

# Do Parents Understand Immunizations? A National Telephone Survey

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**ABSTRACT.** *Background.* Immunization may now be undervalued because vaccines have largely eliminated the threat of serious infectious diseases in childhood. As the incidence of vaccine-preventable diseases has declined, concern about vaccine safety has increased. Significant erosion of public confidence in vaccine safety could lead to reduced immunization rates and a resurgence of vaccine-preventable diseases.

*Objective and Methods.* To assess parents' understanding of vaccine-preventable diseases, vaccines, immunization practices, and policies, we conducted a telephone survey in the United States with a nationally representative sample ( $n = 1600$ ) of parents with children  $\leq 6$  years of age, and expectant parents in April and May 1999.

*Results.* Eighty-seven percent of respondents deemed immunization an extremely important action that parents can take to keep their children well. Although respondents' overall rating of immunization safety was high, a substantial minority held important misconceptions. For example, 25% believed that their child's immune system could become weakened as a result of too many immunizations, and 23% believed that children get more immunizations than are good for them. Children's health care providers were cited as the most important source of information on immunizations.

*Conclusions.* Although the majority of parents understand the benefits of immunization and support its use, many parents have important misconceptions that could erode their confidence in vaccines. A systematic educational effort addressing common misconceptions is needed to ensure informed immunization decision-making. Physicians, nurses, and other providers of primary care have a unique opportunity to educate parents because parents see them as the most important source of information about immunizations. *Pediatrics* 2000;106:1097-1102; *vaccination, immunization, pediatric, safety, health beliefs.*

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ABBREVIATIONS. Hib, *Haemophilus influenzae* type b; CDC, Centers for Disease Control and Prevention; SD, standard deviation; AAP, American Academy of Pediatrics.

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The success of infant and childhood immunization programs is one of the most effective health interventions of the 20th century and is credited with a substantial portion of the overall increase in life expectancy in this period.<sup>1</sup> Immunization's achievements include the global eradication of smallpox, the elimination of polio in the Americas, and the substantial reduction in cases of measles, mumps, rubella and congenital rubella, tetanus, diphtheria, and *Haemophilus influenzae* type b (Hib) in the United States and many other parts of the world.

The paradox of this monumental public health success is that, by virtue of their absence, the diseases that vaccines prevent no longer serve as a reminder of the need for immunization. As Salisbury has noted, "If parents have fear of disease but no fear of vaccines, the argument in favor of vaccination is clear-cut. If they have no fear of disease but also no fear of vaccine, there may be inertia. When they have no fear of disease, but fear of vaccines, parents are likely to refuse immunization" (D. Salisbury, personal communication, 1998).

Since 1997, safety-related calls to the national immunization hot line of the Centers for Disease Control and Prevention (CDC) have increased considerably,<sup>2</sup> as have anecdotal reports of parents' concern from physicians and nurses across the country. Recent media attention has focused on allegations of vaccine risk,<sup>3-5</sup> and numerous Internet web sites question the value of immunizations. Over the past 2 years, scientifically unsubstantiated vaccine safety concerns have been the subject of state legislative debates and congressional hearings.<sup>6,7</sup>

Concerns about vaccines, even if without scientific merit, have the potential to erode the public's support for immunization and can result in decreased immunization rates and a recurrence of disease outbreaks. This has occurred in the United Kingdom, Sweden, Germany, Japan, and in some areas of the United States.<sup>8,9</sup> An understanding of the nature and extent of the public's concerns is required to identify and address misplaced concerns.<sup>10</sup> To this end, we conducted a national telephone survey of parents of young children to better understand their knowledge, attitudes, misconceptions, and concerns about vaccine-preventable diseases, vaccines, and immunization policies.

## METHODS

### Sample and Instrument

During a 3-week period in April and May of 1999, we conducted a nationally representative telephone survey of parents

and expectant parents. Random-digit dialing was used to select households. Households were eligible if there was an English-speaking adult who was a parent, legal guardian, or primary health decision-maker for a child 6 years of age or younger, or an expectant mother or father. A sample size of 1600 was selected to yield a confidence interval of  $\pm 2.5\%$  for the population overall.

Each telephone number was called up to 6 times during various hours of the day and various days of the week until contact was established. The survey, a scripted interview conducted by trained marketing researchers, was presented to respondents as being conducted on behalf of a national, nonprofit organization devoted to children's health issues. No incentive was offered for participation. The average time of administration for the final survey instrument was 18 minutes.

