

Disparities between White and African-American Children in Immunization Coverage

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Introduction: A recent study has shown that the national-scale difference in immunization coverage between non-Hispanic white (abbreviated "white") and non-Hispanic African-American (abbreviated "African-American") children aged 19–35 months in the United States has increased by about 1 percentage point annually. We examined how this widening gap differs with geography and income.

Methods: We used data from the National Immunization Survey, 1998–2003, a national telephone survey. We examined differences between white and African-American children in immunization coverage within income groups (at or above versus below the federal poverty level) for each census region (northeast, south, midwest and west). We tested the hypothesis of constant disparity over time.

Results: Among households at or above the federal poverty level in the northeast census region, disparity is widening (white coverage minus African-American coverage was -0.5 in 1998 but 15.5 in 2003). Among household at or above the federal poverty level in the midwest census region, disparity is narrowing (white coverage minus African-American coverage was 13.9 in 1998 but 2.5 in 2003). We found no significant evidence of a trend in other groups.

Conclusions: Widening national-level disparity in immunization coverage is primarily attributable to trends in the northeast census region. Addressing the widening disparity in coverage requires new strategies that consider current social and economic contexts.

Key words: childhood ■ disparities ■ immunizations

INTRODUCTION

The elimination of racial and ethnic disparities in immunization coverage is one of the Healthy People 2010 goals¹ and one of the six overarching goals identified in the Institute of Medicine's Crossing the Quality Chasm report.² However, a recent study^{3,4} has shown that, at a national level, the difference in immunization coverage (4:3:1:3:3 series, consisting of ≥ 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; ≥ 3 doses of polio vaccine; ≥ 1 dose of measles-containing vaccine; ≥ 3 doses of haemophilus influenzae type-B vaccine; and ≥ 3 doses of hepatitis-B vaccine) between non-Hispanic white (abbreviated "white") and non-Hispanic African-American (abbreviated "African-American") children aged 19–35 months in the United States is increasing by about 1 percentage point per year. However, this disparity is unlikely to be uniform over regions and income levels due to differences in other demographics.

We considered differences in immunization coverage between white and African-American preschoolers within two income categories [at or above the federal poverty level (abbreviated "above poverty"); below the federal poverty level (abbreviated "below poverty")] and the four U.S. census regions (northeast, south, midwest and west).

METHODS

The National Immunization Survey (NIS) is conducted annually by the Centers for Disease Control and Prevention to estimate immunization coverage among the United States population of 19–35-month-old children. The NIS is a random-digit-dialing survey of households with age-eligible children. For those households that give consent, providers are contacted by mail to validate reported immunizations. Provider-verified immunizations are statistically weighted to represent the entire population of 19–35-month-old children. Factors accounted for in the statistical adjustments include provider nonresponse, household nonresponse, nontelephone households and multiple voice telephone lines in a

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single household. Details of NIS methods appear elsewhere.^{5,6}

During the household interview portion of NIS, respondents identify their child's race/ethnicity. Respondents identify their child as Hispanic/non-Hispanic and then identify race. Choices for race are white, black or African-American, American Indian, Alaska Native, Asian, Native Hawaiian and other/Pacific Islander. Up until 2001, respondents chose one race. In 2002 and 2003, respondents were allowed to choose multiple races (about 2% of respondents chose more than one race). For 2002 and 2003, we used data from those who indicated only white or black/African-American.

Using data from the 1998–2003 NIS, we performed a Chi-squared test to test the null hypothesis that the disparity was constant over years. For those groups without a significant time trend, we used Chi-squared tests to test the null hypothesis that the difference was 0 (no disparity). We used SUDAAN version 9.0.0⁷ to obtain coverage estimates.

The states of each census regions are:

- Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont;
- South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas,

Virginia and West Virginia;

- Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin; and
- West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

Statistical tests were two-tailed, with $\alpha=0.05$. All income-related results are among households reporting income.

