National Immunization Survey-Child

A User's Guide for the 2023 Public-Use Data File

Centers for Disease Control and Prevention

National Center for Immunization and Respiratory Diseases

Presented by:

NORC at the University of Chicago

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Convention for Bolding Text

The Data User's Guide uses **bold** font to highlight substantive changes in the methodology or study design from the previous year's Guide.

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1. Introduction

In 1992, the Childhood Immunization Initiative (CII) (CDC, 1994) was established to 1) improve the delivery of vaccines to children; 2) reduce the cost of childhood vaccines; 3) enhance awareness, partnerships, and community participation; 4) improve vaccinations and their use; and 5) monitor vaccination coverage and occurrences of disease. The Healthy People 2030 objectives set the following targets for vaccination coverage in young children: maintain the vaccination coverage level of 1 dose of the measles, mumps, and rubella (MMR) vaccine in children by age 2 years at 90.8% or higher; increase the vaccination coverage level of 4 doses of the diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine in children by age 2 years to at least 90.0%; and reduce the proportion of children who get no recommended vaccines by age 2 years below 1.3% (https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination). To fulfill the CII mandate of monitoring vaccination coverage and marking progress toward achieving those objectives, the National Immunization Survey - Child (NIS-Child) was implemented by the National Center for Immunization and Respiratory Diseases (NCIRD) and the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) in 1994. From 1994 to 2014, the NIS-Child was conducted jointly by NCIRD and NCHS; since 2015, the NIS-Child has been conducted by NCIRD.

The target population for the NIS-Child is non-institutionalized children aged 19 through 35 months living in United States households at the time of the interview. The official coverage estimates reported from the NIS-Child are proportions of children up-to-date with respect to the requisite numbers of doses of all routinely recommended vaccines for this age group (Wodi et al., 2023). These vaccines and their recommended numbers of doses are:

- Diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed, diphtheria and tetanus toxoids and pertussis vaccine, or diphtheria and tetanus toxoids adsorbed (DTaP/DTP/DT) – 4 doses;

- Inactivated poliovirus vaccine IPV (polio) – 3 doses (for guidance to assess doses documented as 'OPV', see https://www.cdc.gov/mmwr/volumes/66/wr/mm6606a7.htm?s_cid=mm6606a7_w);
- Measles, mumps, and rubella vaccine (MMR) – 1 dose;
- *Haemophilus influenzae* type b conjugate vaccine (Hib) – 3 or 4 doses depending on product type;
- Hepatitis B vaccine (Hep B) – 3 doses;
- Varicella (chicken pox) vaccine (VAR) – 1 dose;
- Pneumococcal conjugate vaccine (PCV) – 4 doses;
- Hepatitis A vaccine (Hep A) – 2 doses;
- Rotavirus vaccine (RV) – 2 or 3 doses depending on product type.
- COVID-19 vaccine– 3 or more doses, including an updated (2023-34) formula; and
- Seasonal influenza vaccine (for the recommended number of doses of seasonal influenza vaccine and other vaccines, see https://www.cdc.gov/acip-recs/hcp/vaccine-specific/index.html);

In addition to these vaccines, interest focuses on the combined vaccine series 4:3:1:3*:3:1:4 (4+ DTaP/DTP/DT; 3+ polio; 1+ measles-containing vaccine (MCV); full series Hib, i.e., 3 or 4 doses depending on type of vaccine received; 3+ Hep B; 1+ varicella ; and 4+ PCV).

The NIS-Child collects data on each of these vaccines. Varicella vaccine was added in Quarter 3, 1996, pneumococcal conjugate vaccine in Quarter 4, 2000, influenza vaccine and hepatitis A vaccine in Quarter 1, 2003, rotavirus vaccine in Quarter 3, 2007, and COVID-19 vaccine in Quarter 3, 2022. The remainder of the vaccines have been included in the NIS-Child from its start in 1994. Information about current and past recommendations for each vaccine can be found at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

The NIS-Child uses random digit dialing (RDD) telephone survey methodology to identify households containing children in the target age range, and interviews are conducted with the adult who is most knowledgeable about the child's vaccinations. With consent of the child's parent or guardian, the NIS-Child also contacts (by mail) the child's health care provider(s) to request information on vaccinations from the child's medical records. Since 2005, NIS-Child sampling, data collection, and weighting operations have been conducted by NORC at the University of Chicago.

Samples of cellular telephone numbers are drawn independently for each calendar quarter within selected geographical areas, or strata. In 2023, there are 59 geographic strata for which vaccination coverage levels can be estimated (see Table F.1), including 5 local areas; the remaining 54 estimation areas are either an entire state, the District of Columbia, a U.S. territory (the U.S. Virgin Islands, Guam, or Puerto Rico), or a "rest of state" area. For states with local and "rest of state" estimation areas, estimates for the whole-state area can be produced as well. This design makes it possible to produce annual estimates of vaccination coverage levels for each of the 59 estimation areas with a specified degree of precision (a coefficient of variation of approximately 7.5%). Further, by using the same data collection methodology and survey instruments in all estimation areas, the NIS-Child produces comparable vaccination coverage levels across estimation areas and over time.

When the NIS-Child was established in 1994, 78 areas were chosen for sampling strata, including the 50 states, 6 urban areas that receive federal Section 317 immunization grants (Bexar County, TX; Chicago, IL; District of Columbia; Houston, TX; New York City, NY; Philadelphia County, PA), and 22 other urban areas. These areas were called "Immunization Action Plan" (IAP) areas in reference to plans developed to improve vaccination coverage following the resurgence of measles during 1989-1991. In 2005 and 2006, selected non-awardee IAP areas – areas that do not receive separate Section 317 funds – were "rotated off" (i.e., the sample design no longer ensured adequate sample size to produce estimates for the area) and replaced by new areas "rotated on" (i.e., the sample design did ensure adequate sample size to produce estimates for the area). Starting in 2007, the base NIS-Child geographic strata included 56 areas (5 sub-state awardee urban areas, the District of Columbia, and 50 state or "rest of state" areas). In addition, starting in 2007, state immunization programs could choose additional city/county areas of interest to have adequate sample size to produce estimates for the area, using their Section 317 funds. **In 2023, the NIS-Child included the U.S. Virgin Islands, Guam, and Puerto Rico as additional estimation areas.** As noted throughout this report, some procedures differed for U.S. territories when compared to the rest of the U.S., including the creation of separate survey weight variables for analyses that are to include territories.

The 59 = 56 + 3 areas are called *estimation areas*. Table 11 in Section 8 shows a cross-walk of estimation areas between years. To maintain consistency with past NIS-Child public-use data files (PUFs), variable names and descriptions continue to use the term "IAP" to designate areas included as geographic strata, which was the term used prior to 2008. The changing geographic strata over time will not cause a problem with bias in estimation of state and national coverage levels since the geographic strata are nested within state.

Data for the U.S. Virgin Islands and Guam are not included in the 2023 public-use data file to protect respondent confidentiality, as the sampling fractions were larger in these small-population areas. Interested researchers can access data for the U.S. Virgin Islands and Guam by submitting a proposal and working through the Research Data Center. The link and guidelines for developing a proposal are located at the following URL: www.cdc.gov/rdc.

For the 2023 NIS-Child, telephone interviewing began on January 5, 2023 and ended on December 30, 2023. Provider data collection extended from January 24, 2023 through February 23, 2024. A total sample, including the U.S. territory samples, of approximately 29.8 million telephone numbers yielded household interviews for 39,013 children, 18,570 (47.5%) of whom had adequate provider data (i.e., provider-reported vaccination data adequate to determine whether the child was up-to-date with respect to the recommended immunization schedule). The 2023 NIS-Child public-use data

file, which includes data from Puerto Rico but does not include data for the U.S. Virgin Islands or Guam, contains data for 38,619 children with completed household interviews (37,458 when Puerto Rico is excluded), and more extensive data (e.g. provider-reported vaccinations and facility data) for 18,412 children with adequate provider data, including 314 unvaccinated children (18,032 including 309 unvaccinated children, when Puerto Rico is excluded).

Official NIS-Child vaccination coverage estimates are based on the provider-reported vaccination histories for each child. Among children with data received from vaccination providers identified in the household interview, it must be determined which children have "adequate provider data," that is, which children have provider data adequate to determine whether the child is up to date with respect to the recommended immunization schedule. In 2012, the NIS-Child household questionnaire was modified to reduce the length of the household interview, decrease respondent burden, and potentially improve response rates, with the result that questions that were previously used to define adequate provider data were no longer available. With this questionnaire change, it was no longer possible to use the same definition of adequate provider data as was used prior to 2012, and so beginning in 2012 all children with any provider-reported vaccination data are considered to have adequate provider data. See the user's guide for the 2014 NIS-Child public-use data file (CDC, 2015) for more detail about this change and its impact.

The weights included on this public-use data file afford the data analyst the capability of conducting several different types of analyses, depending on interests and aims. One can choose to analyze all children with completed household interviews or only the subset of children for whom the provider-reported data are adequate. One can also choose to include or exclude children who reside in U.S. territories in the analysis. Previous NIS-Child public-use data files have also provided analysts with these capabilities. Section 6 of this user's guide provides information about the creation of the weight variables included in the 2023 NIS-Child public-use data file, and Section 8 provides guidance for their use.

Vaccination coverage estimates are available on the *ChildVaxView* website, https://www.cdc.gov/childvaxview/. An article summarizing key findings from the NIS-Child data, as published in the *Morbidity and Mortality Weekly Report (MMWR),* will also be available on this website. Historically, these estimates have been based on NIS-Child data collected in a single survey year (e.g., the 2023 NIS-Child) and applied to the population of children age 19-35 months; since 2018, the estimates on *ChildVaxView* and in the MMWR are based on data pooled over 2-3 survey years (e.g., the 2021-2023 NIS-Child surveys) and apply to the population of children in particular annual birth cohorts (e.g., children born in 2020 or 2021). This cohort-based approach to estimating vaccination coverage has been described by Singleton et al. (2019) and Singleton (2019), and was first implemented for NIS-Child data published in 2019 (https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6841e2-H.pdf). **The 2023 NIS-Child public-use file and this user's guide focus on a single survey year (2023) and the production of vaccination coverage estimates for children age 19-35 months in 2023. Therefore, estimates produced from this public-use file will differ from birth cohort-based estimates on *ChildVaxView* and in the MMWR (Hill et al., 2024). Researchers interested in analyzing the NIS-Child data by birth year can request access to the required data via the Research Data Center (http://www.cdc.gov/rdc).**

The accompanying codebook (NCIRD, 2024) documents the contents of the 2023 NIS-Child public-use data file. For reference, the accompanying "Alphabetical Listing of Variables in the NIS-Child Public-Use Data Files" CSV file provides a full list of variables in the 2023 and previous public-use data files. NIS-Child data and documentation for 2015 to the present are available at: https://www.cdc.gov/nis/php/datasets-child.

Additional information on the NIS-Child is available at: https://www.cdc.gov/nis/about.

For additional information on the NIS-Child public-use data file, please contact the NCIRD Information Dissemination Staff:

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Website: https://www.cdc.gov/nis/php/datasets-child

2. Sample Design

The NIS-Child uses two phases of data collection to obtain vaccination information for a large national probability sample of young children: an RDD telephone survey designed to identify households with children 19 through 35 months of age, followed by the Provider Record Check, a mailed survey to children's vaccination providers. This section summarizes these two phases of data collection. Other descriptions of the sample design are given by Ezzati-Rice et al. (1995), Zell et al. (2000), Smith et al. (2001a, 2005), and Wolter et al. (2017a).

2.1 The NIS-Child RDD Telephone Survey

The NIS-Child Random Digit Dial (RDD) telephone survey phase uses independent, quarterly samples of cellular phone numbers. Sampling frames were provided by Marketing Systems Group (MSG). Cellular phone numbers were sampled within estimation areas in each quarter of 2023. Table F.1 lists the estimation areas for the 2023 NIS-Child by state and shows the estimated number of children living in each state and estimation area in 2023.

Prior to 2011, the NIS-Child used a single-frame landline RDD sample design. In 2011, a cellular phone sample was added, and from 2011-2017, the NIS-Child used a dual-frame landline and cellular phone RDD sample design. In 2018, the landline sample was dropped, and the NIS-Child now uses a single-frame cellular phone RDD sample design.

The target sample size of completed telephone interviews in each estimation area is designed to achieve an approximately equal coefficient of variation of 7.5% for an estimator of vaccination coverage derived from provider-reported vaccination histories, given a true coverage parameter of 50%. Cellular phone sample sizes were chosen to meet the target coefficient of variation of 7.5%.

Since 2019, the NIS sample design has included a modification to increase the efficiency of data collection. Immunization Information Systems (IIS) are state or local confidential, computerized, population-based data systems that collect and consolidate vaccination doses administered by participating vaccination providers to persons residing in a given geopolitical area. In participating geographic estimation areas, a two-phase RDD sample of cellular phone numbers is selected, with the second-phase sample stratified by the status of the telephone number in the corresponding IIS:

- Stratum 1: Phone number associated with a 19-35 month old child in the IIS
- Stratum 2: Phone number associated with a 13-17 year old adolescent in the IIS (but not with a 19-35 month old child in the IIS)
- Stratum 3: Phone number associated with a 6-18 month or 3-12 year old child in the IIS (but not with a 19-35 month old child or 13-17 year old adolescent in the IIS)
- Stratum 4: Phone number not associated with a 6 month to 17 year old child in the IIS

In the second phase of sampling, phone numbers falling into Stratum 1 were oversampled. The method was designed to maximize the effective sample sizes for the NIS family of surveys, given fixed cost of data collection, within each of the participating geographic estimation areas. **For the 2023 sample, 33 areas participated in this two-phase sampling process to increase efficiency of sampling.[1]**

The design and implementation of the NIS-Child cellular phone sample involves three procedures. First, statistical models predict the number of sample telephone numbers needed in each estimation area to meet the target precision requirements. Second, the sample for an estimation area is divided into random sub-samples called replicates. By releasing replicates as needed, it is possible to spread the interviews for each sampling area evenly across the entire calendar quarter. Third, an automated procedure eliminates numbers on the NIS do-not-call list from the sample before the interviewers dial them.

[1] The participating geographic areas in 2023 were Alaska, Arkansas, Connecticut, Florida, Georgia, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nebraska, Nevada, New Mexico, New York – City of New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania-Philadelphia County, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Washington, Wisconsin, Wyoming, the U.S. Virgin Islands, and Puerto Rico. Philadelphia County and Wisconsin participated only in quarters 3 and 4.

In 2014 and 2015, an automated process was implemented to remove cellular phone numbers flagged as having no recent activity and that were therefore very likely to be non-working cellular phones. In 2016, a different automated process found to be more efficient in removing non-working cellular phone numbers was used. Following a July 2016 Federal Communications Commission (FCC) declaratory ruling (FCC 16-72, CG Docket No. 02-278) stating that the federal government and contractors working on behalf of the federal government are not subject to the restrictions on cellular phone dialing in the Telephone Consumer Protection Act of 1991 (TCPA, 47 U.S.C. 227), the NIS transitioned from manual dialing of cellular phones to auto-dialing cellular phones in November 2016. After this transition, the automated process to remove non-working cellular phone numbers was no longer cost effective, and beginning in 2017 this process was no longer used in the cellular phone sample.

2.2 The NIS-Child Provider Record Check

At the end of the household interview, consent to contact the child's vaccination provider(s) is requested from the parent/guardian. When oral consent is obtained, each provider is mailed an immunization history questionnaire (IHQ). This mail survey portion of the NIS-Child is the Provider Record Check (PRC).

The instructions ask vaccination providers to mail or fax the IHQ back upon completion. Two weeks after the initial mailing, a telephone call is made to providers who have still not responded, to remind and encourage them to complete the form and either mail or fax the information back. In some instances, provider-reported vaccination histories are completed over the telephone. Providers also have the option to send a medical record or registry printout containing the child's vaccination history, which is then transcribed onto the IHQ form. The data from the questionnaires are edited, entered, cleaned, and merged with the household information from the RDD survey to produce a child-level record.

2.3 Summary of Data Collection

Table 1 presents selected operational results of NIS-Child data collection for calendar year 2023. To facilitate comparisons with prior years, the numbers in Table 1 and discussed in this section exclude the U.S. territory samples. **Children aged 19 through 35 months during 2023 data collection were born between January 2020 and May 2022.**

The total cellular phone sample consisted of 28,360,462 telephone numbers. Of those, 51,450 (0.2%) were eliminated before release to the telephone centers as numbers on the NIS do-not-call list. The remaining 28,309,012 numbers were sent to the telephone centers to be dialed, and 1,847,126 (6.5%) active personal cellular phone numbers (APCNs) were identified, as shown in Row F. Among the identified APCNs, 1,550,623 (83.9%) were successfully screened. Of these, 51,812 (3.3%) were deemed eligible for the NIS-Child interview. Among the identified eligible respondents, 36,132 (69.7%) completed the interview.

A standard approach for measuring response rates in telephone surveys has been defined by the Council of American Survey Research Organizations (CASRO, 1982). The CASRO response rate is equivalent to "RR3" of American Association for Public Opinion Research (AAPOR) Standard Definitions (AAPOR, 2023). **In 2023, the CASRO response rate (Table 1, Row J) was 27.0%. The CASRO response rate equals the product of the resolution rate (46.2%, Row E), the screening completion rate (83.9%, Row G), and the interview completion rate among eligible households (69.7%, Row I).** The resolution rate is the percentage of the total telephone numbers selected that are classifiable as non-working, non-residential, or residential. The screening completion rate is the percentage of known households that are successfully screened for the presence of age-eligible children. The interview completion rate is the percentage of households with one or more age-eligible children who complete the household interview.

Row K of Table 1 shows that household interviews were completed on behalf of 34,675 age-eligible children. Rows L through O give results for the Provider Record Check phase. Specifically, Row L gives the rate of obtaining oral consent from the household respondent to contact the child's vaccination providers – 61.3% in 2023.

The number of IHQs mailed to vaccination providers exceeds the number of completed interviews for children with consent because some children have more than one vaccination provider. **Of the questionnaires mailed to vaccination providers of children, 23,861 (84.9%, Row N) were returned. Among the children with completed household interviews, 18,032 (48.1%, Row O) had adequate vaccination histories based on provider reporting (17,723) including multiple reports for a child or were determined to be unvaccinated (309). The other 51.9% of children lacked adequate provider data for a variety of reasons, such as the parent did not give consent to contact the child's provider(s), the provider(s) did not have records for the child, or the provider(s) did not report the vaccination history.** For each estimation area and each state, Table D.1 (see Appendix D) shows the number of children with completed household interviews and the number of children with adequate provider data. **The percentage of children with adequate provider data varied among the non-territory estimation areas from 39.6% in Texas-Rest of State to 62.8% in Vermont. Among the U.S. territories, the percentages were 37.1% in the U.S. Virgin Islands, 41.8% in Guam, and 32.7% in Puerto Rico.**

The phrase "adequate provider data" originally meant that sufficient vaccination history information was obtained from the provider(s) to determine whether the child is up-to-date with respect to the recommended vaccination schedule. Starting with the 2002 NIS-Child public-use data file, the definition of children with adequate provider data was expanded to include unvaccinated children. These are children for whom either (1) the respondent reported during the household interview that the child had received no vaccinations and has no providers, or (2) the respondent reported during the household interview that the child had received no vaccinations but has one or more providers, and those providers all reported administering no vaccinations. A report from the National Center for Health Statistics (NCHS) on the statistical methodology of the NIS-Child (Smith et al., 2005) includes details of how unvaccinated children are included in the estimates of vaccination coverage. This report can be viewed at http://www.cdc.gov/nchs/data/series/sr_02/sr02_138.pdf. This modification to the NIS-Child produces only small changes in vaccination coverage for estimation areas and states, because the number of unvaccinated children in the sample is very small (**only 323 in 2023**, including the U.S. territory samples). As described in the introduction, the definition of adequate provider data was modified in 2012 to include all children with provider-reported vaccination data as well as unvaccinated children.

Since 2001, the NIS-Child has included an additional Health Insurance Module (HIM) which is administered after completion of the main NIS-Child household survey and collects information about the child's health insurance coverage since birth. **Among the 34,675 children with completed household interviews, 23,504 (62.7%, Row P) went on to complete the HIM, while the remainder terminated the interview prior to completing the HIM. Among the 18,032 children with adequate provider data, 17,433 (96.7%) completed the HIM.**

Table 1: Selected Operational Results of Q1/2023-Q4/2023 NIS-Child Data Collection (Excluding U.S. Territories)

Row	Key Indicator	Cellular Phone Sample		Formula
		Number	Percent	
	Household Phase			
A	Total Selected Telephone Numbers in Released Replicates	28,360,462	--	--
B	Phone Numbers Resolved before Computer-Assisted Telephone Interviewing	51,450	0.2%	B/A
C	Total Phone Numbers Released to Telephone Centers	28,309,012	--	A-B
D	Advance Letters Mailed	0	0.0%	D/C
E	Resolved Phone Numbers[1] – *Resolution Rate*	13,102,664	46.2%	E/A
F	Households Identified – *APCN[2] Rate*	1,847,126	14.1%	F/E
G	Households Successfully Screened[3] – *Screener Completion Rate*	1,550,623	83.9%	G/F
H	Eligible Households – *Eligibility Rate[4]*	51,812	3.3%	H/G
I	Households with Completed Household Interviews – *Interview Completion Rate*	36,132	69.7%	I/H
J	CASRO[5] Response Rate[6]	--	27.0%	--
K	Age-Eligible Children with Completed Household Interviews[7]	37,458	--	--
	Provider Phase			
L	Children with Consent to Contact Vaccination Providers	22,976	61.3%	L/K
M	Immunization History Questionnaires Mailed to Providers	28,091	--	--
N	Immunization History Questionnaires Returned from Providers	23,861	84.9%	N/M
O	Children with Adequate Provider Data	18,032 (includes 309 unvaccinated children)	48.1%	O/K
	Modules			
P	Age-Eligible Children with Completed Household Interview and Completed Health Insurance Module	23,504	62.7%	P/K

[1] A phone number is resolved if it was determined to be either a non-working number or a working residential number. This row includes phone numbers resolved before computer-assisted telephone interviewing (CATI) (Row B). The numbers resolved before CATI interviewing are those on the NIS do-not-call list.

[2] Active personal cellular phone number (APCN) rate.

[3] The household screener screens for non-minor-only cellular phone households with age-eligible children.

[4] Of the screened households, the proportion that were non-minor-only cellular phone households with age-eligible children.

[5] CASRO, Council of American Survey Research Organizations.

[6] The response rate is the number of households with a completed household interview divided by the estimated number of eligible households in the sample. The number of eligible households in the sample was estimated using the CASRO assumptions; these assumptions are that the rate of households among the unresolved telephone numbers is the same as the observed rate of households among the resolved telephone numbers, and the rate of eligible households among unscreened households is the same as the observed rate of eligible households among screened households. Under these assumptions, the CASRO response rate is equal to the product of the resolution rate, the screener completion rate, and the interview completion rate.