Before development of the survey instrument, we conducted 15 focus groups in 4 geographically diverse cities to identify important perceptions and misconceptions; this information was used in designing the survey questions. The instrument was pretested using a variety of methods, including cognitive assessment interviewing, and was revised before survey administration.

### Statistical Analysis

Prevalence and mean estimates for the population overall and for key subgroups were computed. Group differences were tested using  $\chi^2$  tests of independence (for proportions) and Student's *t* tests (for continuous measures). In addition to standard demographic subgroup analysis, we compared respondents based on their medical orientation (conventional vs alternative medical orientation). Respondents were classified as having an alternative medical orientation if they: 1) used any of 9 categories of alternative therapy (ie, acupuncture, chiropractic, herbal therapies, high-dose megavitamins, homeopathy, spiritual healing, imagery or energy healing, folk remedies, biofeedback or hypnosis) in the past year, and 2) indicated that they primarily use alternative therapies or both alternative and conventional therapies to treat their health problems.<sup>11</sup> Respondents who did not use any of these alternative forms of therapy were classified as having a conventional medical orientation.

## RESULTS

### Survey

To complete 1600 interviews, a total of 16 248 telephone numbers were dialed. The final status of these calls was:

- Unknown eligibility: 1) 3197 busy signals/no answer/answering machines; 2) 3971 refused to participate before screener eligibility questions were asked; and 3) 1024 requested a callback before eligibility was determined; subsequent callbacks yielded busy signals/no answer/answering machine.
- Known eligibility: 1) 6111 respondents were ineligible; 2) 345 terminated the interview before it was completed; and 3) 1600 completed interviews.

Using procedures recommended by the American Association of Public Opinion Research, the survey eligibility rate was 24%. Based on the survey eligibility rate, the survey response rate was 41% and the survey cooperation rate was 51%.<sup>12</sup>

### Characteristics of Respondents

Respondents were most likely to be female (72%), married (89%), 30 to 39 years of age (58%; age 18–29 years, 24%; age 40+ years, 19%), white (72%; black, 12%; Hispanic, 11%; other/refused, 5%), college-educated (45%; high school or less, 28%; some college or technical school, 26%), and with a household income of between \$30 000 and \$49 999 (20%; <\$30 000, 6%; >\$50 000+, 27%; don't know, 11%;

refused, 36%). The vast majority of survey respondents (99.6%) were parents or legal guardians of a child 6 years of age or younger.

### Perceived Relative Importance of Immunization

The perceived importance of immunization and 3 other actions parents can take to keep their children well was assessed with a 0 (not at all important) to 10 (extremely important) scale. Immunization was deemed extremely important (a score of 10) by 86.9% of respondents. The prevalence of extremely important ratings for the other actions parents can take was significantly lower: ensuring children eat healthy foods (63.9%); making sure children wash their hands frequently (59.8%); and making sure children get enough physical activity (55.0%).

### Reasons to Immunize

In response to the open-ended statement, "I get my child immunized because. . .," 82.8% of the respondents gave answers referring to disease prevention (eg, to prevent disease, to protect my children, for their well-being). A small proportion gave answers referring to government or school requirements (7.5%), doctor recommendations (3.5%), love for their child (1.8%), or other reasons (2.5%).

### Omitting Specific Vaccines

Respondents were asked, "If you have another child in the future, are there are any immunizations that you would not want your child to have?" The large majority (83.6%) indicated that they would not want to opt out of any of their child's immunizations; however, 14.3% indicated there was at least 1 immunization that they would not want their child to have. Those respondents who indicated a preference to opt out of an immunization ( $n = 229$ ) were asked to specify which immunization(s). A large majority indicated varicella ( $n = 173$ ), with influenza ( $n = 39$ ), hepatitis B ( $n = 18$ ), diphtheria–tetanus–pertussis ( $n = 18$ ), polio ( $n = 17$ ), measles–mumps–rubella ( $n = 12$ ), Hib ( $n = 8$ ), and other immunizations ( $n = 12$ ) mentioned less frequently.

