
Marika K. Iwane*, Sandra S. Chaves, Peter G. Szilagyi, Kathryn M. Edwards, Caroline B. Hall†, Mary A. Staat, Cedric J. Brown, Marie R. Griffin, Geoffrey A. Weinberg, Katherine A. Poehling, Mila M. Prill, John V. Williams, and Carolyn B. Bridges

* Correspondence to Dr. Marika K. Iwane, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road NE, Mailstop A34, Atlanta, GA 30333 (e-mail: miwane@cdc.gov).
† Deceased.

Initially submitted January 20, 2012; accepted for publication June 25, 2012.

Few US studies have assessed racial disparities in viral respiratory hospitalizations among children. This study enrolled black and white children under 5 years of age who were hospitalized for acute respiratory illness (ARI) in 3 US counties during October–May 2002–2009. Population-based rates of hospitalization were calculated by race for ARI and laboratory-confirmed influenza and respiratory syncytial virus (RSV), using US Census denominators. Relative rates of hospitalization between racial groups were estimated. Of 1,415 hospitalized black children and 1,824 hospitalized white children with ARI enrolled in the study, 108 (8%) black children and 111 (6%) white children had influenza and 230 (19%) black children and 441 (29%) white children had RSV. Hospitalization rates were higher among black children than among white children for ARI (relative rate (RR) = 1.7, 95% confidence interval (CI): 1.6, 1.8) and influenza (RR = 2.1, 95% CI: 1.6, 2.9). For RSV, rates were similar among black and white children under age 12 months but higher for black children aged 12 months or more (for ages 12–23 months, RR = 1.7, 95% CI: 1.1, 2.5; for ages 24–59 months, RR = 2.2, 95% CI: 1.3, 3.6). Black children versus white children were significantly more likely to have public insurance or no insurance (85% vs. 43%) and a history of asthma/wheezing (28% vs. 18%) but not more severe illness. The observed racial disparities require further study.

Abbreviations: ARI, acute respiratory illness; NVSN, New Vaccine Surveillance Network; RR, relative rate; RSV, respiratory syncytial virus; RT-PCR, reverse-transcription polymerase chain reaction.

Racial/ethnic health disparities in the United States have long been recognized for many diseases, both chronic and infectious (1). Identifying populations and targeting interventions for specific diseases is an important step towards reducing such disparities. Few studies of racial/ethnic disparities among US children have focused on acute respiratory illness (ARI) in general or on specific respiratory viruses such as influenza and respiratory syncytial virus (RSV), pathogens with a high burden of severe illness (2–4). Recent US studies of 2009 pandemic influenza A(H1N1) in the United States found higher rates of hospitalization with the virus among black children and those in other minority groups than among whites (5–8). A California study using administrative data did not find higher rates of RSV-coded infant hospitalizations for black children compared with white children by insurance type (9). Higher rates of RSV-coded hospitalizations among American Indian/Alaska Native infants (10) and laboratory-confirmed RSV hospitalizations of Alaska Native infants (11)
compared with the US infant population have also been reported.

The primary goal of this prospective, population-based study was to determine whether racial disparities existed between black and white children under 5 years of age for hospitalizations associated with community-acquired ARI and laboratory-confirmed seasonal influenza and RSV illness in 3 large US counties. Secondly, we assessed racial differences in access to care, influenza vaccination, and other characteristics that may affect racial disparities in hospitalization rates.

MATERIALS AND METHODS

Study population

The New Vaccine Surveillance Network (NVSN) prospectively enrolled children under 5 years of age admitted to network hospitals with an admission diagnosis of ARI or fever (“ARI”). ARI admission diagnoses included ARI, apnea, asthma exacerbation, bronchiolitis, croup, cystic fibrosis exacerbation, febrile neonate, febrile seizure, fever without localizing signs, hypothermia, influenza, otitis media, paroxysmal cough, pharyngitis, pneumonia, respiratory distress, RSV, rule-out sepsis, sinusitis, tonsillitis, upper respiratory illness, wheezing, and other respiratory infection. Admissions for fever without localizing signs were included because pediatric respiratory infections can be associated with high fever without respiratory symptoms. Children had to be enrolled in the NVSN within 48 hours of admission. Children were excluded if they had a known nonrespiratory cause for the hospitalization, had been previously hospitalized during the prior 4 days, had remained hospitalized since birth, or had fever and neutropenia related to oncological treatment. This study excluded Hispanic/Latino children of any race because of low numbers and because a lack of Spanish translators in some study years resulted in incomplete ascertainment of Hispanic/Latino children. Children of races other than black or white, including multiracial children, were also excluded because of low numbers.