RESULTS

Approximately 22,000 provider-validated households are included in each year's NIS, approximately evenly divided among the 50 states and 28 selected large urban areas; response rates (percent of households containing an age-eligible child that yield usable provider-verified data) differ among years but range from the mid-to-high 60s. Combining years, the percent of white and African-American households for which income-to-poverty-level ratio could not be computed were (percent): northeast: 14.1 white, 18.6 African-American; midwest: 10.5 white, 14.0 African-American; south: 10.2 white, 12.3 African-American; west: 9.7 white, 13.9 African-American. We found no trends in proportion of households for which poverty status could not be determined.

Table 1. Differences in 4:3:1:3:3¹ coverage in selected years*

Year	Group	Non-Hispanic White 4:3:1:3:3 Coverage, 95% CI	Non-Hispanic African-American 4:3:1:3:3 Coverage, 95% CI	Difference, 95% CI
2003	Northeast, at or above poverty	88.4 (86.2–90.6)	72.5 (61.7–83.3)	15.5 (4.5–26.5)
	Northeast, below poverty	87.7 (81.2–94.2)	69.7 (55.8–83.6)	18.0 (2.7–33.3)
	Midwest, at or above poverty	84.8 (82.8–86.8)	82.3 (76.7–87.9)	2.5 (–3.4–8.4)
	Midwest, below poverty	79.3 (73.2–85.4)	66.0 (57.5–74.5)	13.3 (2.8–23.8)
	South, at or above poverty	82.5 (80.5–84.5)	77.8 (72.7–82.9)	4.7 (–0.8–10.2)
	South, below poverty	75.4 (69.5–13.3)	70.1 (62.8–77.4)	5.3 (–4.1–14.7)
	West, at or above poverty	75.8 (72.7–78.9)	83.0 (71.5–94.5)	–7.2 (–19.1–4.7)
Year	Group	Non-Hispanic White 4:3:1:3:3 Coverage, 95% CI	Non-Hispanic African-American 4:3:1:3:3 Coverage, 95% CI	Difference, 95% CI
1998	Northeast, at or above poverty	79.6 (76.9–81.0)	80.1 (72.4–87.8)	–0.5 (–8.6–7.6)
	Northeast, below poverty	75.7 (66.4–85.0)	73.1 (60.9–85.3)	2.6 (–12.7–17.9)
	Midwest, at or above poverty	76.5 (74.5–78.5)	62.6 (52.8–72.6)	13.9 (3.9–23.9)
	Midwest, below poverty	74.9 (69.3–80.5)	55.8 (46.6–65.0)	19.1 (8.3–29.9)
	South, at or above poverty	74.8 (72.7–76.9)	66.2 (61.3–71.1)	8.6 (3.3–13.9)
	South, below poverty	69.5 (64.2–74.8)	70.3 (65.7–74.9)	–0.8 (–7.8–6.2)
	West, at or above poverty	73.9 (70.8–77.0)	60.5 (43.4–77.5)	13.6 (–3.8–31.0)

1: 4:3:1:3:3: ≥ 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine, ≥ 3 doses of polio vaccine, ≥ 1 dose of measles-containing vaccine, ≥ 3 doses of haemophilus influenzae type-B vaccine and ≥ 3 doses of hepatitis-B vaccine. Households of unknown poverty status are excluded from this table: * Percentage points, 95% confidence intervals (CI), significant differences in bold

Trends in Vaccination Coverage by Region and Income

For each census region and for households above poverty, Table 1 displays the estimated 4:3:1:3:3 coverage for white and African-American households, the differences between these and a 95% confidence interval (CI) for the difference. For brevity, we only present results for 1998 and 2003. In the west census region, we only report results for households above poverty. The number of African-American households below poverty in the west census region sampled in each year (range 23–39) was too small for meaningful analyses. This table shows how disparity has changed between 1998 and 2003 and, in particular, shows how disparity has grown in the northeast census region while declining in the midwest.