### Perceptions of Disease Severity and Likelihood of Infection

Respondents were asked to rate the severity of vaccine-preventable diseases using a 0 (not at all serious) to 10 (extremely serious) scale, and to rate the likelihood of infection if their child is not immunized, also using a 0 (not at all likely) to 10 (extremely likely) scale. Spinal meningitis/Hib, polio, and hepatitis B were perceived as most serious, pertussis and measles were perceived as somewhat less serious, and varicella was perceived as least serious. The perceived likelihood of contracting the disease, if not immunized, spanned the narrow range of 5.7 (polio) to 6.8 (measles) for all diseases except varicella (8.2), for which the likelihood of infection was perceived to be significantly greater (Table 1).

### Perceptions of Immunization Safety

Respondents were asked to use a 0 (not at all safe) to 10 (completely safe) scale to answer the question:

**TABLE 1.** Parents' Perception of Disease Severity, Likelihood of Infection If Not Immunized, and Concern About Side Effects From Immunizations\*

Disease	Perceived Severity	Perceived Likelihood of Infection	Concern About Side Effects	Vaccine
Hib <sup>a</sup>	9.8 (1.0) <sup>b-f</sup>	5.9 (3.2) <sup>b-f</sup>	4.5 (3.4) <sup>b-f</sup>	Hib
Polio <sup>b</sup>	9.3 (1.5) <sup>a,d-f</sup>	5.7 (3.3) <sup>a,c-f</sup>	4.1 (3.4) <sup>a,f</sup>	Polio
Hepatitis B <sup>c</sup>	9.2 (1.4) <sup>a,d-f</sup>	6.3 (3.1) <sup>a,b,e,f</sup>	4.2 (3.4) <sup>a,e-f</sup>	Hepatitis B
Pertussis <sup>d</sup>	8.2 (2.0) <sup>a-c,f</sup>	6.3 (3.0) <sup>a,b,e,f</sup>	4.1 (3.3) <sup>a,f</sup>	DTP
Measles <sup>e</sup>	8.1 (2.1) <sup>a-c,f</sup>	6.8 (3.0) <sup>a-d,f</sup>	3.9 (3.2) <sup>a,f</sup>	MMR
Varicella <sup>f</sup>	6.4 (2.4) <sup>a-e</sup>	8.2 (2.6) <sup>a-e</sup>	3.8 (3.2) <sup>a-d</sup>	Varicella

\* Numbers are means (and standard deviations); superscript letters indicate between-group differences that are significant at  $P < .05$ .

"When considering childhood vaccinations in general, how safe do you think they are?" Respondents indicated they thought that there was a high level of overall vaccine safety ( $\bar{X} = 8.6$ ; standard deviation [SD] = 1.6). Respondents also used a 0 (not at all worried) to 10 (extremely worried) scale to indicate their degree of concern about side effects from specific vaccines. There was a moderate amount of concern about potential side effects for every immunization, ranging from 3.8 (varicella) to 4.5 (Hib; Table 1).

### Key Beliefs

Respondents were asked to state their agreement (strongly agree or agree), disagreement (strongly disagree or disagree) or neutrality (neither agree nor disagree) in response to 12 belief statements (Table 2). Although the majority of respondents held beliefs that are consistent with the evidence about immunization safety and efficacy, a substantial proportion of respondents did not. For example, nearly one quarter of respondents agreed that "children get more immunizations than are good for them," and "I am concerned that my child's immune system could become weakened as a result of too many immunizations." Well over one third agreed that "children should only get immunized against serious diseases,"

**TABLE 2.** Parents' Beliefs About Immunizations\*

	% Agree (% Strongly Agree)	% Disagree (% Strongly Disagree)
Children should only be immunized against serious diseases.	39 (20)	55 (31)
Children get more immunizations than are good for them.	23 (10)	68 (37)
Immunizations are always proven safe before they are approved for use.	71 (33)	19 (7)
I am concerned that my child's immune system could be weakened by too many immunizations.	25 (9)	63 (33)
I am more likely to trust immunizations that have been around for a while.	88 (64)	8 (3)
Immunizations are one of the safest forms of medicine ever developed.	78 (41)	10 (4)
Immunizations are getting better and safer all the time, as a result of medical research.	89 (60)	4 (2)
Vaccines strengthen the immune system.	71 (41)	11 (5)
I have access to all the information I need to make good decisions about immunizing my children.	92 (70)	7 (4)
Parents should be allowed to send their child to school even if not immunized.	14 (6)	79 (63)
I am opposed to immunization requirements because:		
They go against freedom of choice.	18 (10)	75 (52)
Only I know what is best for my child.	18 (9)	75 (47)
Immunization requirements protect my child from getting diseases from unimmunized children.	84 (54)	11 (5)

\* Response scale for these questions is: strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree.

and nearly one fifth disagreed that "immunizations are always proven safe before they are approved for use."