Surveillance was population-based, with participating hospitals accounting for more than 95% of the pediatric hospitalizations of resident children in each county. The 3 surveillance counties, located in the states of Tennessee, New York, and Ohio, are among the 100 largest counties in the United States and encompass the cities of Nashville, Rochester, and Cincinnati, respectively, with combined urban/suburban populations of more than 142,000 children under 5 years of age.

This study included children enrolled during the months of October through May between 2002–2003 and 2008–2009 and excluded the influenza pandemic period after April 14, 2009. During October 2002–April 2005, hospital surveillance was conducted 4 days per week, except for the 2004–2005 influenza season, in which it was conducted 7 days per week. During the remaining seasons, surveillance was conducted 5 days per week. The Ohio county site contributed 3 seasons of data (2003–2004, 2004–2005, and 2008–2009), because NVSN surveillance began at the Ohio site in 2003, and a protocol deviation pertaining to 70% of eligible children at the site from 2005–2006 through 2007–2008 resulted in the exclusion of those years from this study for that site.

The NVSN study design and methods of ARI surveillance have been described previously (3, 4). The study was approved by the institutional review boards at each site and the Centers for Disease Control and Prevention. Informed consent was obtained from each parent/guardian before enrollment.

Data collection and laboratory testing

After obtaining informed consent, study personnel collected nasal and throat swabs for research purposes only, which were tested for influenza A and B viruses and RSV by reverse-transcription polymerase chain reaction (RT-PCR). Viral culture for influenza and RSV was also performed during some years, and specimens found to be positive by RT-PCR or viral culture were considered positive. All influenza and RSV cases in this report were laboratory-confirmed by means of these methods. Study laboratories did not test for RSV during the 2008–2009 season because of study budget constraints; therefore, that season was excluded from RSV-specific analyses.

Study personnel conducted parent/guardian interviews to obtain information on demographic factors (race/ethnicity, maternal education, access to care, exposures, medical history, use of influenza antiviral medication, palivizumab prophylaxis against RSV, and number of days the child had been ill at admission. Medical record review was also conducted to obtain additional data on medical history, demographic characteristics (date of birth, sex), use of influenza antiviral medication, and clinical course. Influenza vaccination data were obtained from vaccination providers from 2003–2004 through 2008–2009.

Race/ethnicity

Parents/guardians were asked 2 questions about race/ethnicity during study interviews: 1) whether the child was Hispanic or Latino and 2) whether the child’s race was white, black/African-American, American Indian/Alaska Native, Asian, Native Hawaiian/other Pacific Islander, or other; additional choices included none, unknown, and refused/no response. Study personnel recorded all responses that were indicated by the parent/guardian.

For this study, a non-Hispanic/Latino child was classified as white if the parent/guardian specified the child to be white and of no other race. A non-Hispanic/Latino child was classified as black if the parent/guardian specified the child to be black or African-American and of no other race. The questions, categories, and terminology were chosen for consistency with those of the US Census (12).

Other data definitions

We assessed other demographic and health-related factors that may affect ARI hospitalizations or that have been associated with racial/ethnic disparities in health care. A preexisting high-risk medical condition was considered
present if it was noted in the medical record or if the parent/guardian responded that s/he had been told by a health-care provider that the child had the condition. High-risk medical conditions, corresponding to those considered by the Advisory Committee on Immunization Practices to increase the risk for serious complications of influenza (13), included: heart disease, chronic pulmonary disease, kidney disease, cancer, diabetes, immunodeficiency, sickle cell anemia, and neurological/neuromuscular conditions. History of asthma/wheezing included a diagnosis of asthma, reactive airway disease, or recurrent or chronic wheezing. Up to 10 discharge diagnoses were collected; asthma discharge diagnoses included all those with International Classification of Diseases, Ninth Revision, code 493.xx (http://www.cdc.gov/nchs/icd/icd9cm.htm).