[7] Rows K-P reflect the removal of children with a completed interview that were later found to be ineligible based on post-survey data cleaning operations, the removal of children who were not sampled but reported living in a U.S. territory, and the addition of children sampled in a U.S. territory who reported living in the non-territory United States.

2.4 Informed Consent, Security, and Confidentiality of Information

The introduction to the telephone survey and oral consent assure the respondent of the confidentiality of his/her responses and the voluntary nature of the survey. Informed consent is obtained from the person in the household most knowledgeable about the eligible child's vaccination history (generally the parent or guardian of the child). Informed consent to contact the child's vaccination provider(s) is obtained at the end of the interview.

Information in the NIS-Child is collected and processed under high security. To ensure privacy of the respondents and confidentiality of sensitive information, standards have been established for release of data from this survey. All CDC staff and contractor staff involved with the NIS-Child sign confidentiality agreements and follow instructions to prevent disclosure.

All information in the NIS-Child is collected under strict confidentiality and can be used only for research [Section 308(d) of the Public Health Service Act, 42 U.S. Code 242m(d) and the Privacy Act of 1974 (5 U.S. Code 552a)]. Prior to public release, the contents of the public-use data file go through extensive review by the NCIRD Disclosure Review Board to protect participant privacy as well as data confidentiality.

3. Content of NIS-Child Questionnaires

This section describes the questionnaires used in the 2023 NIS-Child telephone interview of households and Provider Record Check.

3.1 Content of the Household Questionnaire

The computer-assisted telephone interview (CATI) questionnaire used in the RDD phase of NIS-Child data collection consists of two parts: a screener to identify households with children aged 19 through 35 months and an interview portion. The questionnaire is modeled on the Immunization Supplement to the National Health Interview Survey (NHIS) (NCHS, 1999). The NIS-Child CATI questionnaire has been translated into Spanish, and LanguageLine Solutions® (formerly part of AT&T) is used for real-time translation into many other languages (Wall et al., 1995). Table 2 summarizes the content of each section of the NIS-Child household interview. The CATI questionnaire is available at http://www.cdc.gov/vaccines/imz-managers/nis/datasets.html.

In the screener, the purpose of the survey is explained to the respondent, and the household is screened to determine whether it contains any children aged 19 through 35 months (any child who was or would be aged 19 through 35 months during the calendar quarter is eligible). If the household has an eligible child, the respondent is asked whether he/she is the most knowledgeable person for the child's vaccination history. If the respondent indicates that another person in the household is more knowledgeable, the interviewer asks to speak to him/her at that time. If that person is unavailable to be interviewed, the interview proceeds to Section MR, the name of the most knowledgeable person is recorded, and a "callback" is scheduled for a later date. Prior to screening for age-eligibility, the household is screened to ensure that the cellular phone is used by an adult (i.e., to ensure it is not a minor-only cellular phone). If the household has more than one age-eligible child, data are collected for each eligible child.

Table 2: Content of the Household Interview, National Immunization Survey - Child, 2023

Questionnaire Section	Content of Section
Section S	Screening questions to determine NIS-Child eligibility
Section MR	Most-knowledgeable-respondent callback questions
Section B	Ever vaccinated and influenza vaccination questions
Section C	Demographic and socioeconomic questions
Section D	Provider information and request for consent to contact the eligible child's vaccination provider(s)
Section E	Health Insurance Module (HIM)

Prior to Q1/2012, the person being interviewed was asked during the screener section whether he/she had a written record (shot card) of the child's vaccination history and whether it was easily accessible. If a shot card was available, the respondent was asked to provide information directly from it in Section A (which asked respondents with shot cards about the shots on the card). However, beginning in Q1/2012, Section A and most of Section B were eliminated from the regular questionnaire, and therefore all interviews proceeded directly to a reduced form of Section B asking the respondent to recall information about the child's flu vaccinations. In 2015 and 2016, Section A was reinstated for Guam respondents, but was discontinued for all respondents beginning in 2017.

Section C obtains information that includes relationship of respondent to the child, race and Hispanic origin of the child, household income, educational attainment of the mother, and other information on the socioeconomic characteristics of the household and its eligible children.

In Section D of the NIS-Child household interview, identifying information (such as name, address, and telephone number) for the child's vaccination provider(s) is requested, as well as the full names of the child(ren) and the respondent, so that NIS-Child personnel can contact the provider(s) and identify the child(ren) whose immunization information the NIS-Child is requesting. After this information is obtained, consent to contact the child's vaccination provider(s) is requested. When oral consent and sufficient identifying information are obtained, the immunization history questionnaire is mailed to the child's vaccination provider(s).

Beginning in 2006, a Health Insurance Module (HIM) was administered upon completion of Section D to collect data regarding the types of medical insurance coverage the child has had since birth. If a respondent provided consent to contact medical providers and completed Section D, he/she flowed directly into the HIM. If, however, consent or any other critical provider question was refused, the call was terminated and the respondent was called back later to attempt to complete the Provider Section and obtain consent. Only upon callback on which consent was granted or a second refusal given within Section D was the respondent asked the HIM.

3.2 Content of the Immunization History Questionnaire (IHQ)

The Immunization History Questionnaire (IHQ) mailed to the vaccination providers is designed to be simple and brief, to minimize provider burden and encourage survey participation. The structure and content of this form were initially derived from the National Immunization Provider Record Check Study (NHIS/NIPRCS), which collected and reconciled vaccination data from the providers of respondents to the Immunization Supplement to the NHIS. The IHQ consists of two double-sided pages. Page one includes space for a label that gives the child's name, date of birth, and sex. The remainder of page one contains questions about the facility and vaccination provider. Page two gives instructions for filling out the shot grid, which appears on pages two and three. Page four thanks the vaccination provider for providing the information, and lists websites and telephone numbers that can be used to obtain more information about the NIS-Child and the NCIRD. The IHQ is available at http://www.cdc.gov/vaccines/imz-managers/nis/datasets.html.

Since 2015, a Spanish-translated version of the NIS-Child IHQ has been used for Puerto Rico. This version differs slightly from the IHQ used for other estimation areas in that Question 5b does not contain response options for Indian Health Service or Pharmacy.

4. Data Preparation and Processing Procedures

The household and provider data collection in the NIS-Child incorporate extensive data preparation and processing procedures. During the household interview, the CATI system supports reconciliation of critical errors as interviewers enter the data. After completion of interviewing for a quarter, post-CATI editing and data cleaning produce a final interview data file. The editing of the provider data begins with a manual review of returned immunization history questionnaires, data entry of the questionnaires, and cleaning of the provider data file. After the provider data are merged with the household interview data and responses from multiple providers for a child are consolidated into a child-level data record, the editing continues. A quality assurance check is performed based on the name, sex, and date-of-birth information from all sources to ensure that the provider completed the questionnaire for the correct child and to confirm age-eligibility. Editing of the provider-reported vaccination dates then attempts to resolve specific types of discrepancies in the provider data. The end product is an analytic file containing household and provider data for use in estimating vaccination coverage.

4.1 Data Preparation

The editing and cleaning of NIS-Child data involve several steps. First, the CATI system enables interviewers to reconcile potential errors while the respondent is on the telephone. Further cleaning and editing take place in a post-CATI clean-up stage, involving an extensive review of data values, cross tabulations, and the recoding of verbatim responses for race and ethnicity. The next step involves the creation of numerous composite variables. Provider data are cleaned in a separate step. After these steps have been completed, imputations are performed for item non-response on selected variables, and weights are calculated. The procedures and rules of the NHIS serve as the standard in all stages of data editing and cleaning (http://www.cdc.gov/nchs/nhis.htm).

4.1.1 Editing in the CATI System

The CATI software checks consistency across data elements and does not allow interviewers to enter invalid values. Catching potential errors early increases the efficiency of post-survey data cleaning and processing.

To prevent an overly complicated CATI system, out-of-range and inconsistent responses produce a warning screen, allowing the interviewer to correct real time errors. This allows the interviewer to reconcile errors while respondent is on the telephone. CATI warning screens focus on items critical to the survey, such as those that determine a child's eligibility (e.g., date of birth).

A CATI system cannot simultaneously incorporate every possible type of error check and maximize system performance. To reconcile this trade-off, post-CATI edits are used to resolve problems that do not require access to the respondent, as well as unanticipated logic problems that appear in the data.

4.1.2 Post-CATI Edits

The post-CATI editing process produces final, cleaned data files for each quarter. The steps in this process, implemented after all data collection activities for a quarter are completed, are described below.

Initial Post-CATI Edits and File Creation

After completion of interviewing each quarter, the raw data are extracted from the CATI data system and used to create two files: the sample file and the interview data file. The sample file contains one record for each sample telephone number and summary information for telephone numbers and households. The interview data file contains one record for each eligible sampled child and all data reported for the child during the household survey.

Following creation of these two files, a preliminary analysis of each file identifies out-of-range values and extraneous codes. The first check verifies the eligibility status of children. Once the required corrections are verified, invalid values are replaced with either an appropriate data value or a missing value code.

Frequency Review

After the pre-programmed edits are run, frequency distributions of all variables in each file are produced and reviewed. Each variable's range of values is examined for any invalid values or unusual distributions. If blank values exist for a variable, they are checked to see whether they are allowable and whether they occur in excessive numbers. Any problems are investigated and corrected as appropriate.

File Crosschecks

Crosscheck programs ensure that cases exist across files in a consistent manner. Specifically, checks ensure that each case in the interview data file is also present in the sample file and that each case in the sample file was released to the telephone center. Checks also ensure that no duplicate households exist in the sample file and no duplicate children exist in the interview data file.

When all checks have been performed, the final quarterly interview data file is created. Programmers and statisticians then create composite variables constructed from basic variables for each child. Sampling weights (described in Section 6 of this Guide) are added to each record.

4.1.3 Editing of Provider Data

Six to eight weeks after the close of household data collection for a quarter, the majority of the IHQs have been collected from providers. The data from the hard-copy questionnaires are entered and independently re-entered to provide 100% verification. The provider data file is cleaned, in a similar fashion to the household data file, for out-of-range values and consistency. A computer program back-codes "other shot" verbatim responses into the proper vaccine category (e.g., Engerix B counts as Hep B, and Kinrix counts as DTaP and polio). These translations come from a file that contains all such verbatim responses ever encountered in the NIS-Child. Also, the provider data file is checked for duplicate records, and exact duplicates are removed. If the provider data contain a date of birth, sex, or name for the child that differs from the household interview for that child, the questionnaire is re-examined to see whether it may have been filled out for the incorrect child. Provider data that appear to have been filled out for the wrong child are removed from the provider database. When a child has data from multiple providers, decision rules are applied to produce the most complete picture of the child's vaccination history.

Once these data have been cleaned, they are combined with the household data file. Information from up to five providers can be added to a child's record. If more than one provider reported vaccination data for the child, the data from the multiple provider reports are combined into a single history for the child, called the "synthesized provider-reported vaccination history". The determination of whether the child is up-to-date for recommended vaccines and vaccine series is based on the child's synthesized provider-reported vaccination history.

Many variables in the household data file are checked against or verified with the provider data file. For example, a child's date of birth as recorded by the provider is checked against the date of birth as given by the household, to verify that the provider was reporting for that specific child and to form a "best" date of birth for the child. All children with at least one provider-reported vaccination are considered to have adequate provider data.

4.2 Limitations of Data Editing Procedures

Although data editing procedures were used for the NIS-Child, the data user should be aware that some inconsistent data might remain in the public-use data file. The variables that indicate whether a child is up-to-date on each vaccine or series (on which the estimates of vaccination coverage are based) are derived from provider-reported data, and the NIS-Child does not re-contact households or providers to attempt to reconcile potential discrepancies in provider-reported vaccination dates or to resolve date-of-birth reporting errors. However, beginning with the 1999 NIS-Child, the provider-reported data are manually reviewed and edited to correct specific reporting errors. The *National Immunization Survey: Guide to Quality Control Procedures* (CDC, 2002) discusses the change in editing procedures in more detail. Some children with adequate provider data may have incomplete vaccination histories. These incomplete histories arise from three primary sources: 1) the household does not identify all vaccination providers, 2) some but not all providers respond with vaccination data, and 3) all identified providers respond with vaccination data but fail to list all the vaccinations in the child's medical record. Even with these limitations, the NIS-Child overall is a rich source of data for assessment of up-to-date status and age-appropriate vaccination. Also, the NIS-Child is the only source to provide comparable provider-reported vaccination data across states and local areas in the United States.

4.3 Variable-Naming Conventions

The names of variables follow a systematic pattern as much as possible. The codebook for the public-use data file (NCIRD, 2024), available at https://www.cdc.gov/vaccines/imz-managers/nis/datasets.html, groups the variables into 10 broad categories according to the source of the data (household or provider) and the content of the variable. See Section 7 of this report for detailed information on the contents of the public-use data file.

4.4 Missing Value Codes

Missing value codes for each variable can be found in the codebook (NCIRD, 2024), available at https://www.cdc.gov/vaccines/imz-managers/nis/datasets.html. For household variables, the missing value codes usually are 77 for DON'T KNOW and 99 for REFUSED. Some household variables may also contain blanks, if the question was not asked. The variables developed from the IHQ generally do not have specific missing value codes.

4.5 Imputation for Item Non-Response

The NIS-Child uses imputation primarily to replace missing values in the socioeconomic and demographic variables used in weighting. Missing values of these variables are imputed for all children with a completed household interview – i.e., all children appearing on the public-use data file. Missing values of health insurance variables are also imputed for children with adequate provider data. A sequential hot-deck method is used to assign imputed values (Ford, 1983). Class variables are used to separate respondents into cells. Donors and recipients must agree on the categories of the class variables, which include the estimation area. Within the categories of the class variables, respondents are sorted by variables related to the variable to be imputed. The last case with an observed value is used as the donor for up to four recipients. The “Label” and “Notes” line for each variable in the codebook (NCIRD, 2024) identifies variables that contain imputed values. These variables include the sex, Hispanic origin, race, health insurance status, and first-born status of the child; the education level, age group, marital status, and mobility status of the mother; and the income-to-poverty ratio of the household.

The count of vaccinations for a specific vaccine is based on the number of unique vaccination *dates* reported by the child’s provider(s). In filling out the immunization history questionnaire a provider may not know the date of the first dose of hepatitis B, which is typically given at birth. The provider does, however, have the option of checking the “Given at Birth” box for the first dose of hepatitis B. If it was checked “yes” and the date of the birth dose of hepatitis B was not reported, a program assigns the date of the birth dose for this vaccine. A value is imputed from the distribution of provider-reported dates for the birth dose of hepatitis B. The birth dose for this imputation is defined as being given in the first 7 days of life - between the date of birth (i.e., 0 days) and the date of birth plus 6 days. This imputation procedure was first implemented in 2000. **For 2023 (excluding U.S. territories), a total of 129 children had the date of the birth dose of hepatitis B assigned using the above procedure (see HEP_FLAG).**

Table 3 shows the observed distribution of age in days at the birth dose of hepatitis B for children in 2023 with a provider-reported birth dose. A similar table is included in the 2000-2022 data user’s guides. For 1997, 1998, and 1999, Section 5 of the data user’s guide provides information on the distribution of age in days for the birth dose of hepatitis B vaccine and gives guidance on imputing age in days at birth dose for children with a missing date, but for whom the provider checked the box indicating that a dose was administered at birth (see HEP_BRTH).

Table 3: Distribution of Age (in Days) at the Birth Dose of Hepatitis B Vaccine, National Immunization Survey - Child, 2023

Age in Days at Birth Dose	Unweighted Percentage Of Birth Doses*
0	71.8
1	21.1
2	3.0
3	1.2
4	0.9
5	0.7
6+	1.3

* Excludes U.S. territories.

4.6 Vaccine-Specific Recoding of Verbatim Responses

On the IHQ, providers can list vaccinations in the “other” section of the IHQ shot grid. After data collection, they are reclassified into the listed categories, if possible, using a vaccination recoding table. This table is reviewed by NCIRD personnel to ensure the shots are recoded into the appropriate category or categories (for combination shots).

4.7 Composite Variables

A number of composite variables (constructed from basic variables) are created and included in the NIS-Child public-use data file. Composite variables assist users and data analysts by eliminating duplication of effort and making NIS-Child data easier to use.

Since the initial years of NIS-Child data collection, the household composite variables have included up-to-date status on individual vaccinations, race of child, household income, and up-to-date status on several vaccination series. Many of these household composite variables are included in the NIS-Child public-use data file. See Section 7 of this report for information on the key variables.

In Quarter 3, 1999, the NIS-Child race questions (see questions C3, C9 and C10 in the household questionnaire) were expanded to include Alaska Native, Native Hawaiian, and Pacific Islander, implementing the revised Office of Management and Budget (OMB) standards for classification of race and ethnicity (https://www.whitehouse.gov/wp-content/uploads/2017/11/Revisions-to-the-Standards-for-the-Classification-of-Federal-Data-on-Race-and-Ethnicity-October30-1997.pdf). The composite race variables in the 2002 through present NIS-Child public-use data files, however, contain only three categories: white alone; black alone; and all other races alone/multiple races. (The variable RACE_K classifies each child into one of these three categories, while the variable RACEETHK includes a separate "Hispanic" category.) The "all other races alone" category includes Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and other races. If more than one race was selected during administration of the child race questions, the child is classified as multiple races. Because of small sample sizes and risk of disclosure within estimation areas, the NIS-Child public-use data files do not contain any variables with separate multiple-race categories. Rather, the children with multiple races are included in the "all other races" category. Table 4 shows some characteristics of the current race and ethnicity categories for the vaccine series and selected individual vaccines.

Table 4: Weighted Distribution of Children by Race and Ethnicity and Corresponding Combined Vaccine Series* (4:3:1:3*:3:1:4), Pneumococcal, and Varicella Vaccination Coverage Estimates, National Immunization Survey - Child, 2023

Race and Ethnicity Classification	Weighted Distribution of Children aged 19-35 Months in U.S. Estimate (%)	Weighted Percentage 4:3:1:3*:3:1:4 UTD Estimate (%) (Standard Error (%))	Weighted Percentage 4+ Pneumococcal Estimate (%) (Standard Error (%))	Weighted Percentage 1+ Varicella at 12+ Months Estimate (%) (Standard Error (%))
Hispanic	28.5	67.4 (1.7)	77.8 (1.6)	91.4 (1.2)
Non-Hispanic white only	43.3	71.6 (0.8)	84.3 (0.7)	91.0 (0.5)
Non-Hispanic black only	13.8	66.6 (2.3)	78.7 (2.3)	90.6 (1.3)
Non-Hispanic American Indian or Alaska Native only	0.9	63.1 (7.2)	76.3 (7.5)	91.2 (2.7)
Non-Hispanic Asian only	5.7	72.0 (2.9)	84.5 (2.3)	89.0 (2.5)
Non-Hispanic Native Hawaiian or Pacific Islander only	0.2	74.8 (8.5)	81.9 (7.9)	86.5 (7.7)
Non-Hispanic multiple races	7.6	69.6 (2.0)	81.2 (1.7)	90.5 (1.3)
Non-Hispanic white/black	3.6	68.6 (3.0)	81.2 (2.4)	89.3 (2.0)
Non-Hispanic white/ American Indian or Alaska Native	0.7	66.5 (5.4)	78.3 (4.6)	88.8 (3.4)
Non-Hispanic white/Asian	2.2	75.4 (3.5)	86.0 (3.1)	92.7 (2.6)
Non-Hispanic other combination	1.0	63.0 (5.8)	73.1 (5.8)	91.1 (2.5)

Note: UTD = up-to-date. Weighted by PROVWT_C. Children with an unknown Hispanic origin and/or race were imputed by a hot-deck method. This table excludes U.S. territories.

* 4+ diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed, diphtheria and tetanus toxoids and pertussis vaccine, or diphtheria and tetanus toxoids vaccine adsorbed (DTaP/DTP/DT); 3+ poliovirus vaccine; 1+ measles-containing vaccine (MCV); full series *Haemophilus influenzae* type b conjugate vaccine (Hib), i.e., 3 or 4 doses depending on type of vaccine received; 3+ hepatitis B vaccine (Hep B); 1+ varicella at or after 12 months of age; and 4+ pneumococcal vaccine (PCV).

4.8 Subsets of the NIS-Child Data

The NIS-Child public-use data file contains data for all eligible children who have a completed household interview. An interview is considered complete if the respondent completed Section C of the questionnaire. As explained in Section 6 of this guide, each child with a completed household interview is assigned a weight (**RDDWT_C** for the United States, excluding U.S. territories; **RDDWT_C_TERR** for the United States, including U.S. territories) for use in estimation.

The NIS-Child uses the synthesized provider-reported vaccination histories to form the estimates of vaccination coverage because the provider data are considered more accurate than household-reported data. Thus, the most important subset of the data consists of children with adequate provider data. For these children, one or more providers returned an immunization history questionnaire that included vaccination data. Unvaccinated children are also considered to have adequate provider data. As discussed in Section 7 below, the **PDAT** variable identifies the children with adequate provider data (**PDAT**=1). These children have a separate weight **(PROVWT_C** for the United States, excluding U.S. territories; **PROVWT_C_TERR** for the United States, including U.S. territories), which should be used to form estimates of vaccination coverage (see Section 6).

4.9 Confidentiality and Disclosure Avoidance

To prevent identification of participants in the NIS-Child and the resulting disclosure of information, certain items from the questionnaires are not included in the public-use data file. In addition, some of the released variables either are top- or bottom-coded, or have their categories collapsed. Variable labels indicate which variables have been re-coded in these ways. These decisions are reviewed by the NCHS Disclosure Review Board to ensure the public use data files meet acceptable levels of disclosure risk.

5. Quality Control and Quality Assurance Procedures

A major contributor to NIS-Child data quality is its sample management system, which in 2023 managed over 230 estimation area by quarter samples and used a number of performance measures to track their progress toward completion. Khare et al. (2000), Khare et al. (2001), and the *National Immunization Survey: Guide to Quality Control Procedures* (CDC, 2002) describe quality assurance procedures.

Important aspects of the quality assurance program for the RDD component of the NIS-Child included interviewer monitoring; online provider look-ups in a database system integrated with the CATI system, including names, addresses, and telephone numbers of vaccination providers; and automated range-edits and consistency checks. These and other quality assurance procedures contributed to a reduction in total data collection cost by minimizing interviewer labor and overall burden to respondents.

The Provider Record Check component used quality control measures at four junctions: prior to mailing packets to providers; during the telephone prompting effort; during the editing of returned questionnaires; and during and after their data entry. The final quality assurance activities are implemented during post-processing of the returned questionnaires or vaccination records. All returned questionnaires were examined to identify and correct any obvious errors prior to data entry and then key-entered with 100% verification. The keying error rate is estimated, by way of a second verification process, to be less than 1%.