Respondents also indicated their agreement or disagreement with 4 statements pertaining to immunization requirements. The large majority of parents expressed views supportive of immunization requirements; however, nearly one fifth agreed with statements in opposition to government immunization mandates.

### Sources of Information

In response to an open-ended question about personal sources of immunization information ("Where do you get information about immunizations?"—multiple answers allowed), the majority of respondents indicated a doctor (84.2%); other information sources were newspapers or magazines (18.1%), books or journals (12.3%), a nurse (8.2%), a health clinic (7.5%), friends or family members (7.3%), and the Internet (7.0%).

In response to the question—"Do you prefer to receive information about immunizations from a doctor, a nurse, or do you have no preference?"—the majority of respondents indicated no preference (65.8%). Approximately one third (32.7%) indicated a preference for receiving information from a physician.

Four questions were asked to assess the nature and the quality of the interaction between parents and clinicians with regard to immunization information. A large majority of respondents expressed agreement with statements indicating that their child's doctor or nurse is providing immunization information and answering questions to their satisfaction:

- "They have taken the time to explain which vaccinations they are giving my child, and why" (91.5%).
- "They have provided me with written information about each immunization my child has received" (90.2%).

- “I have asked questions about the vaccinations they are providing” (92.9%).
- “They have answered my questions to my satisfaction” (96.2%; asked only of respondents who indicated they ask questions;  $n = 1486$ ).

The large majority of respondents (91.7%) agreed with the statement: “I have access to the information I might need to make good decisions about immunizing my children.”

### Credibility of Key Sources of Information

Respondents were asked how familiar they were—on a scale from 0 (not at all familiar) to 10 (extremely familiar)—with a number of organizations that provide information about childhood immunizations. In addition to the American Academy of Pediatrics (AAP) and the CDC, which were the 2 groups identified by parents in our previous focus group studies, we also assessed parents’ familiarity with the National Resource Center for Immunization Information (a fictitious organization included as a point of reference to provide context to the ratings of actual organizations). For organizations given a familiarity score of 5 or higher, respondents were subsequently asked how trustworthy they think the organization’s information is—on a scale from 0 (not at all trustworthy) to 10 (extremely trustworthy).

Respondents were slightly more familiar with the CDC ( $\bar{X} = 6.5$ ;  $SD = 3.5$ ) than with the AAP ( $\bar{X} = 5.8$ ;  $SD = 3.7$ ) and were least familiar with the fictitious organization ( $\bar{X} = 2.5$ ;  $SD = 3.0$ ). Trustworthiness ratings, however, were quite high for all 3 organizations: CDC ( $\bar{X} = 8.5$ ;  $SD = 1.7$ ;  $n = 1047$ ), AAP ( $\bar{X} = 8.5$ ;  $SD = 1.8$ ;  $n = 1207$ ), and National Resource Center for Immunization Information ( $\bar{X} = 7.8$ ;  $SD = 2.3$ ;  $n = 430$ ).

### Subgroup Differences

There were a number of subgroup differences on many of the measures; only differences significant at an (unadjusted)  $\alpha$  level of  $P < .05$  are reported.

With regard to the likelihood of rating immunization as “extremely important”:

- Female respondents (88.8%) were more likely than were male respondents (81.8%).
- White respondents (90.8%) were more likely than were black (76.1%) and Hispanic (71.7%) respondents.
- Respondents 18 to 29 years of age (88.9%) and 30 to 39 years of age (87.8%) were more likely than were respondents 40 years of age and older (81.4%).
- Respondents with a high school degree or less (91.3%) were more likely than were those with some college (88.0%) and college graduates (83.8%).
- Respondents with a conventional medical orientation (89.4%) were more likely than were those with an alternative medical orientation (75.5%).

Regarding the likelihood of considering government or school requirements as the principal motivation to have their child immunized:

- Black respondents (16.2%) were more likely than were whites (6.4%) or Hispanics (7.1%).
- Respondents with a high school education or less (9.3%) were more likely than were those with some college (8.4%) and college graduates (6.0%).
- Respondents with an alternative medical orientation (12.7%) were more likely than were those with a conventional medical orientation (6.0%).

