

Background

- Major epidemics of pertussis occurred in 2010 and 2014 in California, with more than 9,100 and 11,200 cases reported, respectively.
- Several pertussis vaccine strategy changes occurred during the interepidemic years, impacting different age groups.
- In 2012, a law was passed in California that mandated one dose of Tdap vaccine for all students who entered 7th-12th grade in the 2011-2012 school year and a 7th grade requirement thereafter¹.
- In 2013, ACIP and ACOG recommended that all pregnant women receive Tdap vaccine at 27-36 weeks gestation of each pregnancy to protect infants in the early weeks of life through transplacental transfer of antibodies².

Objectives

- We compared age-specific incidence of reported pertussis cases in California across two epidemic years among persons ≤ 20 years of age and described changes in disease burden.

Methods

Population

- Reported pertussis cases in California who were 20 years of age and younger with disease onset from January 1, 2010 - December 31, 2010 or January 1, 2014 - December 31, 2014. All cases either met the CSTE case definition for confirmed or probable pertussis³ or were PCR-confirmed.

Data sources

- California Department of Public Health surveillance data.
- California Department of Finance population estimate data.

Statistical analyses

- Age-specific rate ratios and associated 95% confidence intervals were calculated.

Vaccine Coverage

Prenatal Tdap vaccine coverage estimates

- 2010: unknown but estimated $<10\%$ ⁴
- 2014: 45.2% (95% CI: 42.7-47.6%) of pregnant women who delivered an infant in California during 2014 received Tdap vaccine during pregnancy⁵. 75% of pregnant women receiving prenatal care from Northern California Kaiser received Tdap vaccine during pregnancy⁶