Table 2 shows that the change in disparity over time is only significant among those above poverty in the northeast (Chi-squared statistic 11.28, 5 degrees of freedom) and midwest (Chi-squared statistic 13.3, 5 degrees of freedom) census regions. In those groups for which we found no evidence of a trend, 0 disparity was rejected for all groups except census region south below poverty and census region west above poverty. For those below poverty in the south, coverage for both whites and African Americans was typically in the low 70s (percent). For those in the west census region above poverty, sample sizes of African-American households above poverty were small (range 64–73), yielding wide

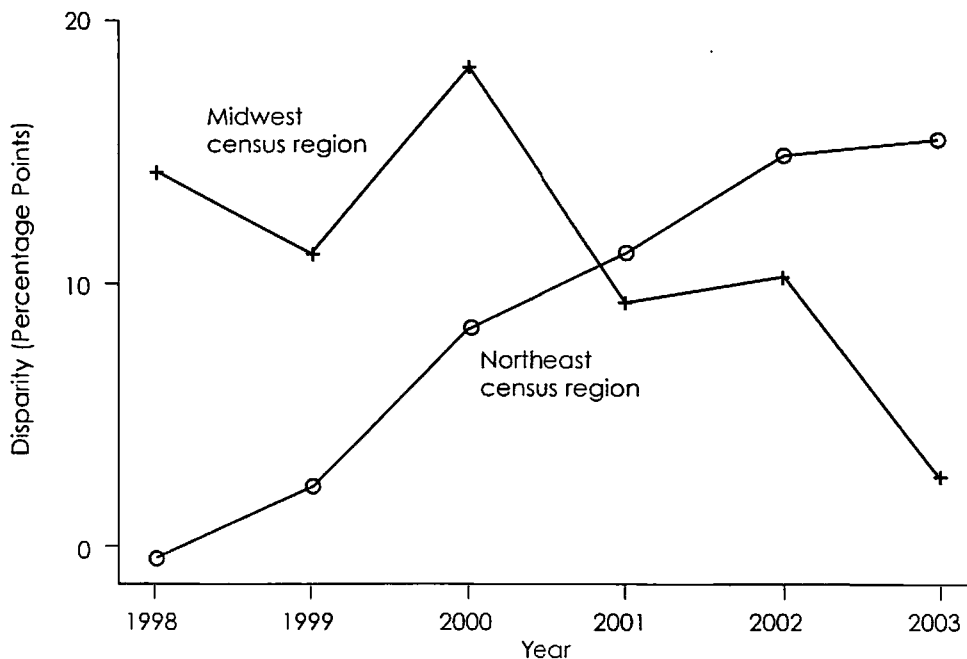
confidence intervals.

Figure 1 displays the estimated differences for those groups for which constant disparity was rejected. Figure 1 shows that disparities among those above poverty are widening in the northeast census region and narrowing in the midwest census region.

An examination of the estimated coverages of whites and African Americans above poverty in the midwest census region revealed that the narrowing gap is due to an increase in coverage among African Americans while that among whites is remaining constant or growing very slowly (Figure 2). A similar examination of data from the northeast showed that the widening gap there is due to an upward trend in white coverage and a general downward trend, with exceptions, among African Americans (Figure 3).

Households above poverty are heterogeneous. Attempts to further stratify children living above poverty [e.g., income-to-poverty threshold ratio between 1.00 and 1.85 vs. ≥ 1.85 (the cut-off for participation in the Women, Infants and Children Supplemental Nutritional Program), income $> \$75,000$ vs. income $\leq \$75,000$ and others] did not identify a particular segment in which disparities were most pronounced (data not shown). Census regions are also heterogeneous. Although sample sizes do not support state-level analyses, visual examination suggests that the same pattern observed in the northeast census region might hold in the states of New York, New Jersey and Pennsylvania (data not shown).

Figure 1. Plot of difference in 4:3:1:3:3 coverage of non-Hispanic whites and non-Hispanic African Americans (percentage points) by year for the two regions with significant trends ($p < 0.05$, test for trend).



Income Status Changes and Immunization Coverage

Higher-income groups tend to have greater immunization coverage. For example, in the 2003 NIS, 4:3:1:3:3 coverage among children living in households with income of >\$75000 was 86.0% (95% CI: 84.3–87.7). Among households with incomes of ≤\$75000, the coverage was 79.6% (95% CI: 78.5–80.9).

