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Tetanus and diphtheria toxoids and acellular pertussis vaccine uptake during pregnancy in a metropolitan tertiary care center

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ABSTRACT

Objectives: Tetanus, diphtheria and acellular pertussis (Tdap) vaccine is recommended during each pregnancy, but national uptake is poor. We assessed Tdap uptake in a tertiary referral hospital served by university-affiliated and private obstetrical offices.
Methods: Review of women delivering at Texas Children's Hospital Pavilion for Women, Houston, Texas, during April 2013–June 2014.
Results: 6577 deliveries occurred during the study period. Mean maternal age was 29.8 years (range 13–49); race/ethnicity was 43.6% White, 27% Hispanic, 21% Black, 7.1% Asian, and 1.3% other. 252 were multiple gestations; 229 sets of twins, 21 triplets and 2 quadruplets. 3678 (56%) women received Tdap during pregnancy, 249 (3.8%) postpartum and 100 (1.5%) received Tdap pre-conception only. Tdap uptake during pregnancy increased from 36% in April 2013 to a sustained uptake of greater than 61% since November 2013, with increases noted coincidental with presentations highlighting Tdap maternal immunization recommendations at faculty and staff meetings, and the release of the ACOG "toolkit". When antenatal Tdap vaccine was administered, mean gestation at receipt of Tdap was 31.4 weeks and 95% of vaccinated women received Tdap at the recommended gestation interval of 27–36 weeks, 71.6% during the 28–32 week window believed optimal for placental transport and 98.5% at least 7 days before delivery. Of 19 women with two pregnancies during the study period, four (21%) had Tdap during both. Black women were less likely to receive antenatal Tdap than women of other race/ethnicity (41% versus 60%; $P < 0.001$).
Conclusions: Sustained antenatal Tdap uptake rates exceeding 61% were achieved after strategies to increase awareness of recommendations were introduced and 95% of women were immunized at a gestation optimal for efficient maternal antibody placental transport. Further increases in uptake will require system changes such as best practice alerts in electronic medical records.

1. Introduction

Pertussis incidence, morbidity and mortality rates are highest in infants too young to have completed their primary immunization series with diphtheria, tetanus and acellular pertussis (DTaP) vaccine. Furthermore, pertussis-related deaths occur almost exclusively in infants under three months of age in resource-rich countries [1–4]. Pertussis immunization strategies in the United States (US) and other resource-rich countries focus on preventing young infant pertussis-associated morbidity and mortality.

In 2006, the Advisory Committee on Immunization Practices (ACIP) to the Centers for Disease Control and Prevention (CDC) recommended targeted immunization of postpartum women and contacts of infants with tetanus, diphtheria and acellular pertussis (Tdap) vaccine (cocooning) [5]. Although immunization of pregnant women was offered as an option, this was not presented as the preferred option. Logistical and financial barriers limited implementation of cocooning at a national level, and outcome studies in

Abbreviations: DTaP, diphtheria, tetanus and acellular pertussis vaccine; US, United States; ACIP, Advisory Committee on Immunization Practices; CDC, Centers for Disease Control and Prevention; Tdap, tetanus, diphtheria and acellular pertussis vaccine; ACOG, American College of Obstetricians and Gynecologists; UK, United Kingdom; PFW, Pavilion for Women; EMR, electronic medical record; MMWR, morbidity mortality weekly report; OR, odds ratio; CI, confidence intervals; PCP, primary care provider.

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the US and Australia demonstrated little or modest effectiveness in preventing infant pertussis, thus limiting cocooning as a stand-alone pertussis prevention strategy [6–8]. In 2011, ACIP recommended that pregnant women who had not previously received it routinely receive Tdap vaccine after week 20 of pregnancy [9], and in 2013, ACIP revised this recommendation stating that Tdap should be given in the third trimester of every pregnancy, regardless of history of previous Tdap receipt [1]. This recommendation was based on continued pertussis-associated morbidity and mortality in young infants and data indicating that pertussis antibody levels in newborn infants whose mothers had received Tdap within the prior two years were likely insufficient for protection [1,10]. The 2013 recommendation was endorsed by the American College of Obstetricians and Gynecologists (ACOG) [11]. Despite studies from the US and United Kingdom (UK) demonstrating the safety [12,13] and effectiveness of maternal immunization in preventing infant pertussis infection and deaths [14], limited US data reveal that only approximately 16% of pregnant women from 2010 to April, 2013 received Tdap vaccine [15,16]. We assessed Tdap vaccine uptake during pregnancy in women receiving prenatal care in practices affiliated with a metropolitan tertiary referral hospital in Houston, Texas.