6. Sampling Weights

Each of the two phases of data collection results in a separate sampling weight for each child that has data at that phase. The RDD-phase sampling weights permit analyses of data for children with completed household interviews. Each child with adequate provider data (the subset on which official estimates of vaccination coverage are based) has a provider-phase sampling weight. The RDD-phase sampling weight variable for producing estimates for children with completed household interviews in the United States excluding U.S. territories is called **RDDWT_C**; the RDD-phase weight variable for producing estimates for the United States including U.S. territories is called **RDDWT_C_TERR**. The provider-phase sampling weight variable for producing estimates for children with adequate provider data in the United States excluding U.S. territories is called **PROVWT_C**; the provider-phase weight variable for producing estimates for the United States including U.S. territories is called **PROVWT_C_TERR**. See Section 8 of this user's guide for more information about the weights included in the data file and the proper way to use them.

As discussed below, revisions in weighting methodology were made on various occasions and the names of the weight variables were also changed to keep track of the revisions. Table 5 lists of the RDD-phase and provider-phase weight variable names used for each year of the NIS-Child.

A sampling weight may be interpreted as the approximate number of children in the target population that a child in the sample represents. Thus, for example, the sum of the sampling weights of children with adequate provider data who are up-to-date (on a particular vaccine or series of vaccines) yields an estimate of the total number of children in the target population who are up-to-date. Dividing this sum by the total of the sampling weights for all children with adequate provider data gives an estimate of the corresponding vaccination coverage rate.

Table 5: RDD-Phase and Provider-Phase Weight Variable Names, National Immunization Survey - Child, 1995-2023

Year(s)	RDD-Phase Weight Variable Name(s)	Provider-Phase Weight Variable Name(s)
1995-2001	HY_WGT	W0
2002	RDD_WT	WT
2003-2004	WGT_RDD	WGT
2005-2008	RDDWT	PROVWT
2009-2010	RDDWT RDDWTVI	PROVWT PROVWTVI
2011	RDDWT_LL RDDWTVI_LL RDDWT_D	PROVWT_LL PROVWTVI_LL PROVWT_D
2012	RDDWT_D RDDWTVI_D	PROVWT_D PROVWTVI_D
2013	RDDWT_D RDDWTVIGU_D	PROVWT_D PROVWTVIGU_D
2014-2016	RDDWT_D RDDWT_D_TERR	PROVWT_D PROVWT_D_TERR
2017	RDDWT_D	PROVWT_D
2018	RDDWT_C	PROVWT_C
2019-2023	RDDWT_C RDDWT_C_TERR	PROVWT_C PROVWT_C_TERR

This section describes how these weights are developed and adjusted so as to achieve an accurate representation of the target population. The base weights reflect each telephone number's probability of being selected into the sample; the adjustments take into account non-resolution of residential/non-residential/non-working status of a telephone number, non-response to the screener and household interviews, number of cellular phones used by parents in the household, raking for differential coverage rates and non-coverage of households that do not have cellular phones, non-response by providers, and a final raking adjustment.

6.1 Base Sampling Weight

In each quarterly NIS-Child sample, each child with a completed household interview receives a base sampling weight. The base sampling weight is equal to the inverse of the probability the phone number was sampled from the sampling frame for the quarter and estimation area.

6.2 Adjustments for Non-Resolution of Telephone Numbers, Screener Non-Response, and Interview Non-Response

Non-response occurs in population-based surveys when potential respondents refuse to participate, are not available at the time of the interview, or could not be reached during the survey period. Thus, the sum of the base sampling weights of children with completed household interviews will underestimate the size of the target population in the estimation area, because not all sampled households respond to all stages of data collection up to the household interview. As a result, the base sampling weights must be adjusted so they accurately reflect the number of children in the target population that each sampled child with a completed household interview represents.

Some sampled households with age-eligible children fail to complete the household interview because of unit non-response: for some telephone numbers, it is never determined whether or not the number is a working residential number despite multiple call attempts; for some households it is never determined whether or not the household contains age-eligible children; and some households with age-eligible children do not complete the household interview. To compensate for these three types of unit non-response, the sampling weights of children with a completed household interview are adjusted to account for the estimated number of age-eligible children in households whose telephone numbers are never resolved, the estimated number of age-eligible children in households that fail to complete the screening interview, and the number of identified age-eligible children for whom the household interview is not completed. Each of these adjustments is carried out within each estimation area by forming weighting cells based on the Metropolitan Statistical Area (MSA) status of the wire center associated with the cellular phone number (MSA/non-MSA). Each cell in each stage of adjustment must have sufficient resolved/responding cases (usually 20, but 15 for interview non-response) at that stage of adjustment. The cells with a deficient number of responding cases are collapsed into neighboring cells, i.e., both MSA categories are collapsed if either of the cells have a deficient number of responding cases. Once the adjustment cells are formed, the weights of the unresolved/non-responding records from the previous adjustment step are distributed to the weights of the resolved/responding records within each cell.

6.3 Adjustment for Multiple Cellular Phones and Deriving Annual Weights

Once the non-response-adjusted interview weights for households are computed, these weights are adjusted for additional cellular phones in the household. Because households with multiple cellular phones have a greater chance of being sampled, each child's household interview weight is adjusted by dividing it by the total number of cellular phones used by parents or guardians (up to a maximum of 3).

Up to the previous step, the sampling weights are adjusted separately for each quarter, and the weights in each quarter pertain to the target population. However, annual vaccination coverage estimates are obtained from data for four consecutive quarters, so the weights in each quarterly file are adjusted when the data from the four quarters are combined. The adjustment factor is proportional to the number of households with completed household interviews in each quarter and estimation area.

6.4 Calibration

Next, survey weights are calibrated to population control totals as described below. The control totals used for the NIS-Child are derived from current natality data from NCHS (2020, 2021) (available at https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm). Because the Vital Statistics data give the counts of all live births in the United States, regardless of whether the household has any cellular phones, the control totals include all eligible children. **The control total for each raking dimension is derived from the NCHS natality files from 2020 and 2021 (children born between July 1, 2020 and November 30, 2021 would have been 19 through 35 months on June 30, 2023).** Use of the natality data to form the required population control totals for the NIS-Child has three limitations: 1) the natality file provides a universe of live births and therefore does not reflect infant mortality; 2) the natality file does not include children born outside the United States who immigrate to this country before reaching ages 19 through 35 months; and 3) the natality file records residence at time of birth, and some children may move from one estimation area to another by the time they reach 19 through 35 months of age. Adjustments are made to the natality data to account for these three factors. **For 2023, the combined 2020, 2021, and 2022 one-year American Community Survey Public Use Microdata Sample data files (https://www.census.gov/programs-surveys/acs/data.html) were used to make the immigration and migration adjustments (U.S. Census Bureau, 2021, 2022, 2023).**

Survey weights are adjusted to agree with independent estimates of the population total by telephone status. The proportions of 19 through 35 month old children by detailed telephone status (cellular-phone-only, landline and cellular phone dual user, landline-only, phoneless) within each estimation area were derived using a similar small area modeling approach as described in Blumberg et al. (2011). These modeled telephone status estimates are applied to the population control total for the estimation area to estimate the control totals by detailed telephone status within the estimation area. In each estimation area, children in dual landline and cellular phone households are weighted to represent children living in dual landline and cellular phone households in the estimation area, and children in cellular-phone-only households are weighted to represent children in cellular-phone-only households in the estimation area. Children in landline-only and phoneless households, which are excluded from the cellular phone sample, are accounted for in the raking step described below.

To reduce sampling variability and improve the precision of estimation, extreme weights are trimmed and then recalibrated to control totals. RDD sampling weight values exceeding the median weight plus three times the interquartile range of the weights within an estimation area are truncated and then recalibrated to control totals. This is done by up to five iterations. This weight trimming prevents children with unusually large weights from having an unusually large impact on immunization coverage estimates.

The final step in adjusting the RDD sampling weights is a raking adjustment (Deming, 1943) of the trimmed, telephone status adjusted weights. The raking procedure uses estimation area-level control totals for maternal education categories, maternal race and ethnicity, age group of the child, sex of the child, and telephone status. Briefly, raking takes each variable in turn and applies a proportional adjustment to the current weights of the children who belong to the same category of the variable. After a number of iterations over all the variables, the raked weights have totals that match all the desired control totals. Raking makes it possible to incorporate additional variables into the weighting and to use more detailed categories for those variables. Wolter et al. (2017a) gives the details of various aspects of the NIS-Child estimation procedures.

The sampling weights after all the foregoing adjustments constitute the "RDD sampling weights" **(RDDWT_C** for the United States excluding territories; **RDDWT_C_TERR** for the United States including territories).

6.5 Adjustment for Provider Non-Response

Among the 37,458 children with a completed household interview (excluding U.S. territories), 18,032 (48.1%) had adequate provider data. Starting with the 2002 NIS-Child public-use data file, the definition of children with adequate provider data includes unvaccinated children. These are children for whom the respondent reported during the household interview that the child had received no vaccinations, and for whom no providers were reported, or one or more providers were reported but those providers reported administering no vaccinations. **Among the 18,032 children with adequate provider data, 309 were unvaccinated children. Failure to obtain adequate provider data for the remaining 19,426 children (51.9%) was attributable to:**

- **parent or guardian not identifying any providers or not giving consent to contact the child's vaccination provider(s) (38.2%);**

- **consent to contact vaccination providers obtained but no providers returned the immunization history questionnaire (10.3%); and**
- **one or more providers returned the immunization history questionnaire, but no providers reported any vaccination data, despite the parent or guardian indicating that the child has received vaccinations (3.4%).**

The 19,426 children for whom a household interview was completed but adequate provider data were not obtained are classified as "partial non-responders" because they have only a partial response to the NIS-Child as a whole.

Empirical results suggest that children with adequate provider data have characteristics believed to be associated with a greater likelihood of being up-to-date, compared with children who had missing provider data. Specifically, children with adequate provider data are more likely to live in households that have higher total family income, have a white mother, and live outside a principal city of a Metropolitan Statistical Area. Also, a child with missing provider data is less likely to live in the state where the mother lived when the child was born. These factors indicate a potential lack of continuity of health care and are associated with lower vaccination coverage (Coronado et al., 2000). If no adjustment is made to the RDD sampling weights to account for these differences, estimated vaccination coverage rates may be biased.

To reduce potential bias in estimators of vaccination coverage attributable to partial non-response, a weighting-class adjustment is used in each estimation area (Brick and Kalton, 1996). This adjustment involves three steps. In the first step, sampled children are classified according to the quintile of their estimated probabilities of having adequate provider data. In the statistical literature these probabilities are called response propensities (Rosenbaum and Rubin, 1983, 1984; Rosenbaum, 1987). Children who have similar response propensities will also be similar with respect to variables that are strongly associated with the probability of having adequate provider data. In this important respect, children in each class are comparable. Because of this comparability, any sub-sample of children in a class may represent all children in the class. Therefore, the weighting-class adjustment uses the children with adequate provider data to represent all children in the class. Details, including the methodology for forming weighting classes based on propensity scores, can be found in the NCHS report on the statistical methodology of the NIS-Child (Smith et al., 2005), available at http://www.cdc.gov/nchs/data/series/sr_02/sr02_138.pdf.

In the second step of this weighting-class adjustment, within each class, an adjustment factor redistributes the RDD sample weights of the children with missing provider data to the weights of the children who have adequate provider data. These adjusted sampling weights of children with adequate provider data are initial non-response-adjusted provider-phase weights.

Within an estimation area, the sums of non-response adjusted weights of children with adequate provider data for the various levels of important socio-demographic variables (such as race and ethnicity) may not be equal to corresponding population totals. To reduce bias attributable to these differences, raking was used in the third step to adjust the non-response adjusted weights to match estimation area control totals. Control totals for these variables were estimated using the weighted totals from the sample of children with completed household interviews. Smith et al. (2001b, 2005) describe the development of this approach in more detail. Similar to the RDD weighting, the extreme weights exceeding the median weight plus three times the interquartile range of the weights within an estimation area are truncated and then recalibrated to control totals. These raked weights of children with adequate provider data are called "final provider-phase weights" **(PROVWT_C** for the United States excluding territories and **PROVWT_C_TERR** for the United States including territories). Because of the comparability of children within each weighting class, any estimate that uses data only from the children with adequate provider data along with their provider-phase sampling weights will have less bias attributable to differences between children with adequate provider data and children with missing provider data.

Appendix B summarizes the distribution of the sampling weights **(RDDWT_C**, **PROVWT_C**, **RDDWT_C_TERR**, and **PROVWT_C_TERR)** in each estimation area for 2023.

NIS-Child public-use data files for 1995 to 2001 do not include sampling weights that account for the effect of unvaccinated children. An assessment of the effect of accounting for unvaccinated children for the period 1995 to 2003 was made. Weights were calculated for each year with and without unvaccinated children and the vaccination coverage estimates compared. Details of this assessment and the results are available in the user's guide for the 2004 NIS-Child public-use data file. At the national level, accounting for unvaccinated children had very little effect on the estimates of 4:3:1:3 vaccination coverage. Within estimation areas also, the two coverage estimates differed little. The largest difference (in either direction) was most often around 2 percentage points. Differences of that magnitude are small relative to the standard errors of the estimates. Although accounting for unvaccinated children has a small effect on estimates of vaccination coverage, data users who use the pre-2002 public-use data files to examine estimation area-level trends over time are advised to interpret the results with appropriate caution.

6.6 Sampling Weights for Territories

The NIS-Child weighting process was followed as closely as possible for U.S. territories. Due to differences in the availability of external data sources for U.S. territories, slight changes were necessary to accurately estimate vaccination coverage for these areas. These differences are stated below.

In step 6.2, each of the non-response adjustments for U.S. territories was done at the estimation area level. That is, no weighting cells were formed for U.S. territories.

Similar to the weights for the United States excluding territories, the final step in adjusting the RDD sampling weights for U.S. territories is a raking adjustment. For Guam and Puerto Rico, a different set of race and ethnicity categories were used for post-stratification and raking adjustments than were used in other areas. The three Guam race and ethnicity categories were: Chamorro/Guamanian, Other Asian/Pacific Islander, and All Other. The two Puerto Rico race and ethnicity categories were: White and All Other.

After sampling weights were calculated for all children, they were stored in the variables **RDDWT_C_TERR** and **PROVWT_C_TERR**. These weight variables permit one to conduct analysis of all estimation areas, including U.S. territories. The weight variables **RDDWT_C** and **PROVWT_C** are equal to **RDDWT_C_TERR** and **PROVWT_C_TERR** for all children except those in U.S. territories, for whom the value of these weight variables is blank or missing. **RDDWT_C** and **PROVWT_C** permit one to conduct analysis of all estimation areas, excluding U.S. territories.

7. Contents of the Public-Use Data File

The NIS-Child public-use data file contains a record for each eligible child for whom Section C of the household interview was completed, along with household-reported information about the child and the child's mother. For children with IHQs returned by one or more providers, the file also contains provider characteristic variables, as well as variables based on the child's synthesized provider-reported vaccination history: the age of the child at each vaccination, the number of each type of vaccination received, and indicators of whether the child is up-to-date with respect to various recommended vaccines and vaccine series.

The public-use data file consists of ten sections, the contents of which are described below in detail. For additional information, users are encouraged to consult the codebook (NCIRD, 2024), available at https://www.cdc.gov/vaccines/imz-managers/nis/datasets.html. The codebook is divided into the ten sections described below and contains variable names, labels, and response frequencies (for categorical variables). For select variables, the codebook also gives additional information about the variable in the "Notes" field.

In this section, Table 6 lists key NIS-Child variables commonly used in analyses (these variables have been included on all previous NIS-Child public-use data files as well unless otherwise stated). This table is followed by a summary of changes from 2022 to 2023 and then a more detailed description of the 2023 contents. A full list of variables appearing on the 2004-2023 NIS-Child public-use data files, along with the reason for the addition, subtraction, or modification of the variables in 2005-2023, can be found in the accompanying "Alphabetical Listing of Variables in the NIS-Child Public-Use Data Files" CSV file, available at: https://www.cdc.gov/nis/php/datasets-child/index.html. Information on changes made between 1995-2004 can be found in the *Alphabetical Listing of Variables that are Not Available in All Public-Use Data Files, National Immunization Survey, 1995-2004*.
http://www.cdc.gov/nchs/data/nis/pufvariables1995to2004.pdf

Table 6: NIS-Child Variables Commonly Used in Analyses or for Published Estimates

Variable	Categories
ID Variables	
SEQNUMC – unique child ID variable	
SEQNUMHH – unique household ID variable	
Geographic Variables	
ESTIAP23 – estimation area number *(introduced in 2023; ITRUEIAP used through 2004, ESTIAP in 2005, and ESTIAPyy since 2006)*	
STATE – state FIPS code	
CEN_REG – census region	Northeast Midwest South West
Child Demographic Variables	
AGEGRP – age category of child	19-23 months 24-29 months 30-35 months
RACEETHK – race and ethnicity of child *(introduced in 2002; RACEKIDR used in 1995-2001)*	Hispanic White alone, non-Hispanic Black alone, non-Hispanic All other races alone and multiple races, non-Hispanic
SEX – sex of child	Male Female
FRSTBRN – firstborn status of the child	No Yes
Mother Demographic Variables	
EDUC1 – education of the mother	<12 years 12 years >12 years, not a college graduate College graduate
MARITAL2 – marital status of mother *(Living with partner response option added to questionnaire in 2015)*	Currently married Never married, widowed, divorced, separated, deceased, or living with partner
M_AGEGRP2 – age group of mother *(introduced in 2016; M_AGEGRP used through 2015)*	<=29 years 30 years or older
Poverty Variables	
INCPOV1 – poverty status *(introduced in 2005; INCPOV1R used through 2004)*	At or above poverty level, income > $75,000 At or above poverty level, income <= $75,000 Below poverty level Not determined
INCPORAR – income-to-poverty ratio *(introduced in 2005; INCPORAT used through 2004)*	
INCPORAR_I – imputed income-to-poverty ratio *(introduced in 2016)*	
WIC Variables	
CWIC_01 – child ever participated in WIC program	Yes No Never heard of WIC Don’t know Refused Missing

Variable	Categories
CWIC_02 – child currently participating in WIC program	Yes No Don’t know Refused Missing
Breastfeeding Variables	
CBF_01 – child ever fed breast milk	Yes No Don’t know Missing
BF_ENDR06 – length of time in days child was fed breast milk	
BF_EXCLR06 – length of time in days child was exclusively fed breast milk or formula *(introduced in 2006)*	
BF_FORMR20 – age in days when child was first fed formula *(introduced in 2020; BF_FORMR06 used in 2006 and 2007; BF_FORMR08 used 2008-2019)*	
Chicken Pox Variables	
HAD_CPOX – did child ever have chicken pox *(introduced in 2005; I_HADCPX used through 2004)*	Yes No Don’t know Refused Missing
AGECPOXR – age in months when child had chicken pox *(introduced in 2005; IAGECPXR used through 2004)*	0-6 months 7-12 months 13-18 months 19-24 months 25-30 months 31 months or older Missing
Presence of Provider Data Variables	
PDAT – adequate provider data indicator	Yes No
Number of Provider-Reported Doses of Vaccine Variables	
P_NUMDTP – total number of DTaP/DTP/DT doses	
P_NUMPOL – total number of polio doses	
P_NUMMMR – total number of MCV doses	
P_NUMHIB – total number of Hib doses	
P_NUMHEP – total number of hepatitis B doses	
P_NUMVRC – total number of varicella doses	
P_NUMPCV – total number of pneumococcal conjugate (PCV) doses	
P_NUMFLU – total number of seasonal influenza doses	
P_NUMHEA – total number of hepatitis A doses	
P_NUMCOV – total number of COVID-19 doses	
P_NUMROT – total number of rotavirus doses	
Provider Characteristic Variables	

Variable	Categories
PROV_FAC – provider facility type	All public facilities All hospital facilities All private facilities All military/other facilities Mixed types Unknown
VFC_ORDER – do child's providers order vaccines for children from state/local health department? *(introduced in 2006)*	All providers Some but not all providers No providers Unknown
REGISTRY – provider(s) reported child's vaccination(s) to state or community immunization registry	All providers Some but not all providers No providers Unknown
Insurance Status Variables	
INS_STAT2_I – child's current health insurance coverage status *(introduced in 2017, INS_STAT_I used in 2016)*	Private insurance only Any Medicaid Other insurance (CHIP*, IHS*, military, or some other form of insurance, alone or in combination with private insurance) Uninsured
INS_BREAK_I – child's insurance history since birth *(introduced in 2016)*	Currently insured but uninsured since birth Currently insured and never uninsured since birth Currently uninsured but insured since birth Currently uninsured and never insured since birth

* CHIP = Children's Health Insurance Program; IHS = Indian Health Service

Before describing the sections of the public-use data file below, we first summarize the differences between the 2022 and 2023 NIS-Child public-use data files:

- **A new 2023 estimation area variable (ESTIAP23) has been added and the 2022 estimation area variable (ESTIAP22) has been dropped. Although data were collected for the U.S. Virgin Islands and Guam in 2023, children in these areas are not included on the public-use data file to protect confidentiality.**
- **A new set of variables have been added to reflect provider-reported COVID-19 vaccinations. These include:**
    - **Shot counter variables for total COVID-19 doses (P_NUMCOV) and for each COVID-19 vaccine subtype, including Moderna (P_NUMCOVM), Pfizer-BioNTech (P_NUMCOVP), and other/unknown (P_NUMCOVX).**

- **Up-to-date indicators for 1+ COVID-19 dose (P_UTDCOV1), fully up-to-date with 2+ Moderna doses or 3+ Pfizer-BioNTech doses (P_UTDCOV_FULL), and fully up-to-date with an additional booster dose (P_UTDCOV_BOOST).**
- **Age-at-vaccination variables, including age in days (DCOVID1-DCOVID9) and age in months (COV1_AGE-COV9_AGE).**
- **COVID-19 vaccination subtype indicators (XCOVTY1-XCOVTY9), which identify if each dose was Moderna, Pfizer-BioNTech, or another/unknown type.**

- **A new shot counter variable P_NUMPCC20 has been added to reflect the new Pneumococcal vaccine type (Conjugate-20) which was added to the IHQ shot grid in 2023.**

7.1 Section 1: ID, Weight, and Flag Variables

SEQNUMHH and **SEQNUMC** are the unique household and child identifiers, respectively. **PDAT** indicates which children are considered to have adequate provider data. As described in Section 6 of this report, **RDDWT_C/RDDWT_C_TERR** and **PROVWT_C/PROVWT_C_TERR** are the final household- and provider-phase weights, respectively. **PROVWT_C/PROVWT_C_TERR** should be used when analyzing the provider-reported data, i.e., the variables in Sections 7, 8, and 9 of the NIS-Child public-use data file.

7.2 Section 2: Household-Reported Vaccination and Chickenpox Information

Section 2 of the public-use data file contains variables derived from the information collected in Section B of the household questionnaire. In particular, it contains variables indicating whether the respondent reported that the child has had chicken pox disease **(HAD_CPOX)** and the child's age in months at chicken pox disease **(AGECPOXR).**

7.3 Section 3: Demographic, Socio-Economic, and Other Household/Child Information

Section 3 of the NIS-Child public-use data file consists of information collected during the household screening interview and Section C of the household main interview. To protect confidentiality, many of these variables have been collapsed, top-coded, or bottom-coded from the original, fully-detailed versions; the variable labels (see the public-use date file codebook) indicate which variables have been collapsed or recoded.

