

Recent Trends in Costs, Length of Stay, and Mortality Associated With Infant Pertussis Hospitalization in the United States

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BACKGROUND

- Pertussis incidence has resurged in the United States (US) after a nadir in the 1970s and is now one of the most prevalent vaccine-preventable infections
- Infants are at greatest risk for severe pertussis-related morbidity and mortality (~50% of infant cases require hospitalization) and account for the majority of cases¹
- Recent surveillance indicates a resurgence of overall pertussis incidence in the US,² but limited data exist on the cost and mortality burden of severe infantile cases

OBJECTIVE

- We sought to quantify the cost and mortality burden of infant pertussis cases severe enough to prompt hospitalization

METHODS

Study Design

- Retrospective database analysis

Data Source

- Discharge data from the 2000-2011 Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS)
- The NIS is the largest all-payer inpatient care database in the US
- The NIS includes many variables for each inpatient stay, including demographics, diagnosis codes, length of stay (LOS), total charges, admission, and discharge status
- Sampling weights allow for generating nationally representative estimates

Inclusion Criteria

- Inpatient discharges containing a diagnosis code (primary or nonprimary) for pertussis (International Classification of Diseases, 9th Revision, Clinical Modification codes 033.0, 033.8, 033.9, 484.3)
- Age < 1 year

Study Measures and Analytical Methods

- Weighted, nationally representative estimates of costs per admission (in 2013 US dollars), LOS, and case fatality rates (CFRs) were descriptively assessed for each year of the study period (2000-2011)
- Charges were converted to costs using a 0.5 cost-to-charge ratio
- Costs and LOS per admission were descriptively compared to all nonpertussis admissions
- CFRs were additionally stratified by race/ethnicity
- Demographic characteristics of infants hospitalized for pertussis during 2000-2011 also were reported
- Analyses were descriptive and carried out using SAS[®] (Version 9.3) statistical software

RESULTS

Demographics (Tables 1a, 1b)

- Total numbers of infant pertussis hospitalizations in the US followed a cyclic pattern, starting at 2,282 in 2000 and peaking at 5,343 in 2005, then declining to 1,614 in 2007 before another peak of 3,221 in 2010
- Infants hospitalized for pertussis were generally evenly distributed by sex each year of the study period
- The racial composition of infant pertussis-related hospitalizations was relatively stable during this period, with whites representing the highest proportion of cases in each year except for 2006 and 2010, when Hispanics represented 33% and 39% of cases, respectively

Costs and Length of Stay (Figures 1, 2)

- Mean (standard deviation [SD]) LOS for these hospitalizations fluctuated minimally year to year, but an overall (albeit modest) increase was observed: from 3.3 (7.3) days in 2000 to 3.9 (9.5) days in 2010
- Mean (SD) cost per admission increased at a greater rate than LOS, from \$12,377 (\$23,985) in 2000 to \$16,339 (\$37,224) in 2010
- Across the study period, both LOS and costs were nearly double those observed for nonpertussis hospitalizations

Case Fatality Rates (Figure 3)

- Overall CFRs were relatively stable during the period, fluctuating between ~1.5% and 3%, although a peak of 4.4% occurred in 2005, coinciding with the incidence peak
- In 5 out of 12 years during the study period, CFRs were highest in black infants, particularly during the peak incidence years of 2005, 2006, and 2007
- From 2003 until the end of the study period, CFRs were consistently higher in whites than in Hispanics
- While CFRs declined steadily for both whites and Hispanics from 2005 to 2011, CFRs trended sharply upward for blacks beginning in 2009

Table 1a. Characteristics of Inpatient Admissions for Infant Pertussis in the United States, 2000-2005

	2000		2001		2002		2003		2004		2005	
	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %
Total	2,282	100.00	2,026	100.00	2,549	100.00	2,410	100.00	3,480	100.00	5,343	100.00
Sex												
Male	1,128	49.43	1,081	53.36	1,251	49.08	1,309	54.32	1,776	51.03	2,664	49.86
Female	1,154	50.57	945	46.64	1,298	50.92	1,101	45.68	1,689	48.54	2,674	50.04
Unknown/missing	—	—	—	—	—	—	—	—	15	0.43	5	0.10
Race/ethnicity												
White	831	36.40	643	31.72	745	29.22	806	33.47	1,245	35.76	1,231	23.04
Black	302	13.25	224	11.04	282	11.08	280	11.63	288	8.28	343	6.42
Hispanic	567	24.86	645	31.82	785	30.82	683	28.34	957	27.50	1,857	34.76
Asian/Pacific Islander	42	1.84	49	2.40	44	1.74	22	0.92	55	1.58	106	1.98
Native American	—	—	6	0.27	—	—	10	0.41	31	0.88	19	0.35
Other	130	5.69	88	4.34	178	7.00	108	4.48	85	2.43	249	4.65
Unknown/missing	410	17.95	373	18.40	513	20.14	500	20.75	820	23.57	1,539	28.80

Table 1b. Characteristics of Inpatient Admissions for Infant Pertussis in the United States, 2006-2011