2. Methods

The Pavilion for Women at Texas Children's Hospital (PFW) in Houston, Texas is a 15-story facility that delivers obstetrical and gynecological care to women. This facility is a tertiary referral center for obstetrics, and has approximately 5000 deliveries annually which include both low and high risk pregnancies, and women whose infants are likely to require Level IV neonatal intensive care at the adjoining pediatric hospital. Approximately 70% of women have private insurance with the remainder being publicly insured. Women who deliver at PFW receive obstetric care from providers in academic or private practices whose offices are located within the facility, all of whom use the same electronic medical record (EMR), or from other providers with offices in the community who have admitting privileges at the hospital. In the latter situation, the woman's prenatal records, including medications and biologics administered that are documented by the provider, are scanned into the EMR at the PFW prior to or at the time of delivery. Vaccines are ordered and supplied through the hospital pharmacy at academic-affiliated practices and may be administered on-site during routine appointments. Individual private practices order vaccines separately, and thus practices, located at the PFW or otherwise, vary as to their ability to administer vaccines on-site versus advising women to be vaccinated at alternate sites such as pharmacies.

The administration of the Tdap vaccine during pregnancy was identified as a quality measurement by study investigators when updated recommendations to administer Tdap in every pregnancy were published in MMWR in early 2013 [1]. PFW physicians received information about pertussis illness in infants and the new Tdap immunization recommendations through email and at regularly scheduled faculty meetings during the fall of 2013. These communications were supplemented by providing updates from professional organizations and by ensuring that all were aware of the ACOG "toolkit" released in September 2013 [17]. Physician representatives from each practice attended faculty meetings during which CDC recommendations were highlighted. The presence of multiple practices, each functioning as an autonomous unit, precluded implementing either "best practice alerts" or standing orders to administer Tdap during pregnancy with a "hard stop" within the EMR.

The study period extended from April 1, 2013 through June 30, 2014. Postpartum women were identified retrospectively from delivery records. Each woman's EMR was reviewed in detail and data were abstracted from PFW records and scanned outside office records, if antenatal care had been provided at an alternate site. Deliveries occurring before 37 0/7 weeks' gestation were defined as preterm. Preterm deliveries were further sub-classified as late preterm (32 0/7 to 36 6/7 weeks), very preterm (28 0/7 to 31 6/7 weeks) and extremely preterm (<28 weeks) as defined by World Health Organization [18]. Deliveries that occurred before 20 weeks were defined as miscarriages and excluded from further analysis. Data reviewed included mother and infant demographics, history of Tdap vaccine immunization including the number and timing of doses, and gestation at the time of administration.

Statistical analysis was performed using SPSS version 20.0 (SPSS, Chicago, IL). Descriptive characteristics were assessed for mothers and infants. Changes in Tdap uptake over the study period were assessed for temporal trends. Pregnancies where mothers received Tdap as per current CDC recommendations were compared with those where the mother did not. Statistical significance for dichotomous outcomes was determined by Chi-square and Fisher exact tests. Normally distributed data were assessed by means and the Student's t test; for non-parametric data, significance was assessed by medians and the Mann–Whitney U test. Multiple logistic regression analysis was used to account for potential demographic confounders where appropriate.

3. Results

During the 15-month study period, there were 6584 deliveries. Seven deliveries occurred before 20 weeks' gestation, leaving 6577 meeting criteria for analysis. Mean maternal age at delivery was 29.8 years (range 13–49). Maternal self-reported race and ethnicity was 43.6% White, non-Hispanic or Latino; 27% White, Hispanic or Latino; 21% Black or Africa-American; 7.1% Asian; 0.5% Native American and 0.8% other or did not disclose. Two hundred fifty two (3.8%) of deliveries were multiple gestations; 229 sets of twins, 21 triplets and 2 quadruplets. Mean gestation at delivery was 38.5 weeks (range 20.4–43.1) and 86.6% of deliveries occurred at term.

During the entire study period 3678 women (55.9%) received Tdap while pregnant, 132 of whom also had documented receipt of Tdap prior to the current pregnancy. One hundred women (1.5%) received Tdap pre-conception only and 249 (3.8%) received it postpartum. The Tdap vaccination rate during pregnancy increased from 36% in women who delivered in April 2013 to a sustained rate in excess of 61% since November 2013 (Fig. 1). Mean maternal gestation at the time of Tdap vaccine administration was 31.4 weeks (range 4–40). Ninety-five percent of women received Tdap during weeks 27 through 36 of pregnancy and 71.6% during weeks 28 through 32. The majority of women, 3621 (98.5%) had received Tdap at least 7 days before delivery. Of 19 women who had two deliveries within the 15-month study period, four (21%) received Tdap in both pregnancies.

Characteristics of women who did and did not receive Tdap during pregnancy are shown in Table 1. Black women were less likely than women of other race/ethnicity to receive Tdap (41% versus 59%; $P < 0.001$). When analyzed in a logistic regression model accounting for age, race/ethnicity and gestation, older maternal age was slightly positive as a predictor of receiving Tdap (odds ratio (OR) 1.05 for each additional year older [95% confidence intervals (C.I.) 1.04–1.06]), and being of black race/ethnicity (odds ratio 0.44 [95% C.I. 0.38–0.51]) or having a very or extremely preterm infant (odds ratio 0.14 [95% C.I. 0.09–0.22]) were negative predictors.

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