Influenza vaccination data verified from providers’ records were included if children were at least 6 months of age (i.e., age-eligible for vaccine) on or after November 1 each season and had received vaccine at least 14 days before illness onset (to allow time for an adequate immunological response). Children were considered fully vaccinated against influenza if they received 2 vaccine doses at least 24 days apart for the season, or 1 dose for the season plus a dose in a previous season. Children were considered partially vaccinated if they received only 1 dose for the season without a dose in a prior season and unvaccinated if they did not receive vaccine for the season.

Statistical methods

Three different outcomes were assessed: any ARI, laboratory-confirmed influenza, and laboratory-confirmed RSV. Rates of hospitalization (per 1,000 children) associated with each of the 3 outcomes and 95% confidence intervals were calculated for black and white children as the bootstrapped weighted number of hospitalizations divided by the census population for the counties, multiplied by 1,000, applying the percentile method (14). A total of 2,000 bootstrap samples were selected, stratified by county and study year. The weights accounted for the non-surveillance days per week and the nonparticipation rates by site, quarter-year, and age. The census denominators were the post-2000 annual bridged race estimates of the number of resident children under 5 years of age for each county during 2003–2009, by single year of age, from the US Census (12).

We calculated hospitalization rates for black and white children overall and by age group. Age-specific relative rates (the black:white ratio of rates) and 95% confidence intervals were obtained using bootstrap methods. We also calculated rates by county and study year to assess descriptively whether trends varied according to these factors. Comparisons of other characteristics (i.e., sociodemographic factors, access to care, clinical characteristics) were considered exploratory. All comparisons and age groups were specified a priori. Median values and interquartile ranges were used to describe continuous data. Wilcoxon rank-sum tests were used to compare durations of hospitalization. Pearson chi-square or Fisher’s exact tests were used for categorical data. A 2-sided 5% α level was applied for all statistical tests without adjustment for multiple comparisons. SAS statistical software was used for all analyses (version 9.2; SAS Institute Inc., Cary, North Carolina).

The unit of analysis for this study was a hospitalization, and all enrolled hospitalizations were included in rates to capture the entire burden. Counts and percentages were also based on the number of hospitalizations. A small percentage of children were enrolled more than once within a season. To assess the impact of multiple hospitalizations, we also compared sociodemographic and clinical characteristics based on unique children using their last hospitalization for the season; results (data not shown) were similar to those based on all hospitalizations.

RESULTS

Study population

Of the 4,329 ARI hospitalizations included in the study seasons during October through May, 1,415 (33%) were among 1,361 black children and 1,824 (42%) were among 1,776 white children (Figure 1). Hospitalizations of Hispanic/Latino children (16%), children of multiple/other races (8%), and children with missing race/ethnicity data (0.8%) were excluded from this analysis. Four percent of black children and 3% of white children had more than 1 hospitalization. Enrollment rates among eligible black and white children were 82% and 84%, respectively, and did not differ significantly between the two racial groups by age (0–5, 6–11, 12–23, or 24–59 months), sex, study year, or insurance status. The main reason for nonenrollment was parental refusal or unavailability among black (84%) and white (83%) children.

The number of ARI hospitalizations that were influenza-positive was 108 (8%) for black children and 111 (6%) for white children. The number that were RSV-positive was 230 (19%) for black children and 441 (29%) for white children (Table 1).

Demographic factors, access to care, and exposure characteristics

The distribution of several socioeconomic characteristics differed between black and white children hospitalized for ARI (Table 1). In particular, a lower proportion of black children had private insurance (14% vs. 57%) or received routine sick care in a private physician’s office (49% vs. 86%). In addition, a higher proportion of black children than of white children had mothers with lower educational levels (32% vs. 18% were not high school graduates) and had a school-age sibling (53% vs. 39%). Similar racial trends were seen for influenza and RSV-associated hospitalizations.

Influenza vaccination and treatment

Among influenza-negative children who were at least 6 months of age, similar proportions of black and white children were fully vaccinated, but a lower proportion of black children received 1 or more doses of influenza vaccine (34% vs. 48%) (Table 1). Among influenza-positive children, 12%
of black children and 42% of white children received 1 or more doses of influenza vaccine.

Use of antiviral agents for influenza was rarely noted by the parent or in the hospital record for either race (<1%). Parental reporting of palivizumab prophylaxis for RSV among premature children younger than age 2 years was not significantly different between black and white children (38% vs. 30%; \( P = 0.13 \)).