The proportion of white children in the northeast census region living in households with incomes of >\$75,000 increased steadily from 22.3% (95% CI: 19.7–24.9) in 1998 to 39.9% (95% CI: 36.8–42.9) in 2003. The proportion of African-American children in the northeast census region living in households with incomes of >\$75,000 increased from 8.4% (95% CI: 3.3–13.5) in 1998 to 8.6% (95% CI: 4.5–13.1) in 2003. The trend was similar in the other census regions, but the differences were most striking in the northeast.

Other Demographic Predictors

We considered demographics beyond those presented here (maternal education, provider type and number of providers). We found no evidence that demographics other than "income within census regions" accounted for trends in disparities.

DISCUSSION

In 2003, significant gaps between coverage for whites and African Americans existed in at least

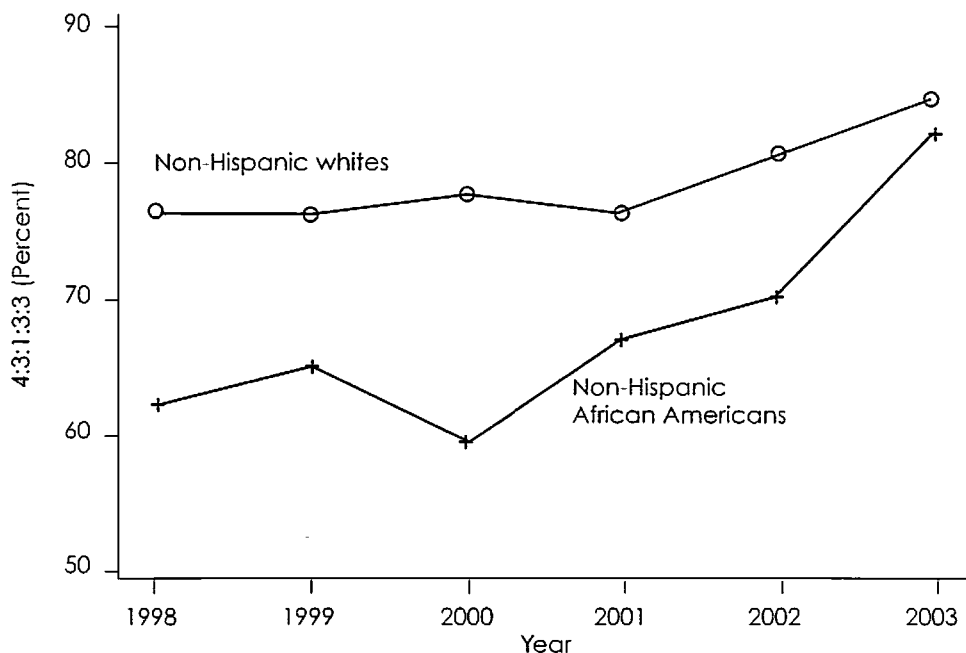
three of the four U.S. census regions (northeast, midwest and south). Only in the northeast was there clear evidence of widening disparity, seen most dramatically among households above poverty. This unexpected finding, linking disparity with higher incomes, reflected both a significant increase in coverage among whites and a significant decrease in coverage among African Americans.

This study builds upon an earlier examination of disparities among preschool children,^{3,4} which only considered national-level coverage. This study contributes to our understanding of disparity by showing that, although disparity is widespread, observed increases in disparity are primarily in one region in one income group.

The extent of regional disparity has changed quickly. Only a few years ago, the midwest's coverage disparity was greater than the northeast's. For example, as recently as in the 2000 NIS, the difference in coverage between whites and African Americans in the northeast census region was 13.2 percentage points (95% CI: 6.3–20.1). That in the midwest census region was 18.4 percentage points (95% CI: 12.0–24.8). In 2003, the gap in the northeast census region was 15.8 percentage points (95% CI: 7.6–24.0). The gap in the midwest census region had narrowed to 11.6 percentage points (95% CI: 5.0–18.2).

The widening disparity in incomes in the northeast census region between households containing white and African-American children might partial-

Figure 2. Estimated 4:3:1:3:3 coverage among non-Hispanic whites and non-Hispanic African Americans at or above the federal poverty level in the midwest census region.



ly explain the overall disparity as well as regional disparities. Between 1998 and 2003, among northeast households in which an African-American child lived, the proportion with an income of \geq \$75,000 increased by 0.2 percentage points. In the same period, among households in the northeast census containing a white child, the proportion with an income of \geq \$75,000 increased by 17.6 percentage points.