	2006		2007		2008		2009		2010		2011	
	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %	Weighted n	Weighted %
Total	2,445	100.00	1,614	100.00	1,676	100.00	2,407	100.00	3,221	100.00	1,349	100.00
Sex												
Male	1,188	48.58	819	50.73	898	53.58	1,295	53.82	1,654	51.35	651	48.25
Female	1,248	51.04	790	48.99	778	46.42	1,112	46.18	1,549	48.10	692	51.33
Unknown/missing	9	0.38	5	0.28	—	—	—	—	18	0.55	6	0.42
Race/ethnicity												
White	664	27.14	499	30.93	632	37.68	998	41.45	1,059	32.87	518	38.38
Black	281	11.51	148	9.20	199	11.86	215	8.92	353	10.95	172	12.79
Hispanic	804	32.90	422	26.17	348	20.77	708	29.43	1,265	39.29	276	20.44
Asian/Pacific Islander	56	2.30	6	0.34	27	1.62	20	0.84	106	3.28	19	1.44
Native American	20	0.81	25	1.58	10	0.59	33	1.37	20	0.63	15	1.11
Other	116	4.76	43	2.67	155	9.24	143	5.93	83	2.57	68	5.07
Unknown/missing	503	20.58	470	29.10	306	18.25	290	12.05	336	10.42	280	20.77

Figure 1. Mean Cost (in 2013 US Dollars) per Infant Pertussis Hospitalization in the United States, 2000-2009

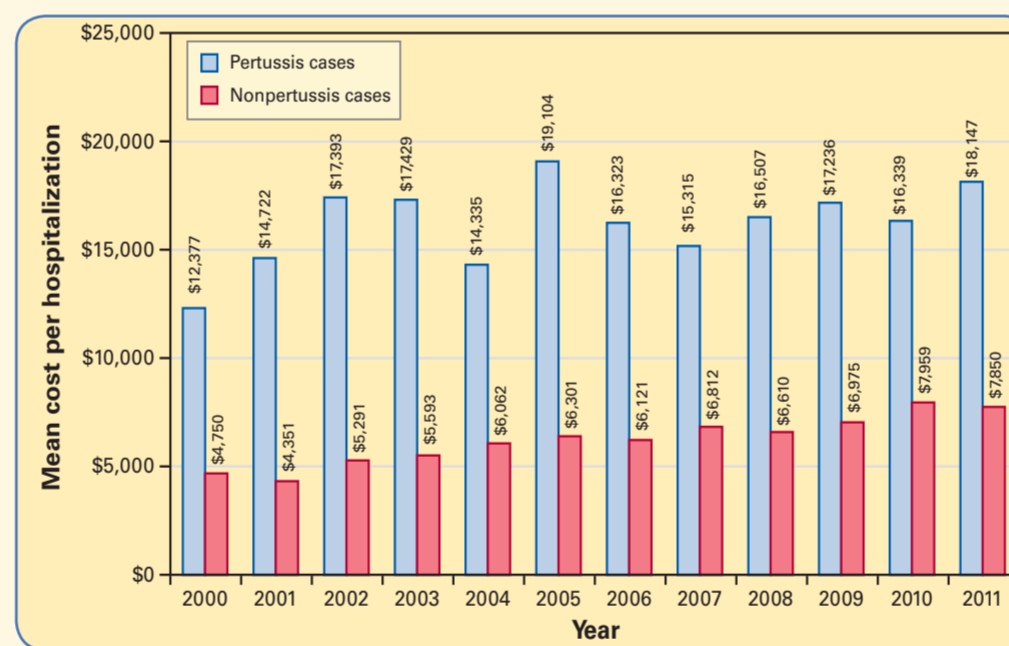


Figure 2. Mean LOS of Infant Pertussis Hospitalizations in the United States, 2000-2009