AGEGRP is the age of the child in months in three categories (19-23 months, 24-29 months, 30-35 months), based on the child's best date of birth and the eligibility date. **SEX** gives the sex of the child, and **FRSTBRN** indicates whether the child is the first born, with missing values of these variables imputed. The language in which the interview was conducted is stored in variable **LANGUAGE**, and **C5R** gives the relationship of the respondent to the child.

The breastfeeding variables include whether the child was ever fed breast milk **(CBF_01)**, length of time in days the child was fed breast milk **(BF_ENDR06)**, the age in days when the child was first fed formula **(BF_FORMR20)**, and the length of time in days the child was exclusively fed breast milk or formula **(BF_EXCLR06)**. Two types of inconsistencies arise in the breastfeeding data: 1) duration of any breastfeeding can exceed age of the child, and 2) age when the child was first fed formula can exceed the age of the child. **BFENDFL06** is set equal to 1 when BF_ENDR06 exceeds the age of the child (with a buffer), and **BFFORMFL06** is set equal to 1 when BF_FORMR20 exceeds the age of the child (with a buffer). Appendix C provides details on how the flags were created. Data users are cautioned to review Appendix C before analyzing any of the breastfeeding variables.

The WIC variables include whether the child ever participated in the WIC program **(CWIC_01)** and whether the child is currently participating **(CWIC_02)**.

C1R and **CHILDNM** give the number of people and children, respectively, in the household. The child's Hispanic origin indicator, race with three categories, and race and ethnicity with four categories are presented in variables **I_HISP_K**, **RACE_K**, **and RACEETHK**, respectively; for each of these variables, missing values have been imputed. The age, education level, and marital status of the mother of the child are stored in variables **M_AGEGRP2**, **EDUC1**, and **MARITAL2** (married vs. not married), with missing values imputed.

The categorized total combined income for the child's family is given by **INCQ298A. INCPOV1** gives the family's poverty status (at or above poverty, income > $75,000; at or above poverty, income <= $75,000; below poverty; unknown), and **INCPORAR** gives the ratio of the family's income to the poverty level. **INCPORAR_I** gives the same ratio after missing values of family income have been imputed. Household tenure is given by **RENT_OWN**.

The number of landline telephone numbers in the household, the number of working cellular phones household members have available for personal use, and the number of these cellular phones that are usually used by parents or guardians are given by **NUM_PHONE**, **NUM_CELLS_HH**, and **NUM_CELLS_PARENTS**, respectively.

Variable **CEN_REG** gives the census region of the respondent's current residence, and **MOBIL_I** indicates whether the mother's current state of residence is the same as her state of residence at the time of the child's birth.

7.4 Section 4: Geographic Variables

Variables **ESTIAP23** and **STATE** give the 2023 estimation area and state of residence, respectively, for each child. **EST_GRANT** indicates which of the 50 states, District of Columbia, and 5 local areas that receive federal Section 317 immunization awards (Bexar County, TX; City of Chicago, IL; City of Houston, TX; New York City, NY; Philadelphia County, PA) the child resides in.

7.5 Section 5: Number of Providers Identified and Consent Variables

Variable **D7** indicates whether the respondent gave consent to contact the child's providers. If D7=1, then consent was granted; if D7=2 then consent was explicitly denied; and if D7 is missing, consent was not granted because the respondent broke off the interview before being explicitly asked for consent.

Variable **D6R** gives the number of providers identified by the respondent. Note that sometimes respondents report erroneous provider counts and sometimes report the same provider more than one time, and D6R does not reflect cleaning or de-duplication of the initially-reported provider count.

7.6 Section 6: Number of Responding Providers Variables

Variable **N_PRVR** indicates the number of providers returning IHQs with vaccination information for the child. That is, N_PRVR is the number of IHQs that were returned for the child that contain information on the IHQ shot grid.

7.7 Section 7: Characteristics of Providers Variables

The variables in this section of the public-use data file summarize the information collected in IHQ questions 5b, 6, and 7 across the child's providers who returned IHQs containing vaccination (i.e., shot grid) data.

PROV_FAC indicates the facility type of the child's vaccination providers based on responses to IHQ question 5b. If all of the child's providers that returned IHQs containing shot grid data (see Section 6 variable N_PRVR) reported the facility type to be:

- a public health department-operated clinic, community health center, or rural health clinic, then PROV_FAC=1 (all public facilities);
- a hospital-based clinic, then PROV_FAC=2 (all hospital facilities);
- a private practice, then PROV_FAC=3 (all private facilities);

- a military health care facility, WIC clinic, school-based health center, pharmacy, or other type of facility, then PROV_FAC=4 (all military/WIC/school/pharmacy or other facilities).

If the responses of providers that returned IHQs containing shot grid data fell into more than one of the above bulleted categories, then PROV_FAC=5 (mixed); otherwise, if at least one of the child's providers returned an IHQ containing shot grid data but the facility type is unknown, then PROV_FAC=6 (unknown). If none of the child's providers returned an IHQ containing shot grid data, PROV_FAC is set to missing.

The Vaccines For Children (VFC) program is a federally-funded program that provides vaccines at no cost to children who might not otherwise be vaccinated because of inability to pay (http://www.cdc.gov/vaccines/programs/vfc/index.html). CDC buys vaccines at a discount and distributes them to awardees—i.e., state health departments and certain local and territorial public health agencies—which in turn distribute them at no charge to those private physicians' offices and public health clinics registered as VFC providers. **VFC_ORDER**, based on responses to IHQ question 6, indicates whether the child's vaccination providers order vaccines from a state or local health department to administer to children. If all of the child's providers that returned IHQs containing shot grid data (see Section 6 variable N_PRVR) reported that they order vaccines from a state or local health department to administer to children, then VFC_ORDER=1 (all providers); if at least one of the child's providers that returned an IHQ containing shot grid data reported that the practice orders vaccines from a state or local health department to administer to children and the child's other providers that returned IHQs containing shot grid data reported either that they did not order such vaccines or that they did not know whether or not they did, then VFC_ORDER=2 (some but possibly or definitely not all providers); if all of the child's providers that returned IHQs containing shot grid data reported that they do not order vaccines from a state or local health department to administer to children, then VFC_ORDER=3 (no providers); if none of the conditions for VFC_ORDER=1, 2, or 3 were met but at least one of the child's providers returned an IHQ containing shot grid data, VFC_ORDER=4 (unknown). If none of the child's providers returned an

IHQ containing shot grid data, VFC_ORDER is set to missing. Note that having a provider that orders VFC vaccines does not imply that the child is VFC-entitled; providers enrolled in the VFC program could also vaccinate children who are not VFC-entitled.

REGISTRY is based on responses to IHQ question 7 and indicates whether the child's vaccination providers reported the child's vaccinations to a local or state immunization registry (also known as an Immunization Information System, or IIS). If all of the child's providers that returned IHQs containing shot grid data (see Section 6 variable N_PRVR) indicated that they reported to a registry, then REGISTRY=1 (all providers); if at least one of the child's providers that returned an IHQ containing shot grid data indicated that the practice reported to a registry and the child's other providers that returned IHQs containing shot grid data indicated that they did not report to a registry, that they did not know whether or not they reported to a registry, or that the question is not applicable, then REGISTRY=2 (some but possibly or definitely not all providers); if all of the child's providers that returned IHQs containing shot grid data indicated that they did not report to a registry or that the question is not applicable, then REGISTRY=3 (no providers); if none of the conditions for REGISTRY=1, 2, or 3 were met but at least one of the child's providers returned an IHQ containing shot grid data, REGISTRY=4 (unknown). If none of the child's providers returned an IHQ containing shot grid data, REGISTRY is set to missing.

7.8 Section 8: Provider-Reported Up-To-Date Vaccination Variables

This section contains vaccination count and up-to-date variables based on the child's synthesized provider-reported vaccination history. To facilitate data processing and to accommodate the large and continually growing number of vaccination types covered by the NIS-Child, the provider-reported vaccination data are organized around the concept of vaccine categories and vaccine types within vaccine category. The vaccine categories correspond to the sections of the IHQ shot grid, and the vaccine types correspond to the type boxes on the IHQ shot grid. (For each vaccine category, an "unknown" vaccine type is created for vaccinations that are reported without a type box being checked. Also, a few vaccine types, such as Measles-Mumps, arise through the backcoding of shots initially reported in the "other" section of the IHQ shot grid.) Table 7 shows the vaccine categories and types for the 2023 NIS-Child. Note that a single vaccination can fall into more than one vaccine category; for example, an MMR-Varicella vaccination is part of both the Measles-containing and Varicella-containing vaccine categories. (The full list of vaccine type codes can also be found in Appendix F.)

For each vaccine category, Section 8 of the public-use data file contains a variable typically named **P_NUM*YYY*** – where "YYY" is the vaccine category abbreviation given in Table 7 – that stores the number of vaccinations in that vaccine category in the child's synthesized provider-reported vaccination history. For each vaccine type in Table 7, Section 8 also contains a variable that stores the number of vaccinations of that vaccine type in the child's synthesized provider-reported vaccination history. For example, **P_NUMDHI** is the number of DTaP/HepB/IPV shots in the child's history.

This section of the public-use data file also contains up-to-date indicators for a variety of recommended vaccines and vaccine series. These variables' names typically begin with "**P_UTD**". Additional variables indicate whether the child is up-to-date for various vaccine series. For example, **P_UTD431** indicates whether the child has received 4 or more DTaP/DTP/DT shots, 3 or more polio shots, and one or more measles-containing shots. The variable labels indicate what is needed to be considered up-to-date for each variable, and the "Notes" field in the codebook shows the vaccine type codes (see Table 7) being included when determining whether the child is up-to-date.

Note that it is possible that the administration of the NIS-Child interview itself prompts some respondents to vaccinate their children following the interview; to ensure that the vaccination coverage estimates are not artificially boosted because of this, the synthesized vaccination history count and up-to-date variables in this section of the public-use data file count only vaccinations received before the date the household interview was completed. Note also that because children are eligible for the NIS-Child if they are 19 to 35 months old on any day of the survey quarter, some children are less than 19 months old or greater than 35 months old on the date the household interview is completed. For children with interviews conducted before they became 19 months old, the Provider Record Check is not conducted until after the child has become 19 months old, and all vaccinations given up to age 19 months are counted, including those given after the household interview date. For children with interviews conducted after they became 36 months old, only vaccinations given through age 35 months are counted.

Table 7: Vaccine Categories and Vaccine Types, National Immunization Survey - Child, 2023

Vaccine Category Abbreviation	Vaccination Category Description	Vaccine Type Code	Vaccine Type Description
DTP	DTaP/DTP/DT-containing vaccine	03	DTaP/DTP/DT-containing, unknown type
		04	DTaP/DTP/DT
		07	DTaP-Hib
		08	DTaP-HepB-IPV
		D3	DTaP-IPV-Hib
		D4	DTaP-IPV-Hib-HepB
POL or POLIO	Polio-containing vaccine	08	DTaP-HepB-IPV
		20	OPV
		21	IPV
		22	Polio-containing, unknown type
		D3	DTaP-IPV-Hib
		D4	DTaP-IPV-Hib-HepB
MCV or MMR	Measles-containing vaccine	30	MMR
		31	Measles only
		32	Measles-mumps
		33	Measles-rubella
		MM	Measles-containing, unknown type
		VM	MMR-Varicella
HIB	Hib-containing vaccine	07	DTaP-Hib
		43	HepB-Hib
		44	Hib-only, unknown type
		D3	DTaP-IPV-Hib
		D4	DTaP-IPV-Hib-HepB
		HG	Hib-only (GSK)
		HI	Hib-containing, unknown type
		HM	Hib-only (Merck)
		HS	Hib-only (Sanofi)
		HY	Hib-MenCY
HEPB or HEP	Hepatitis B-containing vaccine	08	DTaP-HepB-IPV
		43	HepB-Hib
		60	HepB-only
		D4	DTaP-IPV-Hib-HepB
		HB	HepB-containing, unknown type
COV	**COVID-19-containing vaccine**	**CP**	**Pfizer-BioNTech**
		CM	**Moderna**
		CX	**COVID-19-containing, unknown type**
VRC	Varicella-containing vaccine	VA	Varicella-containing, unknown type
		VM	MMR-Varicella
		VO	Varicella-only
PCV	Pneumococcal-containing vaccine	70	Conjugate-unknown
		71	Polysaccharide

Vaccine Category Abbreviation	Vaccination Category Description	Vaccine Type Code	Vaccine Type Description
		72	Pneumococcal-containing, unknown type
		73	Conjugate-7
		74	Conjugate-13
		75	Conjugate-15
		76	**Conjugate-20**
HEPA or HEA	Hepatitis A-containing vaccine	HA	Hepatitis A
FLU	Seasonal influenza vaccine	FL	Seasonal influenza, unknown type
		FM	Seasonal influenza spray
		FN	Injected seasonal influenza
MP	Mumps-only vaccine	MP	Mumps-only
MPRB or MPR	Mumps-Rubella-only vaccine	MB	Mumps-Rubella-only
RB	Rubella-only vaccine	RB	Rubella-only
ROT	Rotavirus-containing vaccine	RG	Rotarix® (GSK)
		RM	RotaTeq® (Merck)
		RO	Rotavirus, unknown type

7.8.1 Hib Up-To-Date Variables

A Hib vaccine shortage and interim recommendation to suspend the booster dose for healthy children occurred December 2007 to September 2009 (CDC, 2010). Furthermore, the NIS-Child has historically considered children to be up-to-date for Hib if the child had 3 or more doses of any Hib-containing vaccine, but for some Hib vaccine product types, 4 doses are required. Because the NIS-Child has historically not distinguished between product types for Hib vaccine, children who received 3 doses of a vaccine product that required 4 doses were misclassified as up-to-date for Hib (CDC, 2010).

Because of the Hib vaccine shortage and because of the dependence of the Hib recommendation on product type, in 2009 the IHQ was modified to capture the manufacturer of the Hib vaccinations the child has received. Beginning with the 2009 NIS-Child public-use data file, new up-to-date variables were added to indicate up-to-date status based on Hib recommendation (i.e., the primary series recommended during the shortage vs. the full series) and on the Hib manufacturer.

Table 8 shows the Hib up-to-date variables appearing on the public-use data file beginning in 2009 and Table 9 shows the up-to-date series variables that include Hib appearing on the public-use-date file beginning in 2009: in addition to the existing vaccine series up-to-date variables based on 3+ Hib of any type (**PUTD4313**, **PUT43133**, **PU431331**, **PU4313313**, **PU4313314**), variables based on the "routine" (i.e., full series) Hib recommendations accounting for manufacturer (4+ Hib of any type or 2 Hib of Merck types followed by 1 Hib of any type) were added (**P_UTD431H_ROUT_S**, **P_UTD431H3_ROUT_S**, **P_UTD431H31_ROUT_S**, **P_UTD431H313_ROUT_S**, **P_UTD431H314_ROUT_S**).

Note that for these Hib up-to-date variables that account for the manufacturer, if the manufacturer is unknown because the provider failed to check a type box on the IHQ, it has been assumed that the manufacturer of the Hib vaccine is not Merck; that is, these variables are based on a "strict" treatment of Hib vaccinations of unknown type, erring on the side of classifying the child as not up-to-date.

Table 8: Up-To-Date Variables for Hib, National Immunization Survey - Child, 2009-2023

Name	Description	Up-To-Date Criteria
P_UTDHIB	Historical UTD flag for Hib.	3+ of any type (07,43,44,D3,D4,HG,HI,HM,HS,HY)
P_UTDHIB_SHORT_S	UTD flag for Hib-shortage (i.e., primary series) recommendation, accounting for manufacturer. Introduced in 2009.	3+ of any type (07,43,44,D3,D4,HG,HI,HM,HS,HY) OR 2+ Merck types (HM,43)
P_UTDHIB_ROUT_S	UTD flag for routine (i.e., full series) Hib recommendation, accounting for manufacturer. Introduced in 2009.	4+ of any type (07,43,44,D3,D4,HG,HI,HM,HS,HY) OR 2 Merck types (HM,43) followed by 1 of any type (07,43,44,D3,D4,HG,HI,HM,HS,HY)

Table 9: Up-To-Date Variables for Vaccine Series Including Hib, National Immunization Survey - Child, 2009-2023

Name	Description
PUTD4313	UTD flag for the 4:3:1:3 series using the 3+ any type UTD definition for HIB
P_UTD431H_ROUT_S	UTD flag for the 4:3:1:3 series using the routine (i.e., full series) UTD definition for HIB
PUT43133	UTD flag for the 4:3:1:3:3 series using the 3+ any type UTD definition for HIB
P_UTD431H3_ROUT_S	UTD flag for the 4:3:1:3:3 series using the routine (i.e., full series) UTD definition for HIB
PU431331	UTD flag for the 4:3:1:3:3:1 series using the 3+ any type UTD definition for HIB
P_UTD431H31_ROUT_S	UTD flag for the 4:3:1:3:3:1 series using the routine (i.e., full series) UTD definition for HIB
PU4313313	UTD flag for the 4:3:1:3:3:1:3 series using the 3+ any type UTD definition for HIB
P_UTD431H313_ROUT_S	UTD flag for the 4:3:1:3:3:1:3 series using the routine (i.e., full series) UTD definition for HIB
PU4313314	UTD flag for the 4:3:1:3:3:1:4 series using the 3+ any type UTD definition for HIB
P_UTD431H314_ROUT_S	UTD flag for the 4:3:1:3:3:1:4 series using the routine (i.e., full series) UTD definition for HIB

7.8.2 Rotavirus Up-To-Date Variables

The up-to-date status for rotavirus vaccine depends on the manufacturer of the vaccines received; the requirement is two or more doses of Rotarix® (GSK) or three or more doses of rotavirus vaccine of any type. Beginning with the 2009 NIS-Child public-use data file, an up-to-date variable for rotavirus vaccine (**P_UTDROT_S**) was added to indicate up-to-date status, accounting for the manufacturer (3+ rotavirus doses of any type or 2+ Rotarix® doses).

Note that for this rotavirus up-to-date variable, if the manufacturer is unknown because the provider failed to check a type box on the IHQ, it has been assumed that the rotavirus vaccine dose is not Rotarix®; that is, this variable is based on a "strict" treatment of rotavirus vaccinations of unknown type, erring on the side of classifying the child as not up-to-date.

7.8.3 COVID-19 Up-To-Date Variables

Beginning with the 2023 NIS-Child public-use data file, three new up-to-date variables were added to reflect up-to-date status for COVID-19 vaccination, which depends on the manufacturer of the vaccines received and the number of doses. P_UTDCOV1 identifies children who have received at least one COVID-19 dose, P_UTDCOV_FULL identifies children who have received the full COVID-19 primary series recommended for their age group (two or more doses of Moderna or three or more doses of Pfizer-BioNTech), and P_UTDCOV_BOOST identifies children who have completed the primary series *and* received at least one booster dose. Note that while children are recommended to receive an additional booster dose each year containing the latest formulation in order to be fully up-to-date, information about the timing of booster doses and the formulations they contain are not included on the NIS-Child public-use file to protect confidentiality. Researchers interested in accessing more detailed information about the types of COVID-19 boosters received can submit a proposal through the Research Data Center (www.cdc.gov/rdc).

7.9 Section 9: Provider-Reported Age-At-Vaccination Variables

This section contains variables storing the child's age in days and months at each vaccination in the synthesized provider-reported vaccination history, along with the vaccine types of those vaccinations.

For each vaccine category, variables named **D*YYY*1 - D*YYY*9** and ***YYY*_AGE1 - *YYY*_AGE9** store the age in days and months, respectively, of the child when the vaccination was administered for up to nine vaccinations in the child's synthesized provider-reported vaccination history, where "YYY" is the vaccine category abbreviation given in Table 7. For vaccine categories that contain multiple vaccine types, variables **X*YYY*TY1 - X*YYY*TY9** give the corresponding vaccine type code (see Table 7).

Unlike the vaccination count and up-to-date variables in Section 8 of the public-use data file, the variables in Section 9 include vaccinations given both before and after the household interview was completed. If desired, users can limit the Section 9 variables to only those before the household interview date by examining the corresponding Section 8 "**P_NUM**" variable and limiting the analysis of the Section 9 variables to only the first *n* variables, where *n* is equal to the number of vaccinations in the vaccine category before the household interview date as indicated by the corresponding "**P_NUM**" variable.

Users of the public-use data file should be aware that the age-at-vaccination variables included in Section 9 may contain a small number of vaccination ages that are implausible according to the recommended immunization schedules (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent.html). Such ages may arise if a medical provider inadvertently records an erroneous vaccination date or if a vaccination date is incorrectly transcribed onto an IHQ. The quality control procedures of the NIS-Child address implausible ages to every extent possible. Suspicious dates are manually reviewed and corrected if there is evidence either from the household interview or from another provider that the date is incorrect. In rare cases, however, when there is no further information with which to correct the reported vaccination date, the vaccination is treated as having actually occurred and the implausible age at vaccination persists on the data file. The data user should consider these issues in deciding how to analyze the NIS-Child data.

7.10 Section 10: Health Insurance Module Variables

The Health Insurance Module (HIM) (Section E) was introduced in 2006 to gather information on the health insurance coverage of the child. HIM data were included in the NIS-Child public-use data file for the first time in 2007. Prior to 2016, seven variables containing HIM data were included in the NIS-Child public-use data file:

- INS_1 – "Is child covered by health insurance provided through employer or union?";
- INS_2 – "Is child covered by any MEDICAID plan?";
- INS_3 – "Is child covered by S-CHIP?";
- INS_3A – "Is child covered by any MEDICAID plan or S-CHIP?";

- INS_4_5 – “Is the child covered by Indian Health Service, Military Health Care, TRICARE, CHAMPUS, or CHAMP-VA?”;
- INS_6 – “Is child covered by any other health insurance or health care plan?”; and
- INS_11 - “Anytime when child was not covered by health insurance?”

In 2016, these variables were replaced by two health insurance variables, INS_STAT_I and INS_BREAK_I, which summarize the child’s health insurance status and history across all of the insurance questions listed above, while also incorporating the imputation of missing values and recoding of verbatim responses. In 2017, INS_STAT_I was replaced with INS_STAT2_I, which provides a different categorization of children with both private and non-private, non-Medicaid insurance.

INS_STAT2_I identifies the child’s current health insurance coverage status. If the child has a form of private health insurance and is not covered by any other type of health insurance, he/she is classified as (1) Private only. If the child is on any form of Medicaid, alone or in addition to other forms of insurance, he/she is classified as (2) Any Medicaid. If the child is not covered by Medicaid but is covered by some other type of health insurance (including, but not limited to, CHIP, Indian Health Service, Military Health Care, TRICARE, CHAMPUS, or CHAMP-VA), either alone or in combination with private insurance, he/she is classified as (3) Other. If the child is not covered by any kind of health insurance, he/she is classified as (4) Uninsured.

INS_BREAK_I describes the child’s coverage history since birth and indicates whether there have been any breaks in coverage during this period. A child may be (1) currently insured but uninsured at some point since birth, (2) currently insured and never uninsured since birth, (3) currently uninsured but insured at some point since birth, or (4) currently uninsured and never insured since birth.

