

OREGON PUBLIC HEALTH DIVISION • OREGON HEALTH AUTHORITY

**PERTUSSIS: PERTINACIOUS BUT STILL VACCINE-VULNERABLE**

Down in the Valley  
And not far off  
A blue jay died of a whooping cough:  
He whooped and he whooped  
And he whooped some more  
He whooped his head and tail right off.  
*Camp Song*

**P**ertussis is an endemic disease with epidemic peaks occurring every 2–5 years. Alone among reportable vaccine-preventable diseases, pertussis has proved painfully persistent despite widespread childhood immunization and use of antibiotics. This issue of the *CD Summary* reviews the latest vaccination recommendations and recent pertussis trends in Oregon.

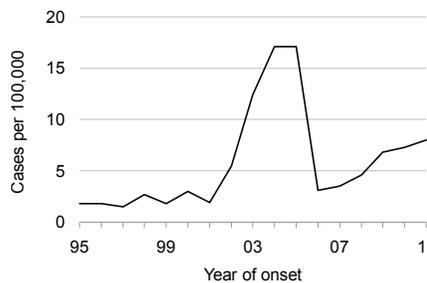
**VACCINATION RECS**

Diphtheria-Tetanus-acellular-Pertussis vaccine (DTaP) is recommended for all children at 2, 4, 6 and 15–18 months of age, with a pre-school booster between 4 years of age and entry into kindergarten. DTaP is not recommended on or after the 7<sup>th</sup> birthday. Two Tdap\* formulations are available. Boostrix® is licensed for persons ≥10 years of age; and Adacel® is licensed for persons 11–64 years of age. Current ACIP recommendations call for a once-in-a-lifetime dose of Tdap for the groups shown in the box (center).

**SECULAR TRENDS**

Pertussis incidence in Oregon is still lower than during 2004–2005, and we haven't seen the kind of numbers in 2012 that Washington State reported recently. However, pertussis has been on the rise here since 2006 (Figure 1). Pertussis is of particular concern in the youngest infants. In Oregon during 2007–2011, the highest annual incidence of reported pertussis was in infants <2 months of age: 323/100,000, compared with 29.7/100,000 in infants aged 6–11 months (Figure 2). The former group is too young to have started the vaccination series and is totally

**Figure 1. Pertussis incidence, Oregon, 1995–2011**



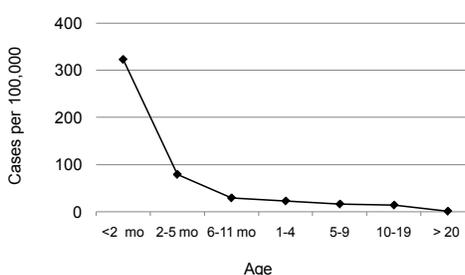
**Who should get Tdap?**

- Children 7–10 years of age who have not received a complete series of DTaP<sup>1</sup>
- Adolescents 11–18 years of age
- Pregnant women at ≥20 weeks' gestation<sup>2</sup>
- All non-pregnant adults<sup>3</sup>
- For adolescents and adults, Tdap can replace one of the decennial Td boosters. However, adults who have not gotten Tdap should be given a dose regardless of the interval since the last Td booster; recent Td does not seem to increase the risk of adverse reactions to Tdap.<sup>1</sup>

dependent on herd immunity. Since 2007, the 1- to 4-year age group had the next highest rate (22.6/100,000), closely followed by the 5- to 9-year age group (16.5/100,000).

The proportion of cases among those ≥10 years of age decreased from 61% of all cases during 2000–2005 to 43% in 2007–2011. The reported incidence among persons ≥20 years of age is a mere 1.6/100,000, but remember that this is a large age cohort, so it

**Figure 2. Pertussis by age, Oregon, 2007–2011**



still accounts for a big part of the reservoir for *Bordetella pertussis*: 20% of all cases reported in Oregon during this time. And if internists are less likely than pediatricians to test for pertussis, then this would be an underestimate.

**SEVERITY**

Infants too young to have completed the primary vaccine series account for the lion's share of pertussis-related complications, hospitalizations and deaths (at least four in Oregon since 2003). We reviewed data on infants hospitalized with pertussis during a two-year period from March 2009 through February 2011. One hundred forty-six infants with pertussis were reported during this time, and 62 (43%) of them were hospitalized for a median of 3 (range, 0–32) days. The median age at onset for hospitalized cases was 8 (range, 2–25) weeks. Symptoms included cough (100%), paroxysms (91%), posttussive vomiting (70%), apnea (70%), and whoop (46%). Up to 30% developed radiographically confirmed pneumonia. Supplemental oxygen was administered to 17 infants, for a median duration of 2 (range, 1–8) days. Sixteen (11%) of the 146 infants were admitted to ICU for a median of 3 (range, 1–7) days. One infant required mechanical ventilation for 5 days.