1+ DTaP coverage estimates among 3 month-olds

- 2010: 84.8% \pm 4.5%⁷
- 2014: 87.5% \pm 5.7%⁸

3+ DTaP coverage estimates among 7 month-olds

- 2010: 63.8% \pm 6.4%⁷
- 2014: 65.8% \pm 8.2%⁸

4+ DTaP coverage estimates among kindergarten entrants

- 2010: 93.1%⁹
- 2014: 92.2%¹⁰

Tdap coverage estimates among 13-17 year-olds

- 2010: 71.2% (65.1% - 76.5%)¹¹
- 2014: 87.7% (83.1% - 92.3%)¹²

Results

Figure 1. Incidence of reported pertussis, by age – California, 2010 and 2014

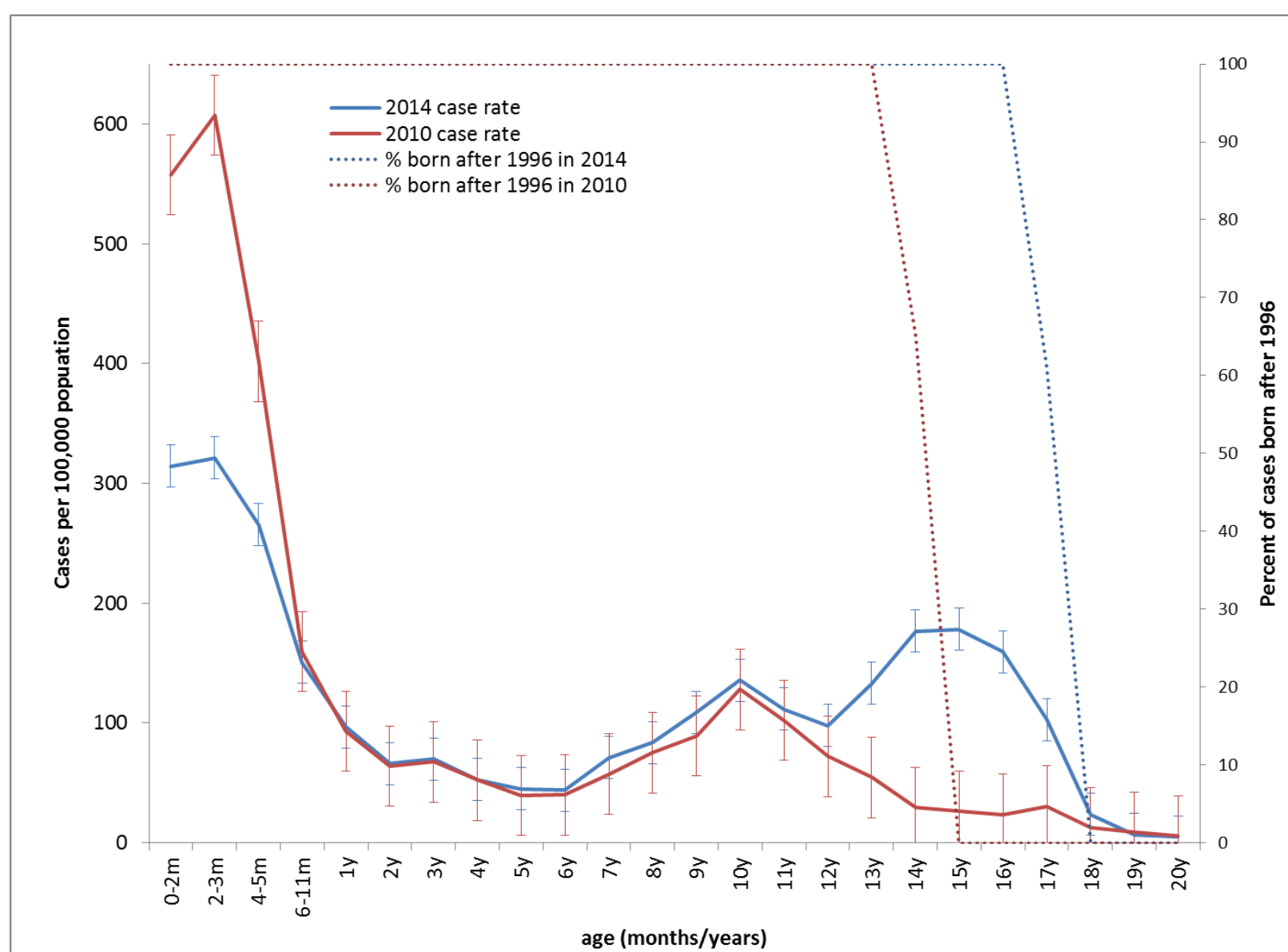


Table 1. Characteristics of pertussis cases <6 months of age – California, 2010 and 2014

	2010		2014		p-value
	N	(%)	N	(%)	
Cases	1,292		835		
Hospitalizations	581	(46)	321	(44)	NS
Deaths	10	(0.8)	3	(0.4)	NS
Age in months					
<2 months	450	(36)	266	(35)	NS
2-3 months	487	(39)	268	(35)	NS
4-5 months	327	(26)	223	(29)	NS
Race/ethnicity					
Hispanic, all races	867	(73)	489	(72)	NS
Asian/Pacific Islander	37	(3)	24	(3)	NS
Black, non-Hispanic	49	(4)	29	(4)	NS
White, non-Hispanic	216	(18)	133	(19)	NS
1+ DTaP vaccine	465	(39)	219	(29)	<0.001

Figure 3. Epidemic curve of pertussis by month of onset – California, 2010 and 2014