Both of these variables are only available for children with adequate provider data.

8. Analytic and Reporting Guidelines

Data from the NIS-Child public-use data file can be used to produce national, state, and estimation-area estimates of vaccination coverage for children age 19-35 months surveyed in 2023 using the **PROVWT_C** weight (**PROVWT_C_TERR** if U.S. territories are to be included). As noted in Section 1 of this user's guide, since 2018 vaccination coverage estimates appearing on *ChildVaxView* and in the MMWR are based on a birth-cohort estimation approach. That is, the estimates are derived from the combination of 2 or 3 years of NIS-Child surveys (e.g., 2021-2023), and the estimates apply to the population of children born in particular years (e.g., 2020 or 2021). Therefore, estimates produced using the 2023 public-use file, which are based on 2023 NIS-Child data alone and apply to the population of 19-35 month old children, will differ from those appearing on *ChildVaxView* and in the MMWR.

Information in the data file can also be used to calculate standard errors of the estimated vaccination coverage rates that reflect the complex sample design of the NIS-Child. The file includes estimation area and state identifiers (**ESTIAP23** and **STATE**) as well as a stratum identifier, **STRATUM** and the coded household identifier (**SEQNUMHH**). The sample is stratified by the 59 geographic estimation areas.

Demographic and socioeconomic variables in the file can be used to obtain national vaccination coverage estimates for sub-groups of the population. Data users should, however, be aware that estimates for such sub-groups at the state or estimation area level will generally have large standard errors because of small sample sizes. The CDC standard for precision of sub-group estimates is that relative standard error (the ratio of the standard error to the estimate) should be less than 0.3, and each analytic cell should contain at least 30 respondents (Parker, 2017).

8.1 Use of NIS-Child Sampling Weights

The 2023 NIS-Child public-use data file contains two sets of child-level weights. The **RDDWT_C** variable gives the household-phase weight for all children 19 through 35 months in the United States excluding territories (**RDDWT_C_TERR** if territories are to be included). These weights should be used to form estimates from children with completed household interviews. The weights reflect the stratified sample design and also have been adjusted for unit non-response, for the number of cellular phones in the household, for post-stratification to population control totals, and for the exclusion of households without cellular phones.

The weight variables that apply to children with adequate provider data are **PROVWT_C/PROVWT_C_TERR**. These weights should be used to form estimates of vaccination coverage. Each child with adequate provider data (**PDAT** = 1) has a positive value for **PROVWT_C/PROVWT_C_TERR**. Starting with the 2002 file, the definition of children with adequate provider data was expanded to include unvaccinated children (as discussed in Section 2). Table 10 presents a summary of the appropriate weights and stratum variables to use for various types of analyses.

The 2023 NIS-Child public-use data file does not contain any provider-level weights. The NIS-Child does not sample providers directly; rather, they are included in the survey through the children they vaccinate. A user of the file should not attempt provider-level analyses (e.g., estimate the percentage of providers in the United States that are private providers), because the NIS-Child sample was not designed for that purpose.

Table 10: Summary of Weights and Stratum Variables, National Immunization Survey - Child, 2023

Weight Variable	Population*	Sample Frame	Strata	Stratum Variable
RDDWT_C	United States excluding territories	Single-Frame Cellular Phone	Estimation Area	STRATUM
RDDWT_C_TERR	United States including territories	Single-Frame Cellular Phone	Estimation Area	STRATUM
PROVWT_C	United States excluding territories, children with adequate provider data	Single-Frame Cellular Phone	Estimation Area	STRATUM
PROVWT_C_TERR	United States including territories, children with adequate provider data	Single-Frame Cellular Phone	Estimation Area	STRATUM

* Each weight will contain a missing value for all records that are not included in the population covered by the weight.

8.2 Estimation and Analysis

8.2.1 Estimating Vaccination Coverage Rates

Vaccination coverage rates are ratio estimators, as described in the statistical literature on methods for complex sample surveys. Because of the adjustment to the sampling weights for provider-phase non-response, statistical analyses require only data from children with adequate provider data (**PDAT** = 1), along with their final provider sampling weights (**PROVWT_C/PROVWT_C_TERR**). To summarize the statistical methodology by which vaccination coverage rates and their standard errors are obtained from these data, let Y_{hij} be an indicator, for the jth child with adequate provider data in the ith sampled household in the hth stratum of the NIS-Child sampling design, equal to 1 if the child is up-to-date according to the provider data and 0 otherwise. Also, let W_{hij} denote the value of

PROVWT_C/PROVWT_C_TERR for this child. Then, letting $\hat{Y}_h = \sum_{i=1}^{n_h}\sum_{j=1}^{m_{hi}} W_{hij}Y_{hij}$ and $\hat{T}_h = \sum_{i=1}^{n_h}\sum_{j=1}^{m_{hi}} W_{hij}$,

the national estimator of the vaccination coverage rate may be expressed as

$$\hat{\theta} = \frac{\sum_{h=1}^{L} \hat{Y}_h}{\sum_{h=1}^{L} \hat{T}_h}$$

where L denotes the number of strata, n_h denotes the number of sampled households containing children with adequate provider data in the hth stratum, and m_{hi} denotes the number of age-eligible children with adequate provider data in the ith household in the hth stratum.

Letting L instead denote the number of strata in a state, the above formula can also be used to calculate vaccination coverage rates for states (regardless of whether the state contains only one or more than one stratum).

8.2.2 Estimating Standard Errors of Vaccination Coverage Rates

The Taylor-series method can be used to estimate the sampling variance of vaccination coverage rates for the overall United States, the individual states, and the estimation areas. Letting $Z_{hij} = \dfrac{W_{hij}(Y_{hij} - \hat{\theta})}{\sum_{h=1}^{L} \hat{T}_h}$,

$Z_{hi} = \sum_{j=1}^{m_{hi}} Z_{hij}$, and $\bar{Z}_h = \dfrac{\sum_{i=1}^{n_h} Z_{hi}}{n_h}$ yields an estimator of the variance of the estimated vaccination coverage rate, $\hat{\theta}$, equal to

$$v(\hat{\theta}) = \sum_{h=1}^{L} \frac{n_h}{n_h - 1} \sum_{i=1}^{n_h} (Z_{hi} - \bar{Z}_h)^2$$

(Wolter, 2007). The standard error is the square root of the variance. The estimation of standard errors for estimates of vaccination coverage rates in the NIS-Child can be implemented in specialized statistical software such as SUDAAN (Research Triangle Institute, 2008), SAS (SAS Institute Inc., 2009), R (Lumley, 2022), and Stata (Stata Corporation, 2009). Several examples of the use of SAS, R, and SUDAAN to estimate vaccination coverage rates and their standard errors for estimation areas and states can be found in the accompanying example SUDAAN, SAS, and R analysis programs (available for download at https://www.cdc.gov/nis/php/datasets-child/index.html). For all procedures, the option of with-replacement sampling of primary sampling units within strata is used, because the sampling fractions for households within an estimation area are all quite small. For all estimates, the variable **STRATUM** is used as the stratum variable and the household identifier (**SEQNUMHH**) is used as the primary sampling unit identifier. The data file should be sorted first on **STRATUM** and then on **SEQNUMHH** before running the programs for SUDAAN and SAS.

8.3 Combining Multiple Years of NIS-Child Data

8.3.1 Estimation of Multi-Year Means

With release of the 2023 NIS-Child public-use data file, 28 years of public-use NIS-Child data are now available. The precision of estimates of vaccination coverage for sub-domains (e.g., by race and ethnicity of child) within estimation areas or states can be improved by combining two or more years of NIS-Child data. Data users should, however, be aware that estimates from combined years of NIS-Child data represent an average over two or more years. Although combining several years of NIS-Child data will yield a larger sample size for estimation areas and states, the composition of the population in a geographic area may change over time, making interpretation of the results difficult. Furthermore, if vaccination administration schedules or vaccination coverage changes over time, the estimate of vaccination coverage for the combined time period applies to a hypothetical population that existed at the middle of the time period, making interpretation of the results even more difficult. Given the use of independent RDD samples in the NIS-Child, it is also possible that a child could appear in more than one public-use data file.

To estimate a multi-year mean for a given NIS-Child variable, the weights in each participating file (see Table 5) should be divided by the number of years being combined. For example, if data for 2017-2023 for children in the United States (excluding territories) with adequate provider data are to be combined, then the weights that exclude the territories in the six files – called **PROVWT_D** in 2017 and **PROVWT_C** in 2018-2023 – should be divided by 7 to obtain revised weights, which should be saved as a new variable, say **NEWWT**. It is necessary to use **NEWWT** in the analysis to obtain correct weighted estimates for children aged 19 through 35 months. Furthermore, the child and household ID numbers

(**SEQNUMC** and **SEQNUMHH**) in the files are unique only within a year, not across years. It is important for the user to create revised, unique ID numbers when combining data from multiple years.

The following SAS code can be used:

YRSEQC = 1 * (**YEAR** || **SEQNUMC**);

YRSEQHH = 1 * (**YEAR** || **SEQNUMHH**);

YEAR is the 4-digit year variable for the NIS-Child data year (e.g., 2023).

To produce valid estimates of sampling variability and valid confidence intervals for multi-year coverage rates and other multi-year means, it is necessary to use specialized software such as SAS or SUDAAN.

Beginning in 2005, an important new complication was introduced for variance estimation not encountered in previous NIS-Child years, because some traditional estimation areas were removed and other new areas were defined and introduced to the survey (see Section 2 above for more information about rotating estimation areas). The variance strata for 2004 and all prior years are defined by the variable **ITRUEIAP**, while the variance strata for 2005-2023 are defined by the variables **ESTIAP** for 2005, **ESTIAP06** for 2006, **ESTIAP07** for 2007, **ESTIAP08** for 2008, **ESTIAP09** for 2009, **ESTIAP10** for 2010, **STRATUM_D/ESTIAP11** for 2011, and **STRATUM** for 2012-2023, with **STRATUM_D** and **STRATUM** being a combination of the estimation area variable for that year and the sampling frame (landline or cellular phone). The estimation area variables **ITRUEIAP**, **ESTIAP**, and **ESTIAP06-ESTIAP23** define mutually exclusive and exhaustive geographic areas. However, they are not exactly the same areas. **For example, Dallas County, TX, was a separate estimation area in 2005-2012, 2016-2017, and 2019 but not in 2013-2015, 2018, and 2020-2023. Other areas, such as New York City, NY and rest of New York, are estimation areas in all years, including 2005-2023.**

To make inferences concerning multi-year means, the user must take two actions. First, he/she must define and save a new stratum variable with a common name for all years included in the analysis. Second, he/she must define a common set of estimation domains that can be supported by each of the files included in the multi-year analysis. To take these actions, the user should follow the following seven-step procedure (or its equivalent):

i. Compute and save the new, common variance-stratum variable for each year participating in the analysis. The variable should be defined by the equation

   STRATUMV = **ITRUEIAP**, for children in the 2004 or prior years' public-use data files

   = **ESTIAP**, for children in the 2005 public-use data file

   = **ESTIAP06**, for children in the 2006 public-use data file

   = **ESTIAP07**, for children in the 2007 public-use data file

   = **ESTIAP08**, for children in the 2008 public-use data file

   = **ESTIAP09**, for children in the 2009 public-use data file

   = **ESTIAP10**, for children in the 2010 public-use data file

   = STRATUM_D if using **PROVWT_D** or

   ESTIAP11 if using **PROVWT_LL**, for children in the 2011 public-use data file

   = STRATUM, for children in the 2012-2023 public-use data files

ii. Compute and save the new, common weight variable, **NEWWT**, as instructed above for each year participating in the analysis.

iii. Compute and save the new, unique child and household identification numbers, **YRSEQC** and **YRSEQHH**, as instructed above for each year participating in the analysis.

iv. Compute and save a variable defining the common estimation domains to be studied for each year participating in the analysis. For example, one could use the CDIAP (Common Denominator Estimation Area) variable set forth in Table 11 or states as geographic domains.

v. Merge the multiple files into one consolidated file in a format compatible with the specialized software to be used.

vi. Sort the consolidated file by **YEAR**, **STRATUMV**, and **YRSEQHH**.

vii. Run the specialized software on the consolidated file, computing estimates, variance estimates, and confidence intervals. For SUDAAN users, sampling levels or stages may be specified by the statement

```
NEST YEAR STRATUMV YRSEQHH / PSULEV = 3;
```

the specification of weights by

```
WEIGHT NEWWT;
```

and the specification of estimation domains, for example, by the two statements

```
CLASS YEAR CDIAP STATE;
TABLES CDIAP;
```

or

```
CLASS YEAR CDIAP STATE;
TABLES STATE;
```

8.3.2 Estimation of Multi-Year Contrasts

Considerations similar to those for multi-year means arise in the estimation of contrasts between NIS-Child years. For example, a typical contrast of interest would be the difference between the immunization coverage parameters in 2022 and in 2023.

To make inferences concerning a multi-year contrast, the user will need to work with the original weights reported on the files and store them in a common variable. One must not divide the original weights by the number of years included in the contrast. For example, one may define the new, common weight variable as

NEWWT2	=	**PROVWT_D/PROVWT_LL**	, if the child is in the 2011 PUF
	=	**PROVWT_D**	, if the child is in the 2012-2017 PUF
	=	**PROVWT_C**	, if the child is in the 2018-2023 PUF.

The user should follow the seven-step procedure set forth in the section on multi-year means, using **NEWWT2** in lieu of **NEWWT**. In SUDAAN, the user should also specify the contrast of interest through use of a CONTRAST statement or an appropriate regression model. For example, to compare the 4:3:1:3:3:1 up-to-date estimate from 2022 to the 2023 estimate, SUDAAN users can use the following WEIGHT, VAR, and CONTRAST statements:

```
WEIGHT NEWWT2;
VAR PU431331;
CONTRAST YEAR = (-1 1);
```

Table 11: Cross-Walk between Annual Estimation Area Variables (ITRUEIAP, ESTIAP, ESTIAP06-ESTIAP23)* and Common Denominator Estimation Area (CDIAP†), National Immunization Survey - Child, 2023

CDIAP	Area Name	ITRUEIAP (1995-2004)	ESTIAP (2005)	ESTIAP06 (2006)	ESTIAP07 (2007)	ESTIAP08 (2008)	ESTIAP09 (2009)	ESTIAP10 (2010)	ESTIAP11 (2011)	ESTIAP12 (2012)	ESTIAP13 (2013)	ESTIAP14 (2014)	ESTIAP15 (2015)
	Alabama												
20	AL-Jefferson County	21	21	20	20	20	20	20	20	20	20	20	20
20	AL-Rest of State	20	20	20	20	20	20	20	20	20	20	20	20
74	Alaska	74	74	74	74	74	74	74	74	74	74	74	74
	Arizona												
66	AZ-Maricopa County	67	67	67	66	66	66	66	66	66	66	66	66
66	AZ-Rest of State	66	66	66	66	66	66	66	66	66	66	66	66
46	Arkansas	46	46	46	46	46	46	46	46	46	46	46	46
	California												
68	CA-Fresno County	68	68	84	68	68	68	68	68	68	68	68	68
68	CA-Los Angeles County	69	69	69	69	69	69	69	68	68	68	68	68
68	CA-Northern CA	68	68	85	68	85	68	68	68	68	68	68	68
68	CA-San Diego County	71	68	71	68	68	68	68	68	68	68	68	68
68	CA-Santa Clara County	70	68	70	68	70	68	68	68	68	68	68	68
68	CA-San Bernardino County	68	80	68	80	68	68	68	68	68	68	68	68
68	CA-Alameda County	68	79	68	79	68	68	68	68	68	68	68	68
68	CA-Rest of State	68	68	68	68	68	68	68	68	68	68	68	68
	Colorado												
60	CO-Denver	60	81	60	60	60	60	60	60	60	60	60	60
60	CO-Rest of State	60	60	60	60	60	60	60	60	60	60	60	60
1	Connecticut	1	1	1	1	1	1	1	1	1	1	1	1
13	Delaware	13	13	13	13	13	13	13	13	13	13	13	13
12	District of Columbia	12	12	12	12	12	12	12	12	12	12	12	12
	Florida												
22	FL-Miami-Dade County	24	22	24	24	24	22	22	22	22	22	22	22
22	FL-Duval County	23	23	23	22	22	22	22	22	22	22	22	22
22	FL-Orange County	22	22	22	22	91	22	22	22	22	22	22	22
22	FL-Rest of State	22	22	22	22	22	22	22	22	22	22	22	22
	Georgia												
25	GA-Fulton/DeKalb Counties	26	26	26	25	25	25	25	25	25	25	25	25
25	GA-Rest of State	25	25	25	25	25	25	25	25	25	25	25	25
72	Hawaii	72	72	72	72	72	72	72	72	72	72	72	72
75	Idaho	75	75	75	75	75	75	75	75	75	75	75	75
	Illinois												
35	IL-City of Chicago	35	35	35	35	35	35	35	35	35	35	35	35

CDIAP	Area Name	ITRUEIAP (1995-2004)	ESTIAP (2005)	ESTIAP06 (2006)	ESTIAP07 (2007)	ESTIAP08 (2008)	ESTIAP09 (2009)	ESTIAP10 (2010)	ESTIAP11 (2011)	ESTIAP12 (2012)	ESTIAP13 (2013)	ESTIAP14 (2014)	ESTIAP15 (2015)
34	IL-Madison and St. Clair Counties	34	34	34	34	92	34	34	34	34	34	34	34
34	IL-Rest of State	34	34	34	34	34	34	34	34	34	34	34	34
	Indiana												
36	IN-Lake County	36	36	36	36	36	96	36	36	36	36	36	36
36	IN-Marion County	37	36	37	37	36	37	36	36	36	36	36	36
36	IN-Rest of State	36	36	36	36	36	36	36	36	36	36	36	36
56	Iowa	56	56	56	56	56	56	56	56	56	56	56	56
	Kansas												
57	KS-Eastern KS	57	57	86	57	57	57	57	57	57	57	57	57
57	KS-Rest of State	57	57	57	57	57	57	57	57	57	57	57	57
27	Kentucky	27	27	27	27	27	27	27	27	27	27	27	27
	Louisiana												
47	LA-Orleans Parish	48	47	47	47	47	47	47	47	47	47	47	47
47	LA-Rest of State	47	47	47	47	47	47	47	47	47	47	47	47
4	Maine	4	4	4	4	4	4	4	4	4	4	4	4
	Maryland												
14	MD-City of Baltimore	15	15	15	14	15	15	14	14	14	14	14	14
14	MD-Prince George’s County	14	14	14	14	14	14	14	103	14	14	14	14
14	MD-Rest of State	14	14	14	14	14	14	14	14	14	14	14	14
	Massachusetts												
2	MA-City of Boston	3	2	3	2	2	2	2	2	2	2	2	2
2	MA-Rest of State	2	2	2	2	2	2	2	2	2	2	2	2
	Michigan												
38	MI-City of Detroit	39	39	39	38	38	38	38	38	38	38	38	38
38	MI-Rest of State	38	38	38	38	38	38	38	38	38	38	38	38
	Minnesota												
40	MN-Twin Cities	40	40	40	40	93	40	40	40	40	40	40	40
40	MN-Rest of State	40	40	40	40	40	40	40	40	40	40	40	40
28	Mississippi	28	28	28	28	28	28	28	28	28	28	28	28
	Missouri												
58	MO-St. Louis County/City	58	82	58	58	58	58	58	58	58	58	58	58
58	MO-Rest of State	58	58	58	58	58	58	58	58	58	58	58	58
61	Montana	61	61	61	61	61	61	61	61	61	61	61	61
59	Nebraska	59	59	59	59	59	59	59	59	59	59	59	59
	Nevada												
73	NV-Clark County	73	83	73	73	73	73	73	73	73	73	73	73
73	NV-Rest of State	73	73	73	73	73	73	73	73	73	73	73	73
5	New Hampshire	5	5	5	5	5	5	5	5	5	5	5	5

CDIAP	Area Name	ITRUEIAP (1995-2004)	ESTIAP (2005)	ESTIAP06 (2006)	ESTIAP07 (2007)	ESTIAP08 (2008)	ESTIAP09 (2009)	ESTIAP10 (2010)	ESTIAP11 (2011)	ESTIAP12 (2012)	ESTIAP13 (2013)	ESTIAP14 (2014)	ESTIAP15 (2015)
	New Jersey												
8	NJ-City of Newark	9	9	9	8	8	8	8	8	8	8	8	8
8	NJ-Rest of State	8	8	8	8	8	8	8	8	8	8	8	8
	New Mexico												
49	NM-Southern NM	49	49	88	49	49	49	49	49	49	49	49	49
49	NM-Rest of State	49	49	49	49	49	49	49	49	49	49	49	49
	New York												
11	NY-City of New York	11	11	11	11	11	11	11	11	11	11	11	11
10	NY-Rest of State	10	10	10	10	10	10	10	10	10	10	10	10
29	North Carolina	29	29	29	29	29	29	29	29	29	29	29	29
62	North Dakota	62	62	62	62	62	62	62	62	62	62	62	62
	Ohio												
41	OH-Cuyahoga County	42	42	42	41	41	41	41	41	41	41	41	41
41	OH-Franklin County	43	43	41	41	41	41	41	41	41	41	41	41
41	OH-Rest of State	41	41	41	41	41	41	41	41	41	41	41	41
50	Oklahoma	50	50	50	50	50	50	50	50	50	50	50	50
76	Oregon	76	76	76	76	76	76	76	76	76	76	76	76
	Pennsylvania												
16	PA-Allegheny County	16	16	87	16	16	16	16	16	16	16	16	16
17	PA-Philadelphia County	17	17	17	17	17	17	17	17	17	17	17	17
16	PA-Rest of State	16	16	16	16	16	16	16	16	16	16	16	16
6	Rhode Island	6	6	6	6	6	6	6	6	6	6	6	6
30	South Carolina	30	30	30	30	30	30	30	30	30	30	30	30
63	South Dakota	63	63	63	63	63	63	63	63	63	63	63	63
	Tennessee												
31	TN-Davidson County	33	33	31	31	31	31	31	31	31	31	31	31
31	TN-Shelby County	32	32	32	31	31	31	31	31	31	31	31	31
31	TN-Rest of State	31	31	31	31	31	31	31	31	31	31	31	31
	Texas												
55	TX-Bexar County	55	55	55	55	55	55	55	55	55	55	55	55
54	TX-City of Houston	54	54	54	54	54	54	54	54	54	54	54	54
51	TX-Dallas County	52	52	52	52	52	52	52	52	52	51	51	51
51	TX-El Paso County	53	53	53	53	53	53	53	53	53	53	53	53
51	TX-Hidalgo County	51	51	51	51	51	51	51	51	51	51	51	107
51	TX-Travis County	51	51	51	51	51	51	51	51	51	51	51	51
51	TX-Tarrant County	51	51	51	51	51	51	51	51	51	51	51	109
51	TX-Rest of State	51	51	51	51	51	51	51	51	51	51	51	51
64	Utah	64	64	64	64	64	64	64	64	64	64	64	64
7	Vermont	7	7	7	7	7	7	7	7	7	7	7	7
18	Virginia	18	18	18	18	18	18	18	18	18	18	18	18

CDIAP	Area Name	ITRUEIAP (1995-2004)	ESTIAP (2005)	ESTIAP06 (2006)	ESTIAP07 (2007)	ESTIAP08 (2008)	ESTIAP09 (2009)	ESTIAP10 (2010)	ESTIAP11 (2011)	ESTIAP12 (2012)	ESTIAP13 (2013)	ESTIAP14 (2014)	ESTIAP15 (2015)
	Washington§												
77	WA-Eastern WA	77	77	771	77	774	774	97	77	77	77	77	77
77	WA-Western WA	77	77	77	773	774	774	102	77	77	77	77	77
77	WA-King County	78	78	78	77	77	77	102	77	77	77	77	77
77	WA-Rest of State	77	77	772	77	77	77	-	77	77	77	77	77
19	West Virginia	19	19	19	19	19	19	19	19	19	19	19	19
	Wisconsin												
44	WI-Milwaukee County	45	45	45	44	44	44	44	44	44	44	44	44
44	WI-Rest of State	44	44	44	44	44	44	44	44	44	44	44	44
65	Wyoming	65	65	65	65	65	65	65	65	65	65	65	65
-	Puerto Rico	-	-	-	-	-	-	-	-	-	-	106	106

* ESTIAP is defined as "estimation Immunization Action Plan (IAP) area of residence"; ESTIAPxx is defined as "estimation Immunization Action Plan (IAP) area of residence" for the years 2006-2023; ITRUEIAP is defined as "Immunization Action Plan (IAP) area of current residence".