**Population-based rates of ARI hospitalization**

ARI hospitalization rates were significantly higher for black children than for white children (14.1 per 1,000 vs. 8.3 per 1,000 overall; relative rate (RR) = 1.7) (Table 2). For both black and white children, rates were highest among children under 6 months of age and decreased with increasing age. The age-specific relative rates of hospitalization for black children versus white children ranged from 1.5 to 2.0, and all were significantly greater than 1 (Table 2).

In all 3 counties, higher ARI hospitalization rates were observed for black children than for white children in the age groups 0–5 months and 6–59 months (Figure 2). Figure 3 shows ARI rates over all study years for black and white children stratified by age group (0–5 and 6–59 months); ARI hospitalization rates were higher for black children for all years in both age groups.

**Population-based rates of laboratory-confirmed influenza hospitalization**

Black children were more likely to be hospitalized for influenza-related ARI than white children. The age-specific relative rates of influenza-associated hospitalization for black children versus white children ranged from 1.9 to 2.5 (Table 2). Similarly, hospitalization rates were higher for black children than for white children by county (Figure 2) and across years (Figure 3), except for 2 seasons with low overall incidence of influenza-associated hospitalization (2002–2003 and 2006–2007).

**Clinical characteristics**

**ARI hospitalizations.** Several clinical characteristics differed between racial groups (Table 3). A history of a high-risk condition, particularly asthma/wheezing, and premature birth were more common among black children than among white children. However, a lower proportion of black children than of white children received supplemental
oxygen or were hospitalized for 3 days or more. A lower proportion of black children than of white children had discharge diagnoses of pneumonia or bronchiolitis, but higher proportions of black children had diagnoses of asthma, both overall and by age group. Black and white children did not differ significantly with respect to other clinical characteristics such as admission to an intensive care unit or receipt of mechanical ventilation. Two children (1 black and 1 white) died.

**Influenza and RSV-associated hospitalizations.** For influenza hospitalizations, only a history of a high-risk condition, including asthma/wheezing, was more commonly
Infection and Age

Table 2. Age-specific Population-based Rates of Hospitalization (per 1,000 Children) for Acute Respiratory Illness, Laboratory-confirmed Influenza, and Laboratory-confirmed Respiratory Syncytial Virus Among Children Under Age 5 Years, by Race, in 3 US Counties, 2002–2009

<table>
<thead>
<tr>
<th>Infection and Age Group, months</th>
<th>Weighted No. of Cases</th>
<th>Black Children</th>
<th>White Children</th>
<th>Relative Rate</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Black Children</td>
<td>White Children</td>
<td>Rate</td>
<td>95% CI</td>
<td>Rate</td>
</tr>
<tr>
<td>ARI or fever</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5</td>
<td>1,275</td>
<td>1,796</td>
<td>58.7</td>
<td>54.1, 63.3</td>
<td>39.7</td>
</tr>
<tr>
<td>6–11</td>
<td>426</td>
<td>477</td>
<td>19.7</td>
<td>17.0, 22.5</td>
<td>10.6</td>
</tr>
<tr>
<td>12–23</td>
<td>611</td>
<td>652</td>
<td>14.3</td>
<td>12.6, 16.2</td>
<td>7.2</td>
</tr>
<tr>
<td>24–59</td>
<td>652</td>
<td>786</td>
<td>5.3</td>
<td>4.6, 5.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Total</td>
<td>2,965</td>
<td>3,712</td>
<td>14.1</td>
<td>13.5, 14.8</td>
<td>8.3</td>
</tr>
<tr>
<td>Influenza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5</td>
<td>88</td>
<td>92</td>
<td>4.0</td>
<td>2.9, 5.2</td>
<td>2.0</td>
</tr>
<tr>
<td>6–11</td>
<td>31</td>
<td>26</td>
<td>1.4</td>
<td>0.8, 2.2</td>
<td>0.6</td>
</tr>
<tr>
<td>12–23</td>
<td>34</td>
<td>37</td>
<td>0.8</td>
<td>0.5, 1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>24–59</td>
<td>46</td>
<td>42</td>
<td>0.4</td>
<td>0.2, 0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>198</td>
<td>0.9</td>
<td>0.8, 1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>RSV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5</td>
<td>258</td>
<td>543</td>
<td>14.8</td>
<td>12.1, 17.4</td>
<td>14.7</td>
</tr>
<tr>
<td>6–11</td>
<td>65</td>
<td>147</td>
<td>3.7</td>
<td>2.5, 5.1</td>
<td>4.0</td>
</tr>
<tr>
<td>12–23</td>
<td>96</td>
<td>125</td>
<td>2.8</td>
<td>2.0, 3.7</td>
<td>1.7</td>
</tr>
<tr>
<td>24–59</td>
<td>83</td>
<td>84</td>
<td>0.8</td>
<td>0.5, 1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>502</td>
<td>899</td>
<td>3.0</td>
<td>2.6, 3.4</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Abbreviations: ARI, acute respiratory illness; CI, confidence interval; RSV, respiratory syncytial virus.