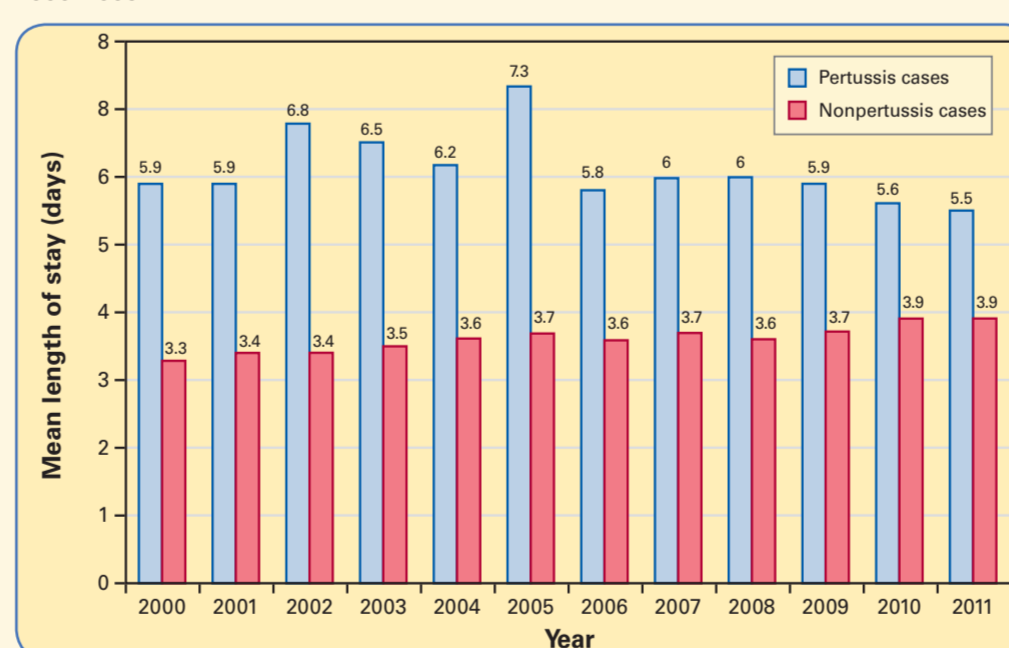
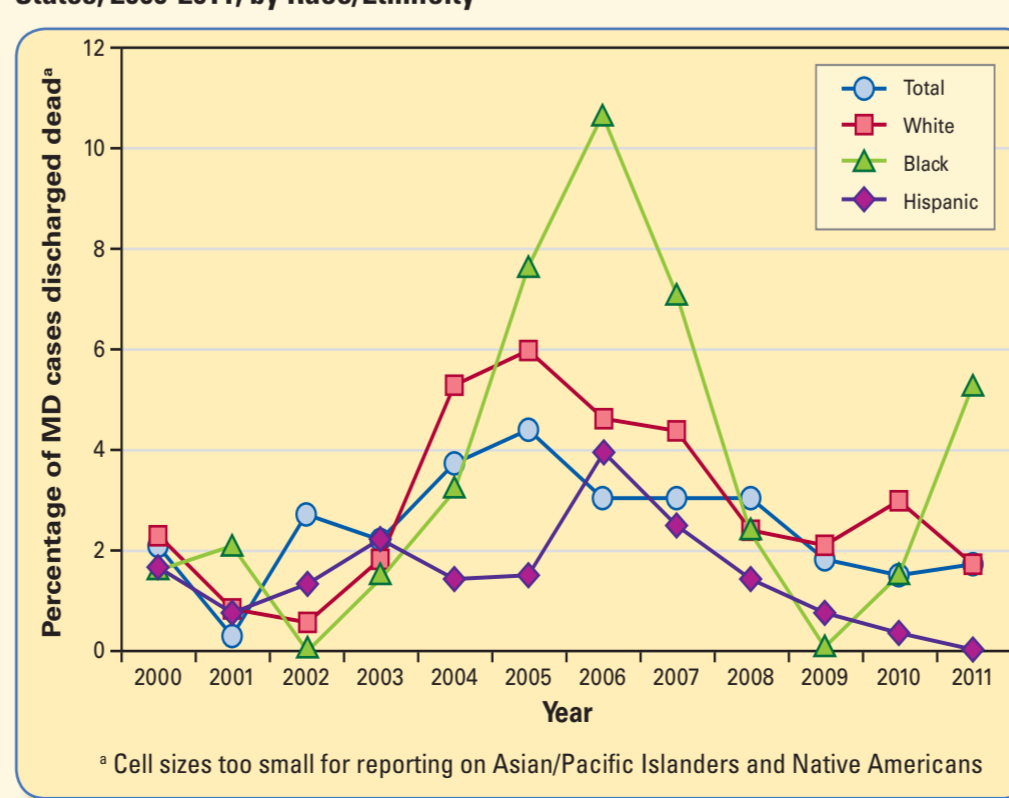


Figure 3. Case Fatality Rate of Infant Pertussis Hospitalizations in the United States, 2000-2011, by Race/Ethnicity



LIMITATIONS

- Patient discharges were identified based upon diagnosis codes that, if recorded inaccurately, may cause misidentification of pertussis
- Because unique patient identifiers were not provided, we were unable to follow patients who moved from facility to facility; results may be biased somewhat if the experiences of patients who transferred from facility to facility differed from those who remained in the analytic sample

CONCLUSIONS

- Infant pertussis hospitalizations typically exceed 3 days and are associated with high costs compared with hospitalizations for other causes
- Observed CFRs were consistent with the ~2% fatality rate previously derived from surveillance by the Centers for Disease Control and Prevention, although some substantial differences in CFRs by race/ethnicity were noted
- These data may help inform economic and cost-effectiveness evaluations of future pertussis vaccination programs
- The stratified analysis of CFRs by race/ethnicity highlights the need for increased focus on minorities, particularly blacks, in pertussis vaccination programs

REFERENCES

1. Centers for Disease Control and Prevention. Pertussis: fast facts. Available at: <http://www.cdc.gov/pertussis/fast-facts.html>. Accessed April 28, 2014.
2. Cherry JD. Epidemic pertussis in 2012 — the resurgence of a vaccine-preventable disease. N Engl J Med. 2012;367(9):785-7.

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