† This table can be used to derive a Common Denominator Estimation Area (CDIAP) variable for use in multi-year NIS-Child analyses. This is necessary because certain areas may be included as separate estimation areas in one year but subsumed within other estimation areas in another year. The CDIAP variable can be derived for each year by mapping the codes in the year-specific estimation area variable column (e.g., ITRUEIAP for the 1995 NIS-Child) to the corresponding codes in the CDIAP column.

§ The estimation area WA-Eastern WA was introduced in 2006, and while this estimation area also existed in 2010, the county definition of the area changed, making cross-year comparisons inadvisable. The estimation area WA-Western WA, introduced in 2007, presents the same issue. The counties included in the area changed (e.g., in 2010 it included King County). Analysis of Washington state data across years should use the entire state as the "Common Denominator".

Table 11 (continued): Cross-Walk between Annual Estimation Area Variables (ITRUEIAP, ESTIAP, ESTIAP06-ESTIAP23)* and Common Denominator Estimation Area (CDIAP†), National Immunization Survey - Child, 2023

CDIAP	Area Name	ESTIAP16 (2016)	ESTIAP17 (2017)	ESTIAP18 (2018)	ESTIAP19 (2019)	ESTIAP20 (2020)	ESTIAP21 (2021)	ESTIAP22 (2022)	ESTIAP23 (2023)
	Alabama								
20	AL-Jefferson County	20	20	20	20	20	20	20	20
20	AL-Rest of State	20	20	20	20	20	20	20	20
74	Alaska	74	74	74	74	74	74	74	74
	Arizona								
66	AZ-Maricopa County	66	66	66	66	66	66	66	66
66	AZ-Rest of State	66	66	66	66	66	66	66	66
46	Arkansas	46	46	46	46	46	46	46	46
	California								
68	CA-Fresno County	68	68	68	68	68	68	68	68
68	CA-Los Angeles County	68	68	68	68	68	68	68	68
68	CA-Northern CA	68	68	68	68	68	68	68	68
68	CA-San Diego County	68	68	68	68	68	68	68	68
68	CA-Santa Clara County	68	68	68	68	68	68	68	68
68	CA-San Bernardino County	68	68	68	68	68	68	68	68
68	CA-Alameda County	68	68	68	68	68	68	68	68
68	CA-Rest of State	68	68	68	68	68	68	68	68
	Colorado								
60	CO-Denver	60	60	60	60	60	60	60	60
60	CO-Rest of State	60	60	60	60	60	60	60	60
1	Connecticut	1	1	1	1	1	1	1	1
13	Delaware	13	13	13	13	13	13	13	13
12	District of Columbia	12	12	12	12	12	12	12	12
	Florida								
22	FL-Miami-Dade County	22	22	22	22	22	22	22	22
22	FL-Duval County	22	22	22	22	22	22	22	22
22	FL-Orange County	22	22	22	22	22	22	22	22
22	FL-Rest of State	22	22	22	22	22	22	22	22
	Georgia								
25	GA-Fulton/DeKalb Counties	25	25	25	25	25	25	25	25
25	GA-Rest of State	25	25	25	25	25	25	25	25
72	Hawaii	72	72	72	72	72	72	72	72
75	Idaho	75	75	75	75	75	75	75	75
	Illinois								

CDIAP	Area Name	ESTIAP16 (2016)	ESTIAP17 (2017)	ESTIAP18 (2018)	ESTIAP19 (2019)	ESTIAP20 (2020)	ESTIAP21 (2021)	ESTIAP22 (2022)	ESTIAP23 (2023)
35	IL-City of Chicago	35	35	35	35	35	35	35	35
34	IL-Madison and St. Clair Counties	34	34	34	34	34	34	34	34
34	IL-Rest of State	34	34	34	34	34	34	34	34
	Indiana								
36	IN-Lake County	36	36	36	36	36	36	36	36
36	IN-Marion County	36	36	36	36	36	36	36	36
36	IN-Rest of State	36	36	36	36	36	36	36	36
56	Iowa	56	56	56	56	56	56	56	56
	Kansas								
57	KS-Eastern KS	57	57	57	57	57	57	57	57
57	KS-Rest of State	57	57	57	57	57	57	57	57
27	Kentucky	27	27	27	27	27	27	27	27
	Louisiana								
47	LA-Orleans Parish	47	47	47	47	47	47	47	47
47	LA-Rest of State	47	47	47	47	47	47	47	47
4	Maine	4	4	4	4	4	4	4	4
	Maryland								
14	MD-City of Baltimore	14	14	14	14	14	14	14	14
14	MD-Prince George’s County	14	14	14	14	14	14	14	14
14	MD-Rest of State	14	14	14	14	14	14	14	14
	Massachusetts								
2	MA-City of Boston	2	2	2	2	2	2	2	2
2	MA-Rest of State	2	2	2	2	2	2	2	2
	Michigan								
38	MI-City of Detroit	38	38	38	38	38	38	38	38
38	MI-Rest of State	38	38	38	38	38	38	38	38
	Minnesota								
40	MN-Twin Cities	40	40	40	40	40	40	40	40
40	MN-Rest of State	40	40	40	40	40	40	40	40
28	Mississippi	28	28	28	28	28	28	28	28
	Missouri								
58	MO-St. Louis County/City	58	58	58	58	58	58	58	58
58	MO-Rest of State	58	58	58	58	58	58	58	58
61	Montana	61	61	61	61	61	61	61	61
59	Nebraska	59	59	59	59	59	59	59	59
	Nevada								

CDIAP	Area Name	ESTIAP16 (2016)	ESTIAP17 (2017)	ESTIAP18 (2018)	ESTIAP19 (2019)	ESTIAP20 (2020)	ESTIAP21 (2021)	ESTIAP22 (2022)	ESTIAP23 (2023)
73	NV-Clark County	73	73	73	73	73	73	73	73
73	NV-Rest of State	73	73	73	73	73	73	73	73
5	New Hampshire	5	5	5	5	5	5	5	5
	New Jersey								
8	NJ-City of Newark	8	8	8	8	8	8	8	8
8	NJ-Rest of State	8	8	8	8	8	8	8	8
	New Mexico								
49	NM-Southern NM	49	49	49	49	49	49	49	49
49	NM-Rest of State	49	49	49	49	49	49	49	49
	New York								
11	NY-City of New York	11	11	11	11	11	11	11	11
10	NY-Rest of State	10	10	10	10	10	10	10	10
29	North Carolina	29	29	29	29	29	29	29	29
62	North Dakota	62	62	62	62	62	62	62	62
	Ohio								
41	OH-Cuyahoga County	41	41	41	41	41	41	41	41
41	OH-Franklin County	41	41	41	41	41	41	41	41
41	OH-Rest of State	41	41	41	41	41	41	41	41
50	Oklahoma	50	50	50	50	50	50	50	50
76	Oregon	76	76	76	76	76	76	76	76
	Pennsylvania								
16	PA-Allegheny County	16	16	16	16	16	16	16	16
17	PA-Philadelphia County	17	17	17	17	17	17	17	17
16	PA-Rest of State	16	16	16	16	16	16	16	16
6	Rhode Island	6	6	6	6	6	6	6	6
30	South Carolina	30	30	30	30	30	30	30	30
63	South Dakota	63	63	63	63	63	63	63	63
	Tennessee								
31	TN-Davidson County	31	31	31	31	31	31	31	31
31	TN-Shelby County	31	31	31	31	31	31	31	31
31	TN-Rest of State	31	31	31	31	31	31	31	31
	Texas								
55	TX-Bexar County	55	55	55	55	55	55	55	55
54	TX-City of Houston	54	54	54	54	54	54	54	54
51	TX-Dallas County	52	52	51	52	51	51	51	51
51	TX-El Paso County	53	53	51	53	51	51	51	51
51	TX-Hidalgo County	51	51	107	51	51	51	51	51
51	TX-Travis County	51	108	51	51	51	51	51	51
51	TX-Tarrant County	51	51	109	51	51	51	51	51

CDIAP	Area Name	ESTIAP16 (2016)	ESTIAP17 (2017)	ESTIAP18 (2018)	ESTIAP19 (2019)	ESTIAP20 (2020)	ESTIAP21 (2021)	ESTIAP22 (2022)	ESTIAP23 (2023)
51	TX-Rest of State	51	51	51	51	51	51	51	51
64	Utah	64	64	64	64	64	64	64	64
7	Vermont	7	7	7	7	7	7	7	7
18	Virginia	18	18	18	18	18	18	18	18
	Washington§								
77	WA-Eastern WA	77	77	77	77	77	77	77	77
77	WA-Western WA	77	77	77	77	77	77	77	77
77	WA-King County	77	77	77	77	77	77	77	77
77	WA-Rest of State	77	77	77	77	77	77	77	77
19	West Virginia	19	19	19	19	19	19	19	19
	Wisconsin								
44	WI-Milwaukee County	44	44	44	44	44	44	44	44
44	WI-Rest of State	44	44	44	44	44	44	44	44
65	Wyoming	65	65	65	65	65	65	65	65
-	Puerto Rico	106	-	-	106	106	106	106	106

* ESTIAP is defined as "estimation Immunization Action Plan (IAP) area of residence"; ESTIAPxx is defined as "estimation Immunization Action Plan (IAP) area of residence" for the years 2006-2023; ITRUEIAP is defined as "Immunization Action Plan (IAP) area of current residence".

† This table can be used to derive a Common Denominator Estimation Area (CDIAP) variable for use in multi-year NIS-Child analyses. This is necessary because certain areas may be included as separate estimation areas in one year but subsumed within other estimation areas in another year. The CDIAP variable can be derived for each year by mapping the codes in the year-specific estimation area variable column (e.g., ITRUEIAP for the 1995 NIS-Child) to the corresponding codes in the CDIAP column.

§ The estimation area WA-Eastern WA was introduced in 2006, and while this estimation area also existed in 2010, the county definition of the area changed, making cross-year comparisons inadvisable. The estimation area WA-Western WA, introduced in 2007, presents the same issue. The counties included in the area changed (e.g., in 2010 it included King County). Analysis of Washington state data across years should use the entire state as the "Common Denominator".

9. Summary Tables

Appendix D contains seven tables. Appendix Table D.1 lists the 59 estimation areas for the 2023 NIS-Child. At the national level and for each state and estimation area, it provides the estimated population total of children aged 19 through 35 months of age in 2023, and (from 2023 NIS-Child data collection) the number of children with completed household interviews and number of children with adequate provider data.

Appendix Tables D.2 through D.6 summarize pairs of variables: age group of child by maternal education (Appendix Table D.2), age group by family poverty status (Appendix Table D.3), race and ethnicity by family poverty status (Appendix Table D.4), age group by race and ethnicity (Appendix Table D.5), and age group by sex (Appendix Table D.6). Each of these tables gives the unweighted and weighted counts of children who have completed household interviews and the unweighted and weighted counts of children with adequate provider data.

Appendix Table D.7 presents estimates of vaccination coverage and symmetric 95% confidence intervals obtained from SUDAAN. The data user should obtain the same estimates from the 2023 NIS-Child public-use data file. (As noted in Section 1 of this report, these estimates will differ from those appearing on *ChildVaxView* and in the MMWR, which use multiple years of NIS-Child data and apply to the population of children born in particular years rather than using a single year of NIS-Child data and applying to the population of children age 19 through 35 months.)

Appendix E contains four tables and time-series charts. Table E.1 and Figure E.1 show key components of the NIS-Child response rates and the CASRO response rates for the landline sample by year of the survey. Table E.2 and Figure E.2 show key components of the NIS-Child response rates and the CASRO response rates for the cellular phone sample by year of the survey. Table E.3 and Figure E.3 show the CASRO response rates for the combined landline and cellular phone samples. Table E.4 and Figure E.4 show vaccination coverage estimates since 1995.

Appendix F shows the vaccine type codes used in the 2023 NIS-Child public-use data file.

Appendix G presents key response rate components and the overall CASRO response rate by estimation area in the 2023 NIS-Child.

10. Assessment of Total Survey Error

Assessing the validity of the NIS-Child estimates of vaccination coverage is a critical and ongoing aspect of the NIS-Child surveillance program. CDC frequently conducts evaluation studies and controlled experiments to understand the causes and impacts of sampling and nonsampling errors on the estimates and to enable formulation of methodological refinements that have the demonstrated capacity to improve data quality. As landline phone use decreased and cellular phone use increased dramatically over the past decade, and the NIS-Child transitioned first from a single-frame landline RDD sampling design to a dual-frame landline and cellular phone RDD design and then to a single-frame cellular phone RDD design, CDC has monitored the NIS-Child estimates utilizing a Total Survey Error (TSE) approach.

TSE is the sum of the errors that arise at every step of a survey, including both sampling error and nonsampling errors such as coverage, nonresponse, and measurement errors (Mulry and Spencer, 1991). Pooling information from multiple evaluations of their precision and accuracy, we have conducted TSE analyses for the 2009-2013 NIS-Child and NIS-Teen data (Molinari et al. 2011; NORC 2011; Pineau et al. 2012; Pineau et al. 2013; Skalland et al. 2016; Wolter et al. 2017b) and for the 2018-2022 NIS-Child and NIS-Teen data (see the Data User's Guides for the 2018-2022 NIS-Child and NIS-Teen public use data files). Data User's Guides from 2015 to present are located at: https://www.cdc.gov/vaccines/imz-managers/nis/datasets.html.

An assessment based on 2023 NIS-Child data was conducted in 2024 (CDC, 2024), with results summarized in this report. The full report is available at: https://www.cdc.gov/childvaxview/media/pdfs/2024/09/Error-Profile-2023-NIS-Child.pdf.

10.1 Comparisons of NIS-Child Data to External Sources

Comparison of Demographic Distributions. Demographic distributions (age, sex, mother's race and ethnicity, mother's education, mother's age) among children with adequate provider data were compared to benchmark values derived from natality data supplied by the National Vital Statistics System (NCHS

2020, 2021). **When using design weights that have not been adjusted for nonresponse or calibrated to external population totals, demographic distributions as estimated in the NIS-Child were generally close to the benchmark distributions. Nonetheless, before calibration of the weights to external population totals, the 2023 NIS-Child somewhat over-represented children whose mothers are college graduates, non-Hispanic White, or age 30 or greater. The survey somewhat under-represented children whose mothers are not college graduates, are Hispanic or non-Hispanic Black, or are age 20 to 29 years. When using the final weights that have been adjusted for nonresponse and calibrated to external population totals, the differences between survey and population proportions are reduced, but the 2023 NIS-Child still overrepresented children whose mothers are four-year college graduates (40.7% in survey, 34.9% in population) or are age 30 or greater (68.3% in survey, 63.5% in population).**

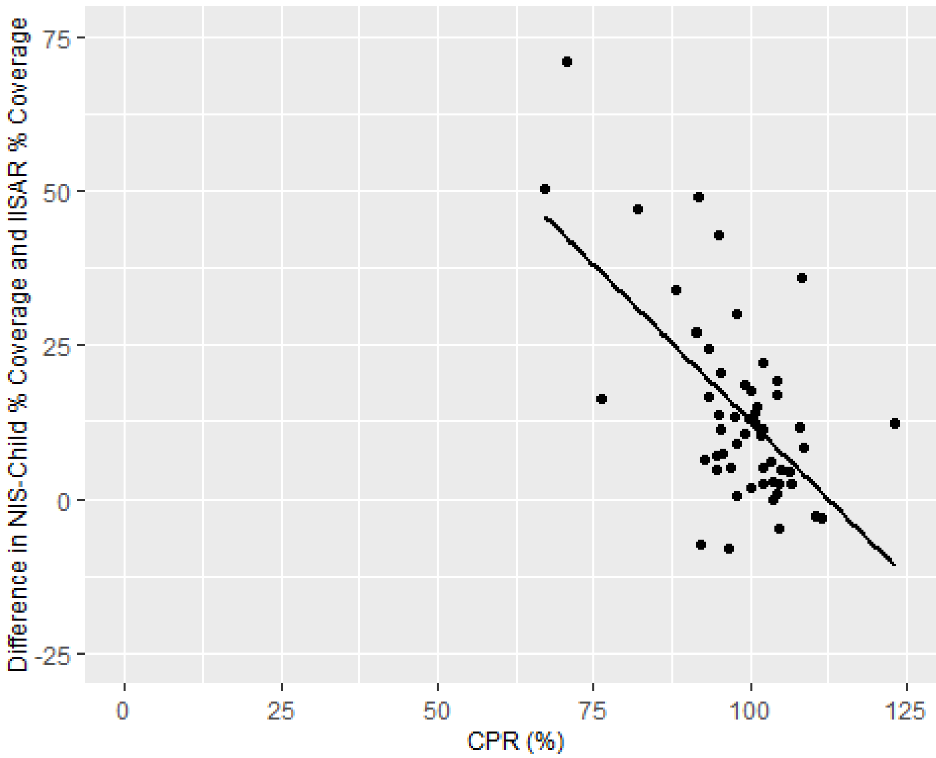
Comparison to IISAR Vaccination Coverage Rates. NIS-Child vaccination coverage rate estimates were compared to vaccination coverage rates reported in the Immunization Information Systems Annual Report (IISAR). Sponsored and conducted by NCIRD, the IISAR is an annual assessment of Immunization Information Systems (IIS)[2] activity among the 64 immunization program awardees, which include the 50 states, 6 cities (Chicago, District of Columbia, Houston, New York City, Philadelphia, and San Antonio), and 8 U.S. territories. To evaluate each awardee's performance, the immunization program manager in the awardee area is asked to complete a self-administered, web-based questionnaire asking for demographic and immunization information, public and private provider site participation levels, and information about achievement of IIS functional standards. Information about the IISAR can be found at: https://www.cdc.gov/iis/annual-report-iisar/index.html.

[2] State IISs are computer databases that attempt to compile information about all of the doses of all vaccines administered to all children resident within the state. State IISs vary in their completeness of both children and the doses they received.

Vaccination coverage rate estimates for the 2022 NIS-Child were compared to those from the 2022 IISAR. The 2022 IISAR was the most recent available, and so the 2022 comparison served as the most current information available about the relative accuracy of the 2023 NIS-Child. There was variation in the level of agreement between NIS-Child vaccination coverage rate estimates and IISAR vaccination coverage rates, including some areas where the NIS-Child estimate was greater and some where the IISAR estimate was greater. However, the child participation rate – the proportion of children in the IIS jurisdiction with two or more vaccine doses in the IIS database[3] – was determined to be a reasonable indicator of the quality of the corresponding IIS database, because the IIS vaccination coverage rate was found to increase as the child participation rate increased. It was also observed (Figure 1) that the difference between NIS-Child and IISAR vaccination coverage rates for the combined 7-vaccine series declines as the child participation rate increases (i.e., as the quality of the IIS increases). These findings are consistent with the view that IIS vaccination coverage rates converge towards NIS-Child vaccination coverage rates as the quality of the IIS increases.

[3] When setting the denominator for the participation rate calculation, some IIS use an external estimate of the number of children living in the jurisdiction rather than a count of children in the IIS itself; this results in some IIS reporting a participation rate of over 100 percent.

Figure 1: Scatter Plot of Percentage Point Difference between 2022 NIS-Child and Immunization Information Systems Annual Report (IISAR) Vaccination Coverage Rates for the Combined 7-Vaccine Series vs. Immunization Information Systems (IIS) Child Participation Rate (CPR) with Regression Line: 56 Estimation Areas



Note for Figure 1: A positive difference indicates the NIS-Child vaccination coverage rate estimate was higher than the corresponding IISAR estimate, and a negative difference indicates the NIS-Child vaccination coverage rate estimate was lower than the corresponding IISAR estimate.

Comparison of Health Insurance Distributions. NIS-Child health insurance distributions were compared to similar distributions produced by the Current Population Survey Annual Social and Economic Supplements (CPS ASEC)[4], the National Health Interview Survey (NHIS)[5], and the American Community Survey (ACS)[6]. All of these surveys use somewhat different definitions of insurance status and report for different age ranges of children. **Nevertheless, we found the NIS-Child distributions to be broadly similar to those from the CPS, NHIS, and ACS, but with some differences. NIS-Child**

[4] https://www.census.gov/data/datasets/time-series/demo/cps/cps-asec.html
[5] https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm
[6] https://www.census.gov/programs-surveys/acs/microdata.html

estimates of percent of children with any public insurance (56.1% in 2022; 57.7% in 2023) were higher than the corresponding benchmark estimates (51.0% (NHIS), 42.7% (CPS ASEC), and 45.9% (ACS) in 2022; 40.6% (CPS ASEC), and 45.4% (NHIS) in 2023), and the NIS-Child estimates of uninsured children (1.9% in 2022; 3.0% in 2023) were lower than the estimates from the benchmark surveys (4.3% (NHIS), 4.7% (CPS ASEC), and 3.9% (ACS) in 2022; 4.4% (CPS ASEC), and 3.2% (NHIS) in 2023).