Regarding whether a parent would choose to opt out of any immunization:

- Females (17.1%) were more likely than were males (7.1%).
- Whites (15.8%) were more likely than were blacks (8.1%). (Note: 12.6% of Hispanics would choose to opt out of at least 1 immunization; however, this rate was not significantly different from the rates of either whites or blacks.)
- College graduates (16.9%) were more likely than were those with a high school degree or less (10.7%).
- Respondents with an alternative medical orientation (24.9%) were more likely than were those with a conventional medical orientation (11.2%).

With regard to concern about side effects for each of the vaccines in the 1999 recommended childhood immunization schedule, black and Hispanic respondents had greater concern about each of the vaccines than did white respondents, and respondents with high school education or less had greater concern about each of the vaccines than did respondents with more education. In addition, respondents with an alternative medical orientation had more concern than did respondents with conventional medical orientation, and they were also more likely to believe each of the misconceptions about immunizations and less likely to believe statements that are consistent with the evidence about immunization safety and efficacy. (Data available from authors.)

## DISCUSSION

Our findings show that the vast majority of parents firmly believe immunizations to be an extremely important way to protect children against serious diseases. The large majority of parents find immunizations to be acceptably safe and only a few parents would choose to opt out of any immunizations for future children. Parents’ positive perceptions about immunizations are also seen in their attitudes toward school entry requirements: <10% of parents cite day care and school entry immunization requirements as the primary reason they have their children immunized. Clearly, the majority of parents recognize that such policies protect their children from getting illnesses from nonimmunized children.<sup>13</sup> Yet, between 19% and 25% of parents surveyed have important misconceptions about immunizations that could undermine their confidence in vaccine safety and could adversely affect their immunization decision-making.

The random-digit-dialing methodology used in this survey and the fact that interviews were conducted only in English limit the generalizability of

these findings to parents of young children and expectant parents from English-speaking households with working telephones. The immunization beliefs and intentions of non-English-speaking parents and those without working telephones may differ from those we report. The 41% survey response rate and 51% survey cooperation rate, although conservative estimates based on a directly observed survey eligibility rate of 24%, may have also biased these findings in unknown ways. (Less conservative estimates of our survey response and cooperation rates, using a 16% survey eligibility rate based on 1998 US Census data, are 49% and 58%.)

These response rates are consistent with response rates from recently published surveys on similar topics.<sup>11,14</sup>

This survey was conducted in the spring of 1999, several months before both the suspension of the rotavirus vaccine because of a possible increased risk of intussusception<sup>15</sup> and the reassessment of the use of thimerosal-containing vaccines for infants.<sup>16</sup> Because both of these events may have reinforced some misgivings about vaccines, it is possible that this survey underestimates the current level of concern.

Nearly all parents surveyed indicated that they have access to the information they need to make good decisions about immunizations and that their child's physician or nurse was meeting their information needs. This juxtaposition of findings—the relatively high rate of concern about too many immunizations being provided at too early an age, and the relatively low perceived need for additional information about immunizations—is worrisome. The childhood immunization schedule is already complex and will become increasingly complex with the addition of new vaccines and new technologies (which also may be misunderstood and feared by the public). Thus, the parents who have concerns centered on too many vaccines being given at too young an age are likely to become more rather than less alarmed unless their underlying misconceptions are addressed.<sup>17,18</sup> Their low perceived need for information, however, poses a distinct challenge.

When people feel little need for additional information, they are unlikely to attend to new information unless it is in some manner striking, such as when it is in conflict with their beliefs.<sup>19–21</sup> Disease prevention, particularly if the disease is perceived as less serious, is not as compelling or striking as the anecdote of an injured child, regardless of whether a causal link between the injury and previous receipt of a vaccine has been established. Therefore, the perceived risk of vaccination may be magnified. As the occurrence of vaccine-preventable disease declines, the challenge of communicating the risk of not being immunized increases.<sup>22–24</sup> The challenge is further increased by omission bias, wherein the perceived responsibility for the consequences of inaction (ie, infection) is more acceptable than for the consequences of an action (ie, adverse event associated with immunization).<sup>25–28</sup> Thus, failure to correct current misconceptions in the minds of parents and parents-to-be will likely lead to a larger proportion of

the parent population questioning the value of childhood immunizations.