Many factors unrelated to income contribute to disparity in immunization coverage. Differences in access to healthcare among African-American populations are well documented: white children see physicians at twice the rate of minority children,⁸ and physicians that treat mostly African American patients have less clinical training and less access to clinical resources.⁹ African-American patients also receive less timely treatment for many illnesses than do white patients,¹⁰ reflecting a general disparity in healthcare that might carry through to immunizations. In addition, conscious or unconscious attitudes on the part of providers can shape patient interactions and expectations, and experiences of discrimination—real or perceived—can discourage minorities from accepting preventive services.⁹ These experiences may contribute to the finding that African-American patients have less trust in the healthcare system than do white patients,¹¹⁻¹³ and report less satisfaction with the healthcare that they receive.¹⁴ Finally, parents who are more concerned with immunization safety might be less likely to have their children immunized. Minority parents are more likely to believe children receive more vaccines than is necessary and that their children would get sick from vaccination.^{13,15} Such differences in beliefs might affect acceptance of vaccination and should be explored further in specific minority populations.

Regarding access to care, reducing out-of-pocket costs for vaccination is a strategy that has been proven to increase children's vaccination coverage.¹⁶

and a number of state-level and federal programs supporting this strategy are currently in place. One example is the Vaccines for Children Program (VFC), a collaboration between states and the federal government that began in 1994 and provides public-purchased vaccines for use in vulnerable children.¹⁷ The State Children's Health Insurance Program (S-CHIP) is another initiative, initially implemented in 1997, which provides comprehensive insurance for another group of vulnerable children who are uninsured but whose family income exceeds state Medicaid requirements.¹⁸ While these programs have been largely successful, our findings suggest that efforts to enhance implementation among vulnerable children living above poverty may be needed. Indeed, the finding of increasing disparities among children living in families above poverty supports the need to look beyond the economic issues that such programs were designed to address. Even with VFC and S-CHIP, factors that may influence racial and ethnic minorities include parental perceptions and concerns about vaccination; logistical issues such as difficulties with transportation, scheduling appointments and missed work; and problems such as discrimination and bias.