Comparison to State Immunization Surveys. **A comparison was undertaken of NIS-Child vaccination coverage rate estimates to estimates from all available state immunization surveys and IIS that have produced 2023 vaccination coverage estimates for resident children in the NIS-Child age range. These included one state immunization survey (the Tennessee Immunization Survey (TIS)[7]) and five state Immunization Information Systems: the Iowa Immunization Registry Information System (IRIS)[8], Michigan Care Improvement Registry (MCIR)[9], Oregon's Immunization Information System (ALERT IIS)[10], Washington State Immunization Information System (WAIIS)[11], and Wisconsin Immunization Registry (WIR)[12]. There is reasonable agreement between NIS-Child and state vaccination rates in Oregon and in Tennessee, except for the Hib full-series and the combined 7-vaccine series estimates in Tennessee, where NIS-Child estimates were lower than those based on the TIS. NIS-Child vaccination coverage estimates tend be higher than IIS estimates from the other four state IIS.**

7 https://www.tn.gov/content/dam/tn/health/2023_Immunization_Status_Survey_of_24-Month-Old_Children.pdf
8 https://hhs.iowa.gov/public-health/data/health/immunization/child-immunizations-data
9 https://www.michigan.gov/mdhhs/adult-child-serv/childrenfamilies/immunization/localhealthdepartment/county-immunization-report-card
10 https://public.tableau.com/app/profile/oregon.immunization.program/viz/OregonChildImmunizations/D-Landing
11 https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/immunization-data/county-public-health-measures-dashboard
12 https://www.dhs.wisconsin.gov/publications/p02003a.pdf

10.2 Assessment of Total Survey Error for NIS-Child Vaccination Coverage Estimates

Next, an assessment of all sources of error in the 2023 NIS-Child was conducted, including sample-frame coverage error, nonresponse error, and measurement error; the component errors were then combined to assess TSE. The change in total survey error between the 2022 NIS-Child and 2023 NIS-Child was also estimated.

Coverage Error. The NIS-Child cellular phone RDD sampling frame fails to cover the landline only and phoneless households; vaccination coverage rates in the former were estimated using data collected in the 2017 NIS-Child (the last year a dual-frame landline and cellular phone sample was fielded for the NIS) and vaccination coverage rates in the latter were estimated using data collected in the 2012 NHIS Provider Record Check. The vaccination coverage rates in the population covered by the sampling-frame were found to be higher than the vaccination rates in the uncovered population. **Because the sampling-frame uncovered population is so small relative to the covered population, however, mean sampling-frame coverage error was estimated to be very minor, at 0.3 percentage points or less for all vaccines/series examined.**

Nonresponse Error. **Nonresponse error in the 2023 NIS-Child was assessed through comparison to the cellular phone domain within the combined 2022 and 2023 NHIS.** NHIS does not offer direct estimates of vaccination coverage rates. Instead, a model-based technique was used to impute NHIS vaccination status, and then the resulting NHIS vaccination coverage rates (treated as vaccination coverage rates void of nonresponse error) were compared to NIS-Child vaccination coverage rates, with the difference treated as nonresponse error in the NIS-Child. **Despite nonresponse in the 2023 NIS-Child, including household nonresponse, non-consent to contact vaccination providers, and provider nonresponse, mean nonresponse error in vaccination rates was estimated to be modest (2.8 percentage points in magnitude for Hep B birth dose and 0.5 percentage points or less for the other three vaccine series) and not statistically significant for any of the vaccine series examined.**

Measurement Error. A form of measurement error called "provider under-reporting" error was assessed. Sometimes called "under-ascertainment," provider under-reporting error arises when a child with adequate provider data is truly vaccinated but is reported as unvaccinated for one or more recommended doses in the child's provider-reported vaccination history. Under-reporting error can occur if the household respondent fails to nominate all of the child's vaccination providers, if one or more of the child's nominated vaccination providers fails to report a vaccination history for the child, or if one or more of the child's nominated providers reports a vaccination history but fails to report all of the vaccinations the child has received. **Underreporting error was estimated using data from projects sponsored by CDC in which the 2017 NIS-Child sample of children in 21 jurisdictions and the 2019 NIS-Child sample of children in 7 jurisdictions was matched to the state or local IIS for the jurisdiction.** In this work, the standard of truth for a given child is taken to be the synthesis of the NIS-Child and IIS vaccination histories. In prior studies conducted in 2012 and 2013 using similar methods, measurement error was found to be by far the largest component of error in the NIS-Child vaccination rates. **Similar conclusions were reached for the 2023 NIS-Child, where it was estimated that measurement error depressed observed vaccination rates by about 2 to 8 percentage points.**

Total Survey Error. Finally, all of the component errors were combined to assess the distribution of total error in the NIS-Child vaccination coverage rates, using a Monte Carlo technique. The mean of the distribution is an estimate of the total survey error, and the 2.5 and 97.5 percentiles of the distribution form a 95% credible interval for the total error. The estimated component errors and total survey errors are presented in Table 12. **For the 4+ DTaP vaccination coverage rate, the mean of the TSE distribution was found to be -5.1 percentage points with a 95% credible interval of (-7.7, -1.9) percentage points. That is, the NIS-Child vaccination coverage rate was on average about 5.1 percentage points too low. For the 1+ MMR vaccination coverage rate, the mean of the TSE distribution was found to be -2.0 percentage points with a 95% credible interval of (-4.3, 1.1) percentage points; for the Hepatitis B birth dose rate, the mean of the TSE distribution was**

estimated at -4.3 percentage points with a 95% credible interval of (-6.9, -1.2) percentage points; and the mean of the TSE distribution for the combined 7-vaccine series was estimated to be -9.4 percentage points with a 95% credible interval of (-13.0, -5.4) percentage points. These results suggest that, according to best estimates, the 2023 NIS-Child underestimated vaccination coverage rates. As in prior NIS-Child total survey error assessments, under-ascertainment of the provider-reported vaccination history was found to be the main source of total survey error.

Table 12: Mean and 95% Credible Interval for the Estimated Total Survey Error (TSE) Distribution and Component Error Distributions for National Vaccination Coverage Rate Estimates, National Immunization Survey - Child, 2023

Vaccine or Series	Component	Mean TSE (pct points)	95% Credible Interval (pct points)
4+ DTaP	TSE (final weighted)	-5.1	(-7.7, -1.9)*
	TSE (design weighted)	-3.9	(-6.5, -0.8)*
	Noncoverage error	0.3	(0.0, 0.7)
	Nonresponse error	0.5	(-2.7, 4.0)
	Measurement error	-4.7	(-6.1, -3.1)*
	Sampling error	0.1	(-1.6, 1.8)
1+ MMR	TSE (final weighted)	-2.0	(-4.3, 1.1)
	TSE (design weighted)	-2.4	(-4.7, 0.7)
	Noncoverage error	0.1	(0.0, 0.4)
	Nonresponse error	0.1	(-2.7, 3.4)
	Measurement error	-2.6	(-3.8, -1.2)*
	Sampling error	0.0	(-1.3, 1.6)
HepB Birth Dose	TSE (final weighted)	-4.3	(-6.9, -1.2)*
	TSE (design weighted)	-5.9	(-8.6, -2.8)*
	Noncoverage error	0.1	(-0.1, 0.4)
	Nonresponse error	-2.8	(-6.2, 0.9)
	Measurement error	-3.3	(-5.2, -1.2)*
	Sampling error	0.0	(-2.0, 2.1)
Combined 7-vaccine series†	TSE (final weighted)	-9.4	(-13.0, -5.4)*
	TSE (design weighted)	-8.0	(-11.6, -4.0)*
	Noncoverage error	0.3	(0.0, 0.7)
	Nonresponse error	-0.0	(-4.2, 4.5)
	Measurement error	-8.3	(-10.1, -6.2)*
	Sampling error	0.0	(-2.0, 2.3)

* 95% credible interval excludes zero.

† The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full Hib series (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

***Change in Total Survey Error*. Change in TSE between the 2022 and 2023 NIS-Child was measured using the bridging cohort method introduced by NCIRD (Yankey, Hill, Elam-Evans, et al., 2015).** Each survey quarter includes children born in 20 monthly birth cohorts. Every pair of adjacent survey quarters spans 23 monthly birth cohorts, of which 17 are in common and 6 are not in common. In turn, every survey year represents 29 monthly birth cohorts. Every pair of adjacent survey years spans 39 monthly birth cohorts, of which 17 are in common and 22 are not in common. **The 17 common months comprise the *bridging cohort*, and for 2022 and 2023, the bridging cohort extends from children born in January 2020 through children born in May 2021.**

Consider a vaccination coverage rate estimated from the bridging cohort as of a given child age, such as 19 months or 24 months. Two estimates are possible, one using the sample of children in the bridging cohort within the 2022 NIS-Child sample and the second using the corresponding sample of children within the 2023 NIS-Child sample. Ideally, the two estimators should exhibit the same statistical expectation (i.e., average value in hypothetical repeated sampling). A large difference between the two estimates may signal a change in the statistical expectation of total survey error from one survey year to the next, which could result from a change in the distribution of sampling-frame coverage error, nonresponse error, or measurement error. Differences may also result simply from the effects of random sampling error.

Table 13 presents the two estimates of vaccination coverage for children as of 19 months of age for the 2022-2023 bridging cohort. Nearly all the vaccine series examined show that the 2023 bridging cohort has significantly lower vaccination coverage estimates than 2022. Out of 18 vaccine series studied, 5 have statistically significant differences at the 1% level, and an additional 5 have statistically significant differences at the 5% level.

Overall, the results suggest a change in total survey error between 2022 and 2023, which may be due in part to a shortened PRC data collection period in 2023. Provider data collection closed approximately one month earlier in 2023, resulting in a lower return rate for provider data (85% in 2023, compared with 91% in 2022) and a higher proportion of children having only partial provider data (16% in 2023, compared with 13% in 2022), which could lead to an increase in measurement error due to incomplete vaccination histories. The full assessment of change in total

survey error is available at: https://www.cdc.gov/childvaxview/media/pdfs/2024/09/Error-Profile-2023-NIS-Child.pdf.

Table 13: Difference Between the Estimates* for the Bridging Birth Cohort† by Age 19 Months, National Immunization Survey - Child, 2022 vs. 2023

Description	2022		2023		Difference		
	Est	Std Error	Est	Std Error	Est	Std Error	*p*-value for Test of No Difference
3+ DTaP/DTP/DT by 19 months	94.7	0.44	92.5	0.60	-2.2	0.74	0.003
4+ DTaP/DTP/DT by 19 months	73.7	0.98	72.5	0.95	-1.2	1.37	0.388
3+ Polio by 19 months	93.9	0.47	92.0	0.61	-1.9	0.77	0.012
1+ MMR by 19 months	90.9	0.59	88.6	0.71	-2.3	0.92	0.012
3+ Hib by 19 months	91.6	0.53	89.4	0.70	-2.2	0.88	0.012
Hib partial series by 19 months	94.1	0.46	91.4	0.68	-2.7	0.82	0.001
Hib full series by 19 months	74.8	0.94	73.8	0.93	-1.0	1.32	0.461
1+ Varicella by 19 months, excluding shots before 12 months	90.3	0.58	87.3	0.75	-3.0	0.95	0.002
3+ Hepatitis B by 19 months	93.0	0.55	91.0	0.63	-2.0	0.84	0.016
3+ Pneumococcal by 19 months	93.5	0.56	90.9	0.67	-2.6	0.87	0.003
4+ Pneumococcal by 19 months	80.2	0.89	79.1	0.88	-1.1	1.25	0.387
1+ Hepatitis A by 19 months	87.0	0.66	83.8	0.78	-3.2	1.02	0.002
2+ Hepatitis A by 19 months	29.9	0.92	28.0	0.95	-1.9	1.33	0.159
2+ or 3+ Rotavirus depending on type by 19 months	79.8	0.88	76.4	0.95	-3.4	1.29	0.009
7-series by 19 months	62.6	1.05	62.5	1.03	0.0	1.47	0.976
1+ Hepatitis B-containing on day of birth or on day 1, 2 or 3 following birth	81.0	0.86	80.4	0.82	-0.6	1.19	0.628
Unvaccinated children	0.5	0.10	0.8	0.11	0.2	0.15	0.129
2+ Flu by 19 months, doses at least 24 days apart	57.6	1.05	55.2	1.06	-2.4	1.49	0.103

* National-level estimates computed among children with adequate provider data, excluding children from U.S. territories.

† The bridging birth cohort used for this analysis of the 2022 and 2023 NIS-Child includes children born between January 2020 and May 2021.

11. Limitations

The findings in this report are subject to at least four limitations. First, because NIS-Child is a telephone survey, results are weighted to be representative of all children aged 19 through 35 months. Although statistical adjustments were made to account for non-response and households without cellular phones, some bias might remain. Second, underestimates of vaccination coverage might have resulted from the exclusive use of provider-reported vaccination histories because completeness of these records is unknown. Third, although national estimates of vaccination coverage are precise, estimates for state and local areas should be interpreted with caution because their sample sizes are smaller and their confidence intervals generally are wider than those for national estimates. Finally, analysis of trends across data years that span from 2010 and earlier to 2011-2017 and from 2011-2017 to 2018-2023 are subject to potential bias that may remain after weighting adjustments because of the switch from landline to dual landline and cellular phone frames in 2011, and from dual landline and cellular phone frames to a single cellular phone frame in 2018 (Hill et al., 2019). In addition, analysis of trends across data years that span from 2011 to 2017 are subject to potential bias that may remain after weighting adjustments because of the expansions and reductions of the share of the total sample that came from the cellular phone frame across these years.

12. Citations for NIS-Child Data

In publications, please acknowledge the original data source. The citation for the 2023 NIS-Child public-use data file is:

U.S. Department of Health and Human Services (DHHS). National Center for Immunization and Respiratory Diseases. The 2023 National Immunization Survey-Child, Atlanta, GA: Centers for Disease Control and Prevention, 2024.

Information about the NIS-Child is located at https://www.cdc.gov/nis/about/.

The NIS-Child public-use data files are located at https://www.cdc.gov/nis/php/datasets-child/.

Please place the acronym "NIS-Child" in the titles, keywords, or abstracts of journal articles and other publications in order to facilitate retrieval of such materials in bibliographic searches.

The following publications use NIS-Child data, published from 2010 or later:

2024

Daley, M. F., Clarke, C. L., Glanz, J. M., Albers, A. N., Michels, S. Y., Freeman, R. E., & Newcomer, S. R. (2024). National trends in patterns of under-vaccination in early childhood: National Immunization Survey-Child, United States, 2011-2021. *Expert Rev Vaccines, 23(1),* 740-749. https://doi.org/10.1080/14760584.2024.2389922

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Appendix A: Glossary of Abbreviations and Terms

3:3:1	The series of 3 or more DTaP vaccinations, 3 or more polio vaccinations, and 1 or more MCV vaccinations
4:3:1	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, and 1 or more MCV vaccinations
4:3:1:3	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, and 3 or more Hib vaccinations of any type
4:3:1:3* (routine Hib)	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, and 3 or 4 Hib vaccinations depending on manufacturer (routine recommendation)
4:3:1:3:3	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or more Hib vaccinations of any type, and 3 or more hepatitis B vaccinations
4:3:1:3*:3 (routine Hib)	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or 4 Hib vaccinations depending on manufacturer (routine recommendation), and 3 or more hepatitis B vaccinations
4:3:1:3:3:1	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or more Hib vaccinations of any type, 3 or more hepatitis B vaccinations, and 1 or more varicella vaccinations given at age 12 months or older
4:3:1:3*:3:1 (routine Hib)	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or 4 Hib vaccinations depending on manufacturer (routine recommendation), 3 or more hepatitis B vaccinations, and 1 or more varicella vaccinations given at age 12 months or older
4:3:1:3:3:1:3	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or more Hib vaccinations of any type, 3 or more hepatitis B vaccinations, 1 or more varicella vaccinations given at age 12 months or older, and 3 or more pneumococcal vaccinations
4:3:1:3*:3:1:3 (routine Hib)	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or 4 Hib vaccinations depending on manufacturer (routine recommendation), 3 or more hepatitis B vaccinations, 1 or more varicella vaccinations given at age 12 months or older, and 3 or more pneumococcal vaccinations
4:3:1:3:3:1:4	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or more Hib vaccinations of any type, 3 or more hepatitis B vaccinations, 1 or more varicella vaccinations given at age 12 months or older, and 4 or more pneumococcal vaccinations

4:3:1:3*:3:1:4 (routine Hib)	The series of 4 or more DTaP vaccinations, 3 or more polio vaccinations, 1 or more MCV vaccinations, 3 or 4 Hib vaccinations depending on manufacturer (routine recommendation), 3 or more hepatitis B vaccinations, 1 or more varicella vaccinations given at age 12 months or older, and 4 or more pneumococcal vaccinations
CATI	Computer-assisted telephone interviewing
CDC	Centers for Disease Control and Prevention
CII	Childhood Immunization Initiative
COV	COVID-19 vaccine
DOB	Date of birth
DTaP	Diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed
DTP	Diphtheria and tetanus toxoids and pertussis vaccine
DT	Diphtheria and tetanus toxoids adsorbed
H1N	Monovalent 2009 H1N1 influenza
Hep A	Hepatitis A vaccine
Hep B	Hepatitis B vaccine
Hib	*Haemophilus influenzae* type b conjugate vaccine
Hib routine recommendation	Four or more doses of Hib vaccine of any type, or two or more doses of Hib vaccine of Merck types followed by one dose of Hib vaccine of any type
Hib shortage recommendation	Three or more doses of Hib vaccine of any type or two or more doses of Hib vaccine of Merck types
IAP	Immunization Action Plan
IHQ	Immunization history questionnaire
IIS	Immunization Information System
IPV	Inactivated poliovirus vaccine
MCV	Measles-containing vaccine
MMR	Measles, mumps, and rubella vaccine
NCHS	National Center for Health Statistics
NCIRD	National Center for Immunization and Respiratory Diseases

NIS	National Immunization Surveys
NIS-Child	National Immunization Survey-Child
NHIS	National Health Interview Survey
NIP	National Immunization Program
OPV	Oral poliovirus vaccine
PCV	Pneumococcal conjugate vaccine
PRC	Provider Record Check
PUF	Public-use (Data) File
RDD	Random digit dialing
RV	Rotavirus
SC	Shot card
UTD	Up-to-date
VFC	Vaccines for Children
VAR	Varicella vaccine

Appendix B: Summary Statistics for Sampling Weights by Estimation Area

Table B.1: Distribution of Sampling Weights* for Children with Completed Household Interviews, National Immunization Survey - Child, 2023

State/Estimation Area	n	Sum[§]	Minimum	Maximum	Mean	Coefficient of Variation
U.S. National[†]	37,458	5,264,074.86	1.49	2,398.48	140.53	146.16
Alabama	525	82,148.68	33.31	469.30	156.47	62.07
Alaska	530	12,294.22	2.57	79.65	23.20	75.19
Arizona	565	115,001.93	79.18	582.16	203.54	56.57
Arkansas	689	49,961.18	2.00	280.34	72.51	95.72
California	999	601,569.68	3.50	2,398.48	602.17	85.97
Colorado	644	88,509.73	18.31	312.90	137.44	48.82
Connecticut	523	52,175.59	3.81	329.85	99.76	83.91
Delaware	410	15,426.29	6.62	91.59	37.63	43.06
District of Columbia	673	10,253.85	4.22	51.60	15.24	81.49
Florida	988	320,949.57	1.49	1,145.87	324.85	92.37
Georgia	803	181,995.20	2.05	793.91	226.64	96.13
Hawaii	494	22,269.96	12.33	96.73	45.08	34.29
Idaho	535	32,938.59	2.86	199.59	61.57	79.55
Illinois	1,217	187,335.18	3.88	375.09	153.93	52.26
IL-City of Chicago	355	42,424.86	16.86	314.38	119.51	51.39
IL-Rest of State	862	144,910.32	3.88	375.09	168.11	49.41
Indiana	450	114,405.89	14.94	685.87	254.24	56.79
Iowa	565	52,217.18	6.13	342.23	92.42	91.78
Kansas	749	50,619.85	8.88	202.52	67.58	72.37
Kentucky	730	72,220.59	7.43	350.80	98.93	76.69
Louisiana	1,062	81,572.21	6.20	292.21	76.81	101.33
Maine	441	17,242.12	7.58	91.88	39.10	40.87
Maryland	1,124	100,005.85	4.92	292.26	88.97	77.43
Massachusetts	534	98,738.22	40.41	447.66	184.90	64.12
Michigan	933	147,850.87	11.37	536.17	158.47	85.04
Minnesota	567	91,331.77	21.70	393.37	161.08	52.43
Mississippi	712	51,023.44	5.28	271.35	71.66	101.66
Missouri	794	99,185.15	14.12	390.59	124.92	69.00
Montana	427	16,996.25	7.72	95.17	39.80	48.65
Nebraska	487	33,446.52	2.49	252.41	68.68	78.27
Nevada	763	50,394.20	1.94	223.79	66.05	82.68
New Hampshire	392	18,027.17	2.77	99.30	45.99	42.24
New Jersey	637	147,384.71	50.32	648.83	231.37	56.45
New Mexico	803	28,976.90	1.86	117.21	36.09	80.91
New York	1,370	289,060.05	3.34	740.37	210.99	72.03
NY-City of New York	809	130,935.64	3.82	481.34	161.85	70.69
NY-Rest of State	561	158,124.40	3.34	740.37	281.86	60.48
North Carolina	981	174,774.54	7.26	651.95	178.16	92.44
North Dakota	545	14,347.38	4.23	85.17	26.33	81.20
Ohio	934	186,372.80	39.68	536.45	199.54	65.12
Oklahoma	597	70,107.72	3.30	335.08	117.43	69.58
Oregon	434	57,920.44	12.29	322.50	133.46	49.73
Pennsylvania	1,539	189,395.02	7.39	679.00	123.06	117.87

State/Estimation Area	n	Sum§	Minimum	Maximum	Mean	Coefficient of Variation
PA-Philadelphia County	783	28,505.28	9.09	119.37	36.41	72.14
PA-Rest of State	756	160,889.74	7.39	679.00	212.82	76.19
Rhode Island	661	14,775.17	6.25	60.52	22.35	49.49
South Carolina	606	84,451.42	27.07	365.21	139.36	54.54
South Dakota	597	16,343.21	3.24	99.80	27.38	93.64
Tennessee	734	118,765.53	5.89	546.33	161.81	85.93
Texas	1,841	549,571.40	2.03	2,361.74	298.52	167.39
TX-Bexar County	468	37,806.31	32.01	211.96	80.78	51.89
TX-City of Houston	487	65,401.53	3.42	429.02	134.29	75.17
TX-Rest of State	886	446,363.56	2.03	2,361.74	503.80	130.24
Utah	600	66,314.27	2.05	278.18	110.52	53.02
Vermont	519	7,478.87	1.68	54.16	14.41	87.51
Virginia	1,079	139,685.04	2.29	381.20	129.46	74.49
Washington	829	120,108.05	6.51	413.16	144.88	68.56
West Virginia	586	24,914.71	13.43	105.98	42.52	53.64
Wisconsin	676	86,262.21	2.92	367.12	127.61	68.82
Wyoming	565	8,958.51	2.69	53.88	15.86	86.33
Puerto Rico	1,161	25,001.69	1.30	86.26	21.53	104.09
U.S. Virgin Islands	143	1,376.54	1.27	31.52	9.63	68.66
Guam	251	4,003.64	4.94	48.52	15.95	67.18

* Distribution of RDDWT_C_TERR.

† Excludes U.S. territories.

§ The sum of the weights is an estimate of the total number of children age 19-36 months in the population.