Our findings indicate that parents with alternative medical beliefs may be particularly susceptible to misconceptions about the benefits and risks of vaccines. This is a population of special concern for educational efforts given their prevalence in the overall population (13% in our sample; 42% in other recent research that used a more liberal definition<sup>11</sup>).

While it seems that most parents understand that vaccines prevent infectious diseases by strengthening a child's immune system, many parents are concerned that their child's immune system could be weakened by too many vaccines. An issue unresolved by this research, but central to the goal of simplifying the childhood immunization schedule by the use of combination vaccines, is whether those parents who believe that children get more immunizations than are good for them are more concerned about the number of antigens or the number of injections received. Since this telephone survey was conducted, the shift to an all-inactivated poliovirus vaccine schedule and the recent recommendation to include the pneumococcal conjugate vaccine have resulted in both additional injections and new antigens being included in the childhood immunization schedule.

Because health care providers are perceived by parents to be the most important source of information and advice about immunizations, they have both an important opportunity and a professional obligation to educate parents and to correct misconceptions.<sup>29,30</sup> Physicians and other primary care providers have multiple opportunities over many years to reaffirm parents' correct beliefs and modify misconceptions.

Some parents seek information from a variety of sources. Both the AAP and the CDC are recognized by many parents and are viewed as credible sources of information on immunizations. However, the fact that a fictitious organization—the National Resource Center for Immunization Information—was seen as a relatively trustworthy source of information by a substantial number of survey respondents is indicative of one problem associated with educating parents about immunization issues. Many parents have little awareness of the various organizations that offer immunization information, and even less awareness that the information offered by different organizations may vary considerably in terms of its scientific basis. An organization with a credible-sounding name—even if fictitious—may be mistaken by some proportion of parents as offering valid information. In light of a proliferating number of organizations with an interest in immunizations and their increasing visibility on the Internet and in the media, parents may have an increasingly difficult time understanding the scientific underpinnings of, and thereby the medical consensus in support of, the contemporary immunization program.

Communication efforts should focus on clarifying and reaffirming parents' correct beliefs about immunizations and on modifying misconceptions. This survey data can be used to help practitioners, pa-

tients, parents, and public health officials craft strategies appropriate to the needs of the community and to help parents better understand why physicians and other experts recommend immunizations.

Periodic national assessments of parental attitudes and understanding of immunizations are needed to refine these communication efforts. The National Immunization Survey of the CDC estimates vaccination coverage for children in the United States but has not routinely monitored trends in public understanding of vaccines,<sup>14</sup> as is done by Britain's Health Education Authority in its semiannual Childhood Immunization Survey.<sup>31</sup> Only in 1976 after the swine flu vaccine episode did the US Public Health Service conduct a national survey to assess knowledge and attitudes about vaccines, with a focus on influenza vaccine.<sup>32</sup>

To compete effectively in today's information marketplace, clinicians and public health officials must understand parents' thinking about vaccine-preventable diseases, vaccines, and immunization policies to design effective public education programs that assist parents to make informed decisions about their children's health. Timely immunization of US children with today's vaccines is essential to maintaining our nation's public health. Tomorrow's vaccines hold the promise of preventing or ameliorating much disease and disability that is now unavoidable. "If you build it, they will come" is a grand fantasy for a baseball park, but we believe that it is a dangerously arrogant premise for immunizations important to public health.

#### APPENDIX

Members of the National Network for Immunization Information Steering Committee are: Samuel L. Katz, MD, Duke University (co-chairperson); Louis W. Sullivan, MD, Morehouse School of Medicine (co-chairperson); Virginia Burggraf, DNS, RN, C, American Nurses Association; Louis Z. Cooper, MD, Columbia University; Kathryn M. Edwards, MD, Vanderbilt University, Vanderbilt Children's Hospital; Edgar K. Marcuse, MD, MPH, University of Washington School of Medicine, Children's Hospital and Regional Medical Center; Georges Peter, MD, Brown University School of Medicine; Gregory A. Poland, MD, Mayo Clinic and Foundation; William Schaffner, MD, Vanderbilt University School of Medicine; and Patricia Whitley-Williams, MD, University of Medicine and Dentistry of New Jersey, Robert Wood Johnson Medical School.

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Tested educational messages intended for parents, based on this and additional research, are available at: [www.immunizationinfo.org](http://www.immunizationinfo.org).

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