, respiratory failure, neurologic complications, and death (Gall, 2012).

Two tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccines were licensed in the United States in 2005 for routine use in *non-pregnant* adolescents and adults (Broder et al., 2006; Kretsinger et al., 2006). While starting in 2006 the American Academy of Pediatrics endorsed the use of Tdap for pregnant adolescents (Anon., 2006); more often cocooning or vaccinating parents and other close contacts was recommended to prevent pertussis transmission and severe illness in newborns (Anon., 2011; Kretsinger et al., 2006). In 2010, in response to a statewide pertussis outbreak with infant deaths (CDC, 2010; Winter et al., 2012), the California Department of Health (CDPH) advised that Tdap be administered to previously unvaccinated pregnant women (CDPH, n.a). In 2011, the Advisory Committee on Immunization Practices (ACIP) followed with similar recommendations for pregnant women across the United States. In 2012, ACIP further revised recommendations that Tdap be administered to all pregnant women during every pregnancy, even if previously vaccinated (Anon., 2013). To date there is limited data on receipt of Tdap during pregnancy. The aim of this report was to describe Tdap coverage for pregnancies occurring from 2007 to 2102 at seven geographically diverse integrated health care systems within the Vaccine Safety Datalink (VSD).

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## Materials and methods

The VSD is a collaborative effort between the Center for Disease Control and Prevention's Immunization Safety Office and 9 large medical care organizations in the U.S. and includes data on approximately 2.5 million women of reproductive age (Baggs et al., 2011). For this report, data on Tdap coverage was available from seven VSD sites: Group Health Cooperative (WA), Kaiser Permanente Northwest (OR) and (WA), Kaiser Permanente Northern California (CA), Southern California Kaiser Permanente (CA), HealthPartners (MN), Marshfield Clinic (WI), and Kaiser Permanente Colorado (CO).

Pregnancies ending between 1/1/2007 and 11/15/2012 were identified using a validated algorithm (Naleway et al., 2013). The algorithm utilizes claims, administrative, and birth data to a) identify pregnancies, b) determine pregnancy outcomes and c) estimate gestational age at pregnancy outcome (Naleway et al., 2013). This algorithm has been used in prior studies of vaccine safety (Kharbanda et al., 2013; Nordin et al., 2013) and vaccine coverage during pregnancy (Naleway et al., 2014).

To be included in this report, pregnant women 14–49 years of age were required to have continuous insurance coverage from 6 months prior to pregnancy through 6 weeks after pregnancy end with no more than a 30-day gap. Women with ectopic pregnancies, gestational trophoblastic disease, and pregnancies whose outcome could not be determined with available data were excluded. Women with live births and no medical visits recorded throughout pregnancy were also excluded.

### *Identification of Tdap administrations*

Receipt of Tdap from 1/1/2005 to 12/31/2012 was identified from electronic medical record and claims data. All Tdap doses were then classified as: *Pre-pregnancy* (1/1/2005 through 7 days after the last menstrual period (LMP); *During pregnancy* (8 days after LMP through 7 days before pregnancy end); and *Post-pregnancy/Postpartum* (6 days before pregnancy end through 42 days after pregnancy end). Categories were assigned to avoid pre-pregnancy and postpartum vaccines being misclassified as occurring during pregnancy (Kharbanda et al., 2012).

### *Analysis*

For pregnancies in the cohort, we report the proportion receiving Tdap pre-pregnancy, during pregnancy, and post-pregnancy/postpartum. We then describe Tdap coverage by pregnancy outcome, year, age, and socioeconomic status. Among pregnancies ending in a live birth, we evaluated Tdap coverage by year, age, socio-demographic factors, health care utilization and pregnancy risk, stratified by California versus other VSD sites. All data were analyzed using SAS/STAT software, Version 9.3 (SAS Institute Inc). This study was approved by the Institutional Review Boards at all participating sites and the Centers for Disease Control and Prevention.

## Results

Of 535,851 pregnancies at seven VSD sites over six years with continuous insurance enrollment, we excluded 15,157 (2.8%) based on pregnancy outcome and 2994 (0.6%) for having no medical claims throughout pregnancy. The final study cohort included 517,700 pregnancies with end dates between 1/1/07 and 11/15/2012. Pregnancy outcomes were: live birth (71.7%), spontaneous abortion (14.8%), therapeutic abortion (13.0%) and stillbirth (0.4%).