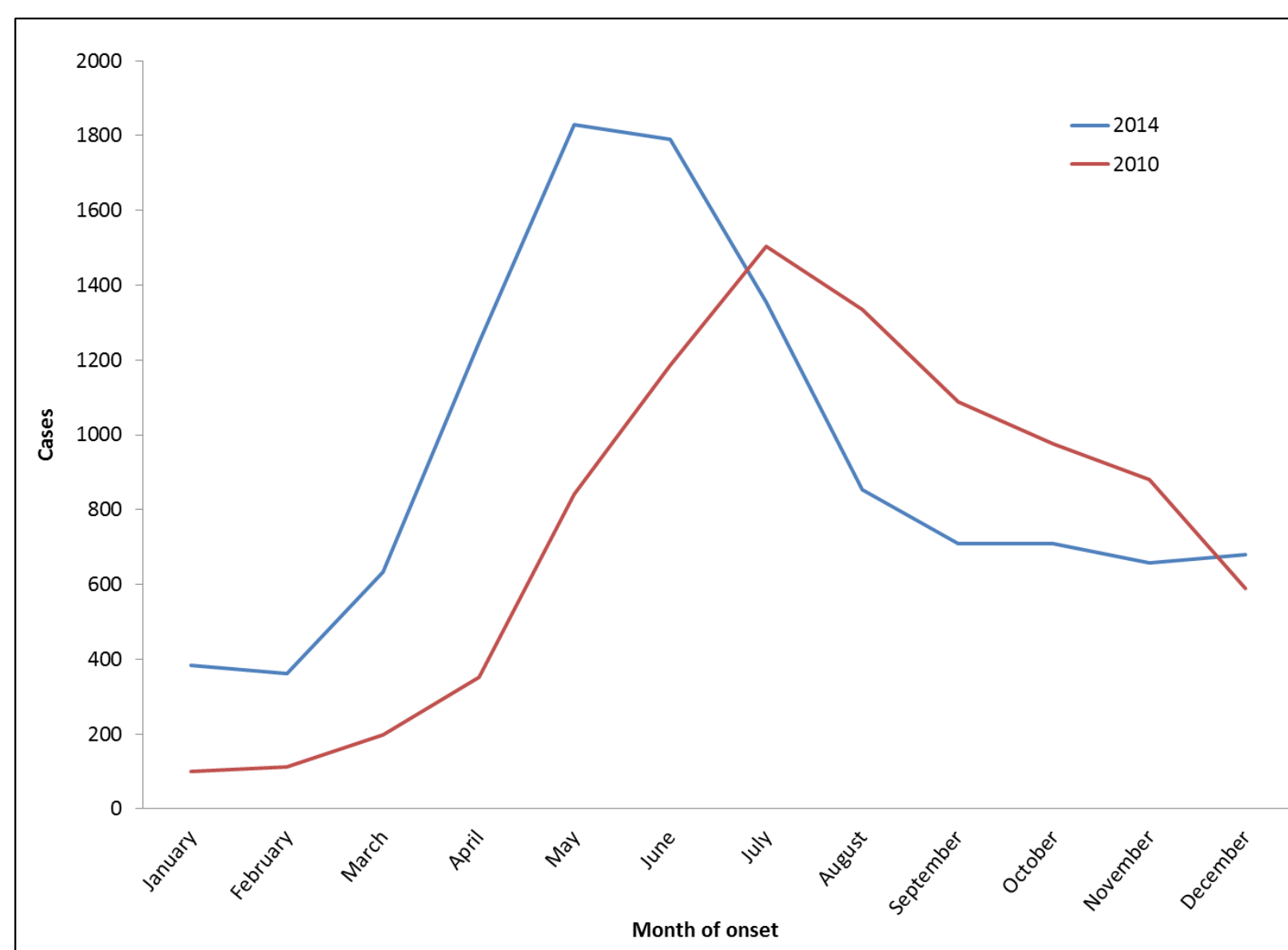


Figure 2. Rate ratios of reported pertussis by age – California, comparing 2010 and 2014