a Ninety-five percent confidence intervals that exclude 1 are considered to represent statistically significant results.

b Rounded down to 1.0.

reported among black children than among white children. For RSV-associated hospitalizations, the characteristics that were significantly different between black and white children were generally the same as for all ARI hospitalizations.

**DISCUSSION**

Our findings indicated that a racial disparity existed in hospitalizations for ARI among black children compared with white children. ARI hospitalization rates were higher for black children than for white children, with age-specific relative rates ranging from 1.5 to 2.0. The county-specific and yearly rates by age group were also higher for black children, providing further support for a racial disparity. However, our finding that black children were not more severely ill than white children might suggest that other factors, such as access to care, may possibly affect hospitalization rates.

We also found influenza-associated hospitalization rates to be significantly higher for black children than for white children (RR = 2.1). These disparities, however, were absent or less discernible during the mild influenza seasons. Our findings were consistent with 3 US studies of laboratory-confirmed influenza hospitalization during the 2009 influenza A(H1N1) pandemic (5–7). Specifically, age-adjusted pandemic influenza hospitalization rates were higher among minorities and among African Americans versus white persons in 10 states (10.9 per 100,000 population vs. 2.0 per 100,000 in the spring/summer of 2009 and 29.7 per 100,000 population vs. 16.3 per 100,000 in the fall/winter of 2009–2010) (5), in New Mexico (RR = 1.7) (6), and in Chicago, Illinois (9 per 100,000 population vs. 2 per 100,000) (7); investigators in the latter study noted that disparities persisted among children under 15 years of age. In a review of US pneumonia and influenza mortality during the past century, Hutchins et al. (8) noted higher rates among African Americans and other minorities in comparison with white persons. Our study did not assess racial disparities in mortality because fatal cases were rare in our population.

Unlike ARI and influenza rates, RSV-associated hospitalization rates were not higher among black infants than among white infants, but they were higher among older black children aged 12–59 months. Our results are consistent with a retrospective study of California hospital discharge data, which did not find higher RSV-coded hospitalization rates per 1,000 livebirths among black infants compared with white infants for the MediCal-insured (27.9 vs. 34.9) or the non-MediCal-insured (12.1 vs. 11.9) (9).

The reasons for these racial disparities in ARI hospitalization rates, for both a potentially vaccine-preventable disease (influenza) and other ARIs for which vaccines are not available, are unclear. One possibility is that severity of illness might be greater among black children. However,
we did not find black children to be more severely ill than white children based on their admission to an intensive care unit or receipt of mechanical ventilation. Lower vaccination rates among black children might potentially explain these findings, but the proportion fully vaccinated among children with ARI was similar for the two races. Other factors might influence hospitalization rates, such as poorer access to health care and less effective use of preventive measures.

For example, a substantially higher proportion of black children in our study were publicly insured and were more likely to receive their usual sick care outside of a private physician’s office compared with white children.
studies that have evaluated geographic disparities in pediatric hospitalizations have noted that lower hospitalization rates existed in areas that had a higher quality of primary care (15). Further, Rinderknecht et al. (16) noted that children referred to a pediatric emergency department by a health-care provider tended to be white and more severely ill. In our study, black children were more likely to have a history of asthma/wheezing and asthma discharge diagnoses, and their mothers were less educated. Respiratory viruses have been associated with asthma exacerbation (17). Studies have noted higher hospitalization rates for asthma among black children compared with white children (18), and hospitalizations for asthma exacerbations may be associated with poorer asthma management, which has been associated with lower socioeconomic status (19–21). In this study, we could not distinguish the factors that most likely resulted in the racial disparities in hospitalization rates. Further study is needed to elucidate these factors, especially those which can potentially be modified, such as the quality of primary care.