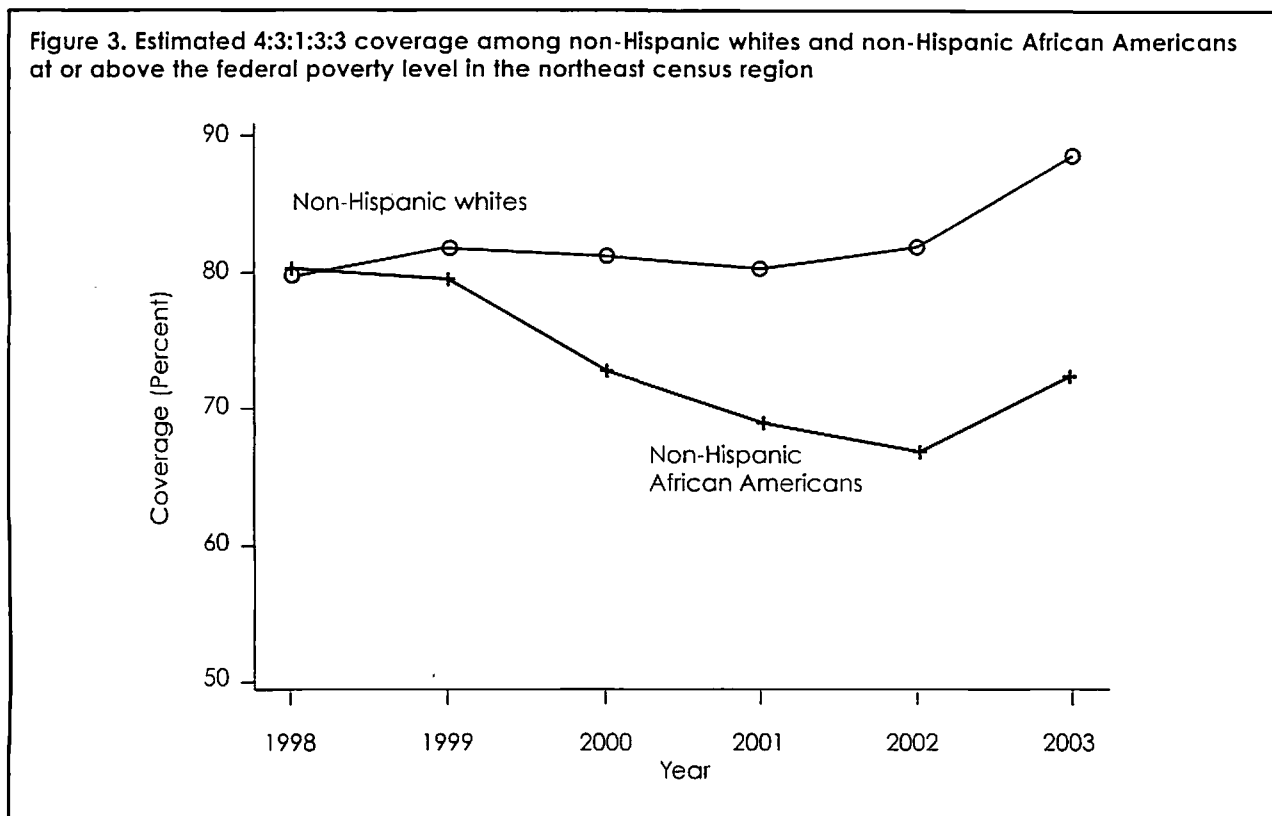
These results are subject to the limitations of the NIS. The NIS is a surveillance system that tells us what is happening but does not tell us why. The authors view this work as a call to action for more focused research that will allow us to say why disparity is widening in some groups but not in others. The NIS is a telephone survey in which only provider-validated immunizations are reported, making the survey subject to both household and provider nonresponse bias. Although statistical adjustments correct for many biases, some could remain.^{5,6} Incomes are household reported and are of unknown accuracy. Similarly, poverty status could only be determined for those households that report-

Table 2. Average differences in 4:3:1:3:3¹ and tests of constant disparity and no disparity

Group	Average Disparity over 1998-2003 (Percentage Points)	Test Statistic for the Null Hypothesis of Constant Disparity (P Value, χ^2 with Five Degrees of Freedom)	Where Appropriate, Test Statistic for the Null Hypothesis of 0 Disparity (P Value, χ^2 with Six Degrees of Freedom)
Northeast, at or above poverty	8.86	11.28 (0.046)	NA
Northeast, below poverty	10.50	2.28 (0.808)	12.96 (<0.001)
Midwest, at or above poverty	10.83	13.32 (0.020)	NA
Midwest, below poverty	12.06	2.95 (0.707)	31.65 (<0.001)
South, at or above poverty	5.65	5.21 (0.390)	29.41 (<0.001)
South, below poverty	1.97	4.52 (0.477)	5.42 (0.900)
West, at or above poverty	5.45	9.75 (0.082)	10.88 (0.092)

NA: not applicable; 1: 4:3:1:3:3: \geq 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine, \geq 3 doses of polio vaccine, \geq 1 dose of measles-containing vaccine, \geq 3 doses of haemophilus influenzae type-B vaccine and \geq 3 doses of hepatitis-B vaccine. Households of unknown poverty status are excluded from this table.

Figure 3. Estimated 4:3:1:3:3 coverage among non-Hispanic whites and non-Hispanic African Americans at or above the federal poverty level in the northeast census region



ed both an income and the number of persons living in the household. Finally, our results cover only the 4:3:1:3:3 series. Determining if similar results hold for individual vaccines or other series must await further research. Finally, some of our CIs are wide due to small sample size: the associated point estimates should be used with caution.

These results indicate that disparities in immunization coverage between white and African-American children are real and, in some segments of the population, growing. To address this divergent trend in coverage, new strategies, which consider current social and economic contexts, are needed along with additional research to understand the specific causes of the disparities. The findings of such research can guide the development of new strategies and the enhancement of existing strategies to eliminate disparities in immunization coverage among U.S. preschool children.

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