Across all pregnancies, 25.3% received Tdap before pregnancy, 7.1% during pregnancy and 10.8% within six weeks of pregnancy end. Receipt of Tdap during pregnancy increased steadily in 2010 and 2011 but then decreased in 2012 (Table 1).

Of 289,141 pregnancies from the CA VSD sites with a live birth, receipt of Tdap during pregnancy increased markedly from 0.3% in 2007 to 30.4% in 2011 but decreased to 19.5% in 2012. Pre-pregnancy receipt of Tdap increased steadily each year, by 2011 35.3% and by 2012 53.8% of women with live births in CA had received Tdap prior to pregnancy. In 2011, 15.9% of pregnancies did not receive Tdap in any period (pre-pregnancy, during pregnancy or postpartum); this decreased to 14.6% in 2012. Among those vaccinated during pregnancy, receipt of Tdap at ≥20 week gestation increased from 12.3% in 2007 to 69.4% in 2012.

Of 82,398 pregnancies occurring in the WA, OR, MN, WI and CO VSD sites and ending in a live birth, receipt of Tdap during pregnancy increased from 0.8% of pregnancies in 2007 to 16.1% in 2012. Pre-pregnancy and postpartum Tdap administration also increased substantially over time. The proportion who did not receive Tdap in any period decreased consistently from 87.3% in 2007 to 17.4% in

**Table 1**
Receipt of Tdap among all pregnancies in cohort[e].

| | *N* | Pre-pregnancy (%) | Pregnancy (%) | Postpartum[d] (%) | Did not receive Tdap (%) |
|---|---|---|---|---|---|
| Pregnancy outcome | | | | | |
| Live birth | 371,539 | 23.5 | 9.5 | 14.4 | 53.8 |
| SAB, SB or TAB[a] | 146,161 | 30.0 | 1.2 | 1.6 | 67.2 |
| Year | | | | | |
| 2007 | 84,278 | 3.2 | 0.5 | 2.3 | 94.0 |
| 2008 | 84,827 | 8.6 | 0.7 | 6.4 | 84.5 |
| 2009 | 84,581 | 16.8 | 1.0 | 13.4 | 69.3 |
| 2010 | 89,888 | 26.5 | 9.2 | 18.9 | 47.0 |
| 2011 | 91,445 | 40.1 | 17.1 | 14.2 | 30.1 |
| 2012 | 82,681 | 56.1 | 13.7 | 8.8 | 22.6 |
| Site | | | | | |
| California VSD sites | 407,239 | 23.6 | 8.3 | 10.7 | 58.2 |
| Other VSD sites[b] | 110,461 | 31.5 | 3.0 | 11.2 | 55.2 |
| Maternal age | | | | | |
| <18 | 12,488 | 46.6 | 4.3 | 5.7 | 45.7 |
| 18–24 | 90,069 | 28.4 | 6.0 | 8.5 | 58.3 |
| 25–34 | 286,516 | 23.7 | 7.8 | 11.8 | 57.5 |
| ≥35 | 128,627 | 24.8 | 6.8 | 10.6 | 58.4 |
| Socioeconomic status[c] | | | | | |
| Medium/high | 314,364 | 26.2 | 7.4 | 13.0 | 54.3 |
| Low | 142,354 | 23.2 | 9.3 | 9.9 | 58.7 |
| Missing | 60,982 | 25.8 | 1.1 | 1.5 | 71.7 |
| total, all pregnancies | 517,700 | 25.3 | 7.1 | 10.8 | 57.6 |

[a] SAB = Spontaneous abortion, SB = Stillbirth, TAB = Therapeutic abortion.
[b] Other VSD sites located in: Colorado, Minnesota, Oregon, Washington and Wisconsin.
[c] Low socioeconomic status defined as living in data census tract having 20% or more of the population living at less than 150% of the federal poverty level.
[d] Within 42 days of end of pregnancy/postpartum for live births.
[e] Row percents may add to >100 as women may have received Tdap in more than one period (e.g., pre-pregnancy and postpartum).