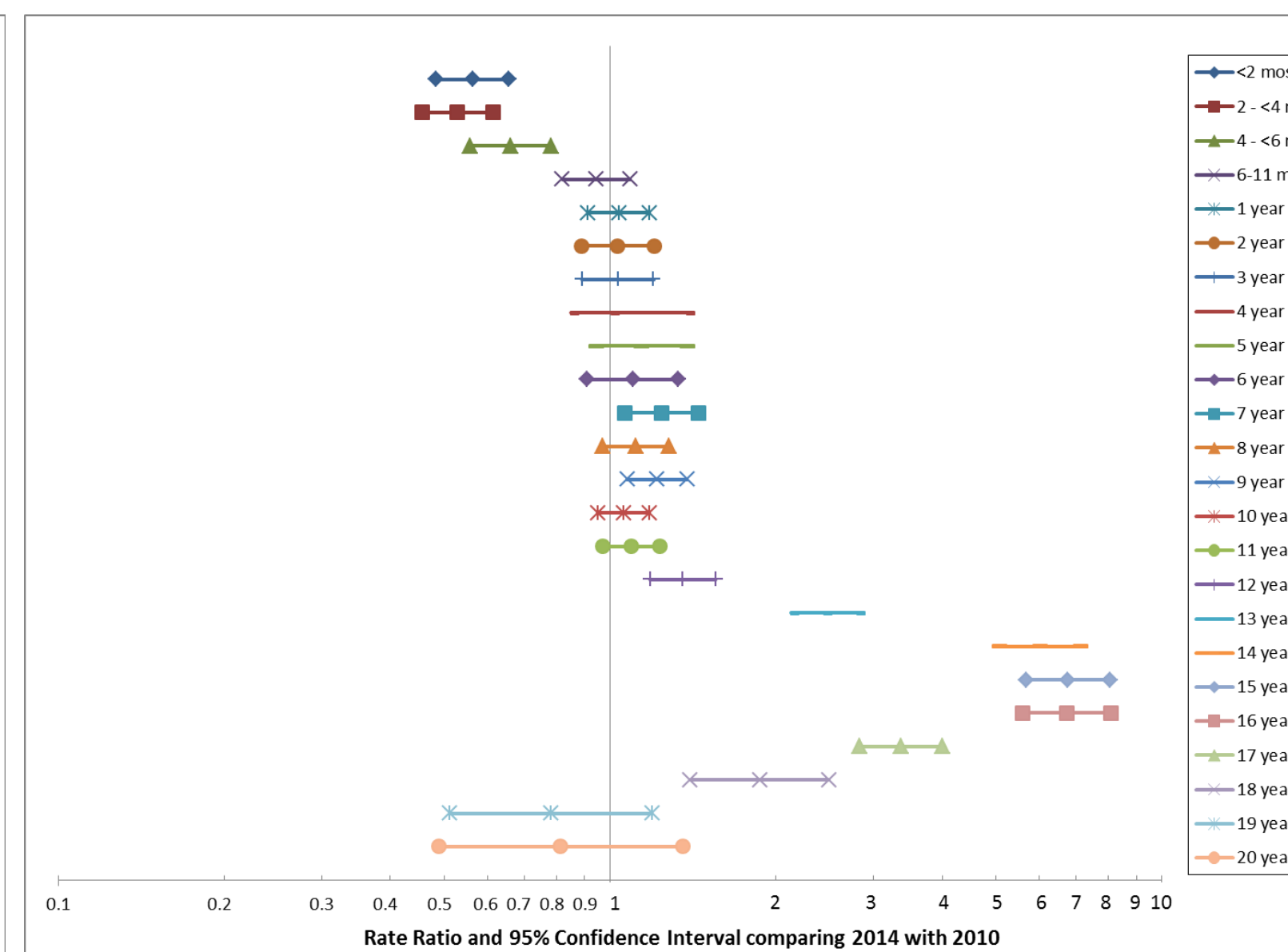


Table 2. Characteristics of pertussis cases aged 13-17 years of age – California, 2010 and 2014

	2010		2014		p-value
	N	(%)	N	(%)	
Cases	886		3,837		
Hospitalizations	8	(0.9)	10	(0.3)	0.019
Ever vaccinated against pertussis	726	(96)	3,241	(98)	0.002
Years from last dose, median [IQR]*	3.5	[1-8.5]	3	[2-5]	N/A
Born after January 1, 1997 (DTaP)	181	(20)	3,621	(94)	<0.001

*Among 32 cases w/ data (2010) and 1,628 cases w/ data (2014)

Summary

- The incidence of pertussis declined significantly among infants <6 months of age in 2014 compared to 2010 (RR 0.58, 95% CI 0.53-0.63) and fewer hospitalizations and deaths were reported. No significant change was observed in the racial/ethnic distribution of cases (Figures 1 and 2, Table 1).
- Incidence remained stable among infants >6 months of age, children, and adolescents <12 years of age (RR 1.1, 95% CI 0.5-1.3). Nearly all cases with complete data had been previously immunized; the median time since vaccination was 3 years [IQR 0.85 -5 years] (Figures 1 and 2).
- Adolescents 12-18 years of age had significantly higher rates of pertussis in 2014 compared to 2010, with the highest rates observed among 14-16 year-olds (RR 6.5, 95% CI 5.4-7.8). Nearly all cases with complete data had previously received Tdap vaccine; the median time since vaccination was 3 years [IQR 3-4 years] (Figures 1 and 2, Table 2).
- Among 19 and 20 year-olds, who would have received DTP, rather than DTaP, for their primary vaccination series, incidence remained low and did not change (RR 0.8, 95% CI 0.5-1.3) (Figures 1 and 2).
- The 2010 epidemic peak was observed in June-September 2010, with the most cases reported in July; the 2014 peak was observed in April-July 2014 (Figure 3).

Conclusions

- The reduced incidence observed only among infants <6 months of age in 2014, suggests that efforts to encourage Tdap vaccination among women during each pregnancy has likely been having some impact.
- The excess number of cases observed in 2014 compared to 2010 occurred almost exclusively among the 12-17 year-old age group, nearly all of whom received DTaP for their primary immunization series, despite increased Tdap vaccine coverage among adolescents.
- Beyond infancy, the peak age of pertussis is shifting upwards, consistent with aging of the cohort of children born in 1997 and after who have received only acellular pertussis vaccine.
- The burden of disease remained stable among older infants and children who were recently vaccinated and for whom no changes in vaccine recommendations occurred. This suggests that background factors, such as provider awareness and reporting were similar across epidemic years.
- It is likely that large outbreaks occurring among fully-vaccinated children, adolescents and adults who have only received acellular pertussis vaccines will be observed in future epidemics.
- Surveillance data should be used to inform public health efforts and policies related to pertussis.

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