**INCOMPLETE PROTECTION**

Is the problem of pertussis in infants ≥6 months of age one of vaccine failure, or is it failure to vaccinate? The immunization status of 2011 pertussis cases ≥6 months of age

**Table. Vaccination history of pertussis cases ≥6 months of age, Oregon, 2011**

| Age      | Cases | Case counts by vaccination status |         |     | Incidence per 100,000 by vaccination status |     |
|----------|-------|-----------------------------------|---------|-----|---|-----|
|          |       | Full                              | Partial | Not | Full  | Not |
| 6–11 mo  | 5     | 0                                 | 0       | 5   | 0   | 735 |
| 1–3 yrs  | 54    | 10                                | 5       | 39  | 11.9  | 920 |
| 4–6 yrs  | 37    | 2                                 | 7       | 28  | 2.4   | 636 |
| 7–10 yrs | 72    | 35                                | 8       | 29  | 23.5  | 397 |
| ≥11 yrs  | 111   | 21                                | 0       | 90  | 2.8   | 6.3 |

\*Lower-case “d” indicates reduced amount of diphtheria toxoid.



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is shown in the Table (*verso*). “Fully immunized” was defined according to ACIP recommendations: three pertussis-containing vaccines for 6–11-month-olds, four pertussis-containing vaccines for 1–3-year-olds, five shots for 4–10-year-olds and a single dose of Tdap for those  $\geq 11$  years of age.

The data suggest that undervaccination is the major issue. Of those who were completely unvaccinated, 86% were because the parents declined vaccination. Nineteen of the 111 cases  $\geq 11$  years of age were subject to Oregon’s Tdap school vaccination requirement, phase in of which began with 7<sup>th</sup> grade in September 2008 and which currently applies to those in grades 7–10. Of these 19 cases, 7 had received Tdap, and 6 had exemptions based on religion.<sup>†</sup>

Because survey data indicate that the vast majority of Oregon children end up receiving all of the recommended pertussis vaccine doses, we were surprised to see the high proportion of pertussis cases in completely unvaccinated children. We reviewed data from our statewide immunization registry to ascertain denominators for children who were up-to-date for age on their pertussis series and for those who had received zero doses. The incidence figures in the last two columns of the Table demonstrate that declining the vaccine carries a whopping risk for pertussis.

#### “COCOONING”

What about the infants too young to be vaccinated? We tried to identify

<sup>†</sup> Defined for this purpose as “any system of beliefs, practices or ethical values.” See Oregon Administrative Rule 333-050-0010.

the source of transmission to infant cases reported in Portland-area counties during 2010–2011. The source was presumed to be a person with cough illness who had contact with the infant case 7–20 days before the infant’s cough began. Forty-five infant cases were identified. The source of infection was identified for 30 (66%) of the cases. The most common sources were siblings (53%), parents (17%) and grandparents (10%).

For this reason, it seems prudent to try to create a “cocoon” of immunized persons around vulnerable infants, by vaccinating with Tdap mom and dad, family members, other caregivers, and perhaps grandma and grandpa. Moreover, very young infants should benefit from transplacental transfer of maternal antibodies — if, of course, mom has any to transfer. The recommendation for vaccination of pregnant women should induce the production of those antibodies; and administering the Tdap after 20 weeks’ gestation ensures that said Tdap could not interfere, even theoretically, with organogenesis.

Healthcare personnel are also singled out for special attention. Persons with persistent cough tend to go to healthcare facilities,<sup>‡</sup> so healthcare workers are more likely to be exposed — and, in turn, to expose other vulnerable persons. Healthcare employers should provide Tdap for healthcare personnel and do what they can to maximize vaccination rates — e.g., by educating about the benefits of vaccination, providing Tdap at no charge and making vaccination convenient.<sup>4</sup>

<sup>‡</sup> and movie theatres

#### THE BOTTOM LINE

Notwithstanding questions about pertussis vaccine efficacy and duration of immunity, most of our cases are occurring among under- or unvaccinated children: so getting these kids vaccinated seems the most obvious approach to reducing illness. Humans are the only reservoir for *Bordetella pertussis*, and chronic carriage is not known to occur. In principle, then, pertussis could be eradicated; but we have a long way to go.<sup>5</sup>

#### FOR MORE INFORMATION

- OPHD pertussis page : <http://1.usa.gov/vpdpertussis>
- ACIP references on pertussis: [www.cdc.gov/vaccines/recs/acip/live-meeting-feb12.htm](http://www.cdc.gov/vaccines/recs/acip/live-meeting-feb12.htm)
- CDC’s pertussis page: [www.cdc.gov/pertussis/](http://www.cdc.gov/pertussis/)

#### REFERENCES

1. CDC. Updated recommendations for the use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis (Tdap) vaccine from the Advisory Committee on Immunization Practices, 2010. *MMWR* 2011;60:13–5.
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3. CDC. ACIP provisional Tdap recommendations. Available at [www.cdc.gov/vaccines/recs/provisional/Tdap-feb2012.htm](http://www.cdc.gov/vaccines/recs/provisional/Tdap-feb2012.htm). (Accessed 10 Apr 2012).
4. CDC. Immunization of health-care personnel: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR* 2011;60(RR-7):1–45.
5. Edwards K, Decker M. Pertussis vaccine. In: Plotkin S, Orenstein W, Offit P, eds. *Vaccines*. 5<sup>th</sup> ed. Philadelphia: W.B. Saunders Co.; 2008:509–10.