Our study had several limitations. Not all eligible children were enrolled, and this may have biased our results. However, the proportions enrolled were similar for black children and white children. Another limitation was that the Ohio site did not contribute data for 4 of the 7 study years because of a later start and a protocol deviation, which might have affected our estimated rates for the Ohio county. Although our study counties are geographically diverse, they may not be representative of the entire United States, and all of the participating hospitals were academic institutions, which may differ from nonacademic hospitals. The proportion of black children was higher and the
proportion of Hispanic/Latino children was lower in our study than in the overall US population. Additionally, smaller percentages of black (6%) and white (4%) children in our study were uninsured, as compared with national estimates of 18% for black children and 9% for white children (22). Another limitation was the lack of study data on asthma medications, asthma classification, and host and environmental risk factors for asthma. In addition, we relied on parental reports to assess palivizumab use and did not have enough detailed data on risk factors to identify accurately those children for whom palivizumab was indicated. Furthermore, we did not examine the potential contribution of bacterial coinfections or collect data on antibiotic use. Finally, our study was based on a comparison of rates, which required county denominators that were not available for many characteristics such as medical history and access to care. For this reason, our study and other studies with a similar approach can identify a racial disparity but cannot determine the reasons for the disparity.

In conclusion, compared with white children, black children in this study had significantly higher rates of hospitalization for ARI, influenza and, among children aged 12 months or more, RSV illness. Although our data suggest that less access to and effective use of health care and preventive measures by black children may have contributed to the racial differences in hospitalization rates, additional studies are needed to determine what factors affect racial disparities. Identifying these factors, especially those that are potentially modifiable, such as the quality and availability of primary care, higher rates of influenza vaccination, and improved asthma management, are important steps in reducing existing racial disparities and the burden of respiratory disease hospitalizations.

ACKNOWLEDGMENTS

Author affiliations: Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia (Marika K. Iwane, Cedric J. Brown, Mila M. Prill); Influenza Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia (Sandra S. Chaves); Department of Pediatrics, School of Medicine and Dentistry, University of Rochester, Rochester, New York (Peter G. Sziyagyi, Caroline B. Hall, Geoffrey A. Weinberg); Department of Medicine, School of Medicine and Dentistry, University of Rochester, Rochester, New York (Caroline B. Hall); Department of Pediatrics, Vanderbilt University Medical Center, Nashville, Tennessee (Kathryn M. Edwards, John V. Williams); Division of Infectious Diseases, Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio (Mary A. Staat); Department of Preventive Medicine, Vanderbilt University Medical Center, Nashville, Tennessee (Marie R. Griffin); Department of Pediatrics, Wake Forest School of Medicine, Winston-Salem, North Carolina (Katherine A. Poehling); Department of Epidemiology and Prevention, Wake Forest School of Medicine, Winston-Salem, North Carolina (Katherine A. Poehling); and Immunization Services Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia (Carolyn B. Bridges).

This work was supported by the Centers for Disease Control and Prevention (cooperative agreements U38/CCU217969, U01/IP00017, U38/CCU417958, U01/IP00022, U38/CCU522352, and U01/IP000147).

We thank the participating staff from the New Vaccine Surveillance Network, as well as Mary McCauley for her thoughtful review and comments.

This work was presented in part at the Pediatric Academies annual meeting, Vancouver, British Columbia, Canada, May 1–4, 2010.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Dr. Edwards received grant funding from Novartis (Basel, Switzerland) for an unrelated vaccine and previously was a consultant to NexBio (San Diego, California). Dr. Griffin received grant funding from MedImmune (Gaithersburg, Maryland). Dr. Hall has served on the MedImmune Advisory Board and has been a consultant for MedImmune and GlaxoSmithKline (London, United Kingdom). Dr. Williams served on the Scientific Advisory Board of Quidel (San Diego, California). Dr. Staat received funding from MedImmune for RSV studies and has served on the MedImmune Advisory Board.

REFERENCES