Table B.2: Distribution of Sampling Weights* for Children with Adequate Provider Data, National Immunization Survey - Child, 2023

State/Estimation Area	n	Sum§	Minimum	Maximum	Mean	Coefficient of Variation
U.S. National†	18,032	5,264,074.86	2.88	6,339.12	291.93	169.76
Alabama	253	82,148.68	40.68	1,097.32	324.70	81.74
Alaska	322	12,294.22	5.48	139.74	38.18	88.63
Arizona	251	115,001.93	94.15	1,307.97	458.18	64.70
Arkansas	332	49,961.18	5.87	542.94	150.49	99.17
California	405	601,569.68	7.62	6,339.12	1,485.36	100.92
Colorado	291	88,509.73	29.67	890.53	304.16	62.69
Connecticut	257	52,175.59	6.09	733.73	203.02	96.72
Delaware	182	15,426.29	26.91	236.26	84.76	56.63
District of Columbia	270	10,253.85	5.60	153.16	37.98	105.05
Florida	450	320,949.57	3.16	2,788.67	713.22	105.62
Georgia	404	181,995.20	18.52	1,705.77	450.48	96.17
Hawaii	218	22,269.96	23.98	230.11	102.16	47.84
Idaho	274	32,938.59	4.74	429.34	120.21	96.14
Illinois	543	187,335.18	5.83	1,035.11	345.00	69.05
IL-City of Chicago	155	42,424.86	36.64	798.84	273.71	71.39
IL-Rest of State	388	144,910.32	5.83	1,035.11	373.48	66.37
Indiana	223	114,405.89	35.66	1,462.27	513.03	61.01
Iowa	301	52,217.18	15.07	589.25	173.48	95.76
Kansas	410	50,619.85	15.74	401.56	123.46	81.61
Kentucky	363	72,220.59	20.74	649.37	198.95	79.70
Louisiana	456	81,572.21	16.07	708.94	178.89	108.63
Maine	230	17,242.12	11.88	193.80	74.97	47.37
Maryland	558	100,005.85	12.23	617.94	179.22	89.27
Massachusetts	271	98,738.22	52.19	1,207.41	364.35	78.18
Michigan	494	147,850.87	18.05	1,190.60	299.29	98.71
Minnesota	268	91,331.77	40.77	959.36	340.79	59.06
Mississippi	332	51,023.44	12.22	600.24	153.69	114.67
Missouri	428	99,185.15	32.46	762.15	231.74	81.18
Montana	205	16,996.25	11.39	229.00	82.91	57.68
Nebraska	282	33,446.52	11.70	448.09	118.60	82.08
Nevada	366	50,394.20	5.08	469.50	137.69	88.85
New Hampshire	194	18,027.17	5.93	251.95	92.92	54.89
New Jersey	265	147,384.71	81.61	1,883.47	556.17	76.73
New Mexico	392	28,976.90	6.72	265.70	73.92	91.95
New York	615	289,060.05	8.09	1,935.98	470.02	85.21
NY-City of New York	352	130,935.64	8.09	1,238.61	371.98	86.18
NY-Rest of State	263	158,124.40	9.19	1,935.98	601.23	75.86
North Carolina	471	174,774.54	11.33	1,469.41	371.07	102.02
North Dakota	231	14,347.38	6.54	228.70	62.11	95.62
Ohio	481	186,372.80	51.98	1,149.01	387.47	74.72
Oklahoma	271	70,107.72	13.62	868.72	258.70	81.64
Oregon	220	57,920.44	22.65	722.10	263.27	62.51
Pennsylvania	706	189,395.02	12.29	1,500.46	268.26	127.14
PA-Philadelphia County	358	28,505.28	12.95	268.39	79.62	93.55
PA-Rest of State	348	160,889.74	12.29	1,500.46	462.33	85.47
Rhode Island	368	14,775.17	8.51	117.74	40.15	64.24
South Carolina	264	84,451.42	38.25	979.16	319.89	68.43
South Dakota	296	16,343.21	3.40	222.31	55.21	113.23

State/Estimation Area	n	Sum[§]	Minimum	Maximum	Mean	Coefficient of Variation
Tennessee	365	118,765.53	27.62	1,086.90	325.39	94.73
Texas	742	549,571.40	4.75	6,337.63	740.66	175.03
TX-Bexar County	198	37,806.31	35.50	601.37	190.94	73.57
TX-City of Houston	193	65,401.53	6.49	1,171.25	338.87	88.96
TX-Rest of State	351	446,363.56	4.75	6,337.63	1,271.69	135.16
Utah	338	66,314.27	5.47	500.43	196.20	61.88
Vermont	326	7,478.87	3.42	78.36	22.94	90.54
Virginia	483	139,685.04	2.88	1,047.85	289.20	98.20
Washington	462	120,108.05	11.67	804.13	259.97	81.76
West Virginia	261	24,914.71	24.15	266.08	95.46	60.39
Wisconsin	318	86,262.21	6.09	794.25	271.26	77.22
Wyoming	324	8,958.51	3.92	98.91	27.65	100.31
Puerto Rico	380	25,001.69	2.90	249.16	65.79	107.93
U.S. Virgin Islands	53	1,376.54	1.31	103.85	25.97	83.07
Guam	105	4,003.64	4.76	132.34	38.13	87.03

* Distribution of PROVWT_C_TERR.

† Excludes U.S. territories.

§ The sum of the weights is an estimate of the total number of children age 19-36 months in the population.

Appendix C: Flags for Inconsistent Values in the Breastfeeding Data

Two different types of inconsistency can arise in breastfeeding data. The first is that the duration of any breastfeeding can exceed the age of the child, and the second is that the age of the child when first fed formula can exceed the age of child. BF_ENDR06 stores the duration of any breastfeeding, and BF_ENDFL06 flags the inconsistency; BF_FORMR20 stores the age of the child when first fed formula, and BF_FORMFL06 flags the inconsistency.

1. **Both BF_ENDR06 and BF_FORMR08 are formulated using the following conversion factors:**

   if unit=1(days) then BF_ENDR06 = number x 1
   if unit=2(weeks) then BF_ENDR06 = number x 7
   if unit=3(months) then BF_ENDR06 = number x 30.4375
   if unit=4(years) then BF_ENDR06 = number x 365.25

   if unit=1(days) then BF_FORMR20 = number x 1
   if unit=2(weeks) then BF_FORMR20 = number x 7
   if unit=3(months) then BF_FORMR20 = number x 30.4375
   if unit=4(years) then BF_FORMR20 = number x 365.25

2. **Flagging BF_ENDR06 when the duration of any breastfeeding exceeds the age in days with a buffer for different units:**

   if unit=1(days) flag when BF_ENDR06 > age + 1
   if unit=2(weeks) flag when BF_ENDR06 > age + 3
   if unit=3(months) flag when BF_ENDR06 > age + 15
   if unit=4(years) flag when BF_ENDR06 > age + 182

The different buffers allow for the impact of rounding durations upward in the specified units (for example, 50 days might be reported as 2 months).

3. **Flagging BF_FORMR20 when the age when first fed formula exceeds the age in days with a buffer for different units:**

   if unit=1(days) flag when BF_FORMR20 > age + 1
   if unit=2(weeks) flag when BF_FORMR20 > age + 3
   if unit=3(months) flag when BF_FORMR20 > age + 15
   if unit=4(years) flag when BF_FORMR20 > age + 182

The different buffers allow for the impact of rounding durations upward in the specified units (for example, 50 days might be reported as 2 months).

Appendix D: Summary Tables

Table D.1: Estimated Population Totals and Sample Sizes of Children 19 through 35 Months of Age by State and Estimation Area, National Immunization Survey - Child, 2023

State/Estimation Area	Estimation Area Number (ESTIAP23)	Estimated Population Total of Children	Number of Children with Complete Household Interviews	Number of Children with Adequate Provider Data	Percent of Children with Adequate Provider Data
U.S. National†		5,264,075	37,458	18,032	48.1
Alabama	20	82,149	525	253	48.2
Alaska	74	12,294	530	322	60.8
Arizona	66	115,002	565	251	44.4
Arkansas	46	49,961	689	332	48.2
California	68	601,570	999	405	40.5
Colorado	60	88,510	644	291	45.2
Connecticut	1	52,176	523	257	49.1
Delaware	13	15,426	410	182	44.4
District of Columbia	12	10,254	673	270	40.1
Florida	22	320,950	988	450	45.5
Georgia	25	181,995	803	404	50.3
Hawaii	72	22,270	494	218	44.1
Idaho	75	32,939	535	274	51.2
Illinois		187,335	1,217	543	44.6
IL-City of Chicago	35	42,425	355	155	43.7
IL-Rest of State	34	144,910	862	388	45.0
Indiana	36	114,406	450	223	49.6
Iowa	56	52,217	565	301	53.3
Kansas	57	50,620	749	410	54.7
Kentucky	27	72,221	730	363	49.7
Louisiana	47	81,572	1,062	456	42.9
Maine	4	17,242	441	230	52.2
Maryland	14	100,006	1,124	558	49.6
Massachusetts	2	98,738	534	271	50.7
Michigan	38	147,851	933	494	52.9
Minnesota	40	91,332	567	268	47.3
Mississippi	28	51,023	712	332	46.6
Missouri	58	99,185	794	428	53.9
Montana	61	16,996	427	205	48.0
Nebraska	59	33,447	487	282	57.9
Nevada	73	50,394	763	366	48.0
New Hampshire	5	18,027	392	194	49.5
New Jersey	8	147,385	637	265	41.6
New Mexico	49	28,977	803	392	48.8

State/Estimation Area	Estimation Area Number (ESTIAP23)	Estimated Population Total of Children	Number of Children with Complete Household Interviews	Number of Children with Adequate Provider Data	Percent of Children with Adequate Provider Data
New York		289,060	1,370	615	44.9
NY-City of New York	11	130,936	809	352	43.5
NY-Rest of State	10	158,124	561	263	46.9
North Carolina	29	174,775	981	471	48.0
North Dakota	62	14,347	545	231	42.4
Ohio	41	186,373	934	481	51.5
Oklahoma	50	70,108	597	271	45.4
Oregon	76	57,920	434	220	50.7
Pennsylvania		189,395	1,539	706	45.9
PA-Philadelphia County	17	28,505	783	358	45.7
PA-Rest of State	16	160,890	756	348	46.0
Rhode Island	6	14,775	661	368	55.7
South Carolina	30	84,451	606	264	43.6
South Dakota	63	16,343	597	296	49.6
Tennessee	31	118,766	734	365	49.7
Texas		549,571	1,841	742	40.3
TX-Bexar County	55	37,806	468	198	42.3
TX-City of Houston	54	65,402	487	193	39.6
TX-Rest of State	51	446,364	886	351	39.6
Utah	64	66,314	600	338	56.3
Vermont	7	7,479	519	326	62.8
Virginia	18	139,685	1,079	483	44.8
Washington	77	120,108	829	462	55.7
West Virginia	19	24,915	586	261	44.5
Wisconsin	44	86,262	676	318	47.0
Wyoming	65	8,959	565	324	57.3
Puerto Rico	106	25,002	1,161	380	32.7

*Excludes U.S. territories.

Table D.2: Estimated Population Totals and Sample Sizes for Age Group by Maternal Education, National Immunization Survey - Child, 2023

Age Group in Months	Maternal Education	Children with Completed Household Interviews* Unweighted Completes	Children with Completed Household Interviews* Weighted Completes[†]	Children with Adequate Provider Data* Unweighted Completes	Children with Adequate Provider Data* Weighted Completes[§]
19-23 Months	<12 Years	681	180,592	323	186,999
19-23 Months	12 Years	1,895	436,937	850	453,668
19-23 Months	>12, Non College Graduate	2,687	328,359	1,258	324,207
19-23 Months	College Graduate	6,111	678,861	3,184	659,875
24-29 Months	<12 Years	677	194,096	302	181,979
24-29 Months	12 Years	1,904	465,806	846	458,619
24-29 Months	>12, Non College Graduate	2,695	388,032	1,228	397,506
24-29 Months	College Graduate	5,938	732,593	3,056	742,422
30-35 Months	<12 Years	919	216,745	410	211,569
30-35 Months	12 Years	2,505	496,521	1,032	496,529
30-35 Months	>12, Non College Graduate	3,583	389,365	1,610	409,725
30-35 Months	College Graduate	7,863	756,168		740,975
Total		37,458	5,264,075	18,032	5,264,075

* Excludes U.S. territories.

[†] Weighted by RDDWT_C.

[§] Weighted by PROVWT_C.

Table D.3: Estimated Population Totals and Sample Sizes for Age Group by Poverty Status, National Immunization Survey - Child, 2023

Age Group in Months	Poverty Status	Children with Completed Household Interviews* Unweighted Completes	Children with Completed Household Interviews* Weighted Completes†	Children with Adequate Provider Data* Unweighted Completes	Children with Adequate Provider Data* Weighted Completes§
19-23 Months	Above poverty, > $75K	6,051	700,238	3,142	672,537
19-23 Months	Above poverty, <= $75K	2,883	436,124	1,439	441,459
19-23 Months	Below poverty	1,790	376,980	836	386,186
19-23 Months	Unknown	650	111,407	198	124,567
24-29 Months	Above poverty, > $75K	5,880	747,009	3,019	767,249
24-29 Months	Above poverty, <= $75K	2,869	500,708	1,399	497,289
24-29 Months	Below poverty	1,799	404,825	833	411,477
24-29 Months	Unknown	666	127,986	181	104,512
30-35 Months	Above poverty, > $75K	7,820	794,668	3,912	803,597
30-35 Months	Above poverty, <= $75K	3,860	489,797	1,808	490,332
30-35 Months	Below poverty	2,380	440,057	1,046	445,151
30-35 Months	Unknown	810	134,277	219	119,719
Total		37,458	5,264,075	18,032	5,264,075

* Excludes U.S. territories.

† Weighted by single-frame cellular phone weight RDDWT_C.

§ Weighted by single-frame cellular phone weight PROVWT_C

Table D.4: Estimated Population Totals and Sample Sizes for Race and Ethnicity by Poverty Status, National Immunization Survey - Child, 2023

Race and Ethnicity[†]	Poverty Status	Children with Completed Household Interviews* Unweighted Completes	Children with Completed Household Interviews* Weighted Completes[§]	Children with Adequate Provider Data* Unweighted Completes	Children with Adequate Provider Data* Weighted Completes[¶]
Hispanic	Above poverty, > $75K	2,509	402,974	1,202	387,494
Hispanic	Above poverty, <= $75K	2,179	424,798	1,060	429,048
Hispanic	Below poverty	2,170	525,708	972	525,219
Hispanic	Unknown	638	146,805	206	157,076
Non-Hispanic White Only	Above poverty, > $75K	13,014	1,304,795	6,919	1,299,837
Non-Hispanic White Only	Above poverty, <= $75K	4,804	580,184	2,420	568,542
Non-Hispanic White Only	Below poverty	1,845	301,566	918	312,806
Non-Hispanic White Only	Unknown	920	129,908	235	97,660
Non-Hispanic Black Only	Above poverty, > $75K	1,217	177,786	471	185,629
Non-Hispanic Black Only	Above poverty, <= $75K	1,258	240,437	497	244,684
Non-Hispanic Black Only	Below poverty	1,046	245,013	393	244,685
Non-Hispanic Black Only	Unknown	255	49,461	62	51,878
Non-Hispanic Other & Multiple Races	Above poverty, > $75K	3,011	356,360	1,481	370,423
Non-Hispanic Other & Multiple Races	Above poverty, <= $75K	1,371	181,211	669	186,806
Non-Hispanic Other & Multiple Races	Below poverty	908	149,575	432	160,104
Non-Hispanic Other & Multiple Races	Unknown	313	47,495	95	42,183
Total		37,458	5,264,075	18,032	5,264,075

* Excludes U.S. territories.

[†] Race and ethnicity categories are self-reported and mutually exclusive.

[§] Weighted by RDDWT_C.

[¶] Weighted by PROVWT_C.

Table D.5: Estimated Population Totals and Sample Sizes for Age Group by Race and Ethnicity, National Immunization Survey - Child, 2023

		Children with Completed Household Interviews*	Children with Completed Household Interviews*	Children with Adequate Provider Data*	Children with Adequate Provider Data*
Age Group in Months	**Race and Ethnicity of Child**†	**Unweighted Completes**	**Weighted Completes**§	**Unweighted Completes**	**Weighted Completes**¶
19-23 Months	Hispanic	2,296	470,764	1,100	478,299
19-23 Months	Non-Hispanic White Only	6,253	712,295	3,260	686,415
19-23 Months	Non-Hispanic Black Only	1,147	213,217	448	229,641
19-23 Months	Non-Hispanic Other & Multiple Races	1,678	228,473	807	230,394
24-29 Months	Hispanic	2,302	512,787	1,046	487,161
24-29 Months	Non-Hispanic White Only	6,176	798,128	3,173	811,444
24-29 Months	Non-Hispanic Black Only	1,070	223,580	390	213,727
24-29 Months	Non-Hispanic Other & Multiple Races	1,666	246,032	823	268,196
30-35 Months	Hispanic	2,898	516,733	1,294	533,377
30-35 Months	Non-Hispanic White Only	8,154	806,030	4,059	780,987
30-35 Months	Non-Hispanic Black Only	1,559	275,900	585	283,507
30-35 Months	Non-Hispanic Other & Multiple Races	2,259	260,135	1,047	260,928
Total		37,458	5,264,075	18,032	5,264,075

* Excludes U.S. territories.

† Race and ethnicity categories are self-reported and mutually exclusive.

§ Weighted by RDDWT_C.

¶ Weighted by PROVWT_C.

Table D.6: Estimated Population Totals and Sample Sizes for Age Group by Sex, National Immunization Survey - Child, 2023

Age Group in Months	Sex	Children with Completed Household Interviews* Unweighted Completes	Children with Completed Household Interviews* Weighted Completes†	Children with Adequate Provider Data* Unweighted Completes	Children with Adequate Provider Data* Weighted Completes§
19-23 Months	Male	5,845	826,710	2,883	813,672
19-23 Months	Female	5,529	798,039	2,732	811,077
24-29 Months	Male	5,795	918,142	2,788	917,583
24-29 Months	Female	5,419	862,385	2,644	862,944
30-35 Months	Male	7,545	946,703	3,582	960,300
30-35 Months	Female	7,325	912,096	3,403	898,499
Total		37,458	5,264,075	18,032	5,264,075

* Excludes U.S. territories.

† Weighted by RDDWT_C.

§ Weighted by PROVWT_C.

Table D.7: Estimated Vaccination Coverage* with Individual Vaccines and Selected Vaccination Series Among Children 19-35 Months of Age by State and Estimation Area, National Immunization Survey - Child, 2023[†]

	≥4 DTaP[§]	≥3 Polio[¶]	≥1 MMR**	Hib-FS[††]	≥3 HepB[¶¶]	HepB Birth Dose	≥1 HepA	≥1 Var***	≥4 PCV[†††]	Rotavirus	4:3:1:3*:3:1:4[§§§]
U.S. National[¶¶¶]	82.2 ± 1.2	91.9 ± 0.9	91.1 ± 0.9	78.2 ± 1.2	91.3 ± 0.9	79.1 ± 1.2	87.7 ± 1.1	90.9 ± 0.9	81.4 ± 1.3	75.1 ± 1.4	69.5 ± 1.4
Alabama	80.7 ± 6.7	86.2 ± 6.1	88.4 ± 5.7	71.6 ± 7.7	83.1 ± 6.6	77.6 ± 6.5	84.3 ± 6.3	87.0 ± 6.1	77.4 ± 7.2	67.1 ± 8.3	63.4 ± 7.9
Alaska	75.2 ± 6.7	86.9 ± 5.3	84.8 ± 5.6	73.3 ± 6.5	90.0 ± 4.4	74.7 ± 6.1	85.1 ± 5.5	83.7 ± 5.7	73.8 ± 6.6	72.1 ± 6.7	61.3 ± 7.1
Arizona	82.6 ± 5.7	90.9 ± 4.4	89.3 ± 4.5	79.1 ± 6.0	87.6 ± 5.0	87.1 ± 4.5	88.9 ± 4.4	91.2 ± 4.2	81.9 ± 5.9	75.8 ± 6.8	71.7 ± 6.8
Arkansas	82.5 ± 6.0	90.3 ± 4.7	90.8 ± 4.5	77.7 ± 6.4	92.2 ± 3.8	84.9 ± 5.2	87.9 ± 4.8	91.0 ± 4.5	76.4 ± 6.6	74.1 ± 6.7	67.1 ± 7.2
California	75.4 ± 7.0	87.6 ± 4.7	87.3 ± 5.4	73.6 ± 6.5	87.3 ± 5.5	72.7 ± 6.2	81.9 ± 6.8	85.3 ± 5.6	73.0 ± 7.3	68.9 ± 7.2	60.8 ± 7.3
Colorado	80.5 ± 5.8	90.3 ± 4.3	87.6 ± 4.9	73.2 ± 6.4	90.8 ± 4.2	81.2 ± 5.6	85.0 ± 5.4	87.7 ± 4.8	82.0 ± 5.7	73.6 ± 6.4	67.8 ± 6.6
Connecticut	92.2 ± 4.8	96.0 ± 3.7	96.7 ± 3.4	88.7 ± 5.3	97.0 ± 2.8	83.0 ± 6.9	95.8 ± 3.5	98.3 ± 2.1	91.1 ± 5.0	82.9 ± 6.7	82.3 ± 6.4
Delaware	85.6 ± 5.7	93.0 ± 4.3	89.9 ± 4.9	79.0 ± 6.8	89.6 ± 4.9	80.2 ± 6.8	91.1 ± 4.6	91.0 ± 4.6	82.9 ± 6.3	75.0 ± 7.6	68.9 ± 7.7
Dist. of Columbia	83.5 ± 6.1	91.1 ± 4.1	91.1 ± 4.2	79.9 ± 6.7	89.5 ± 4.5	82.3 ± 6.1	89.4 ± 4.8	90.6 ± 4.3	86.3 ± 5.8	78.1 ± 7.2	74.2 ± 7.3
Florida	83.1 ± 5.0	93.3 ± 3.5	92.4 ± 3.5	79.7 ± 5.7	92.5 ± 3.5	72.0 ± 6.1	85.8 ± 4.8	92.1 ± 3.6	80.7 ± 5.3	72.6 ± 5.9	71.6 ± 6.1
Georgia	78.8 ± 5.7	91.2 ± 3.8	86.7 ± 5.0	73.6 ± 6.2	89.1 ± 4.2	79.5 ± 5.5	83.6 ± 5.6	85.9 ± 5.1	78.0 ± 6.1	70.3 ± 6.5	65.0 ± 6.7
Hawaii	83.6 ± 5.6	90.8 ± 4.3	89.1 ± 4.7	78.8 ± 6.1	89.6 ± 4.4	84.5 ± 5.2	86.4 ± 5.2	87.8 ± 4.9	81.4 ± 6.0	72.2 ± 6.8	70.6 ± 6.8
Idaho	74.2 ± 7.6	87.8 ± 5.5	87.9 ± 5.4	74.5 ± 7.5	87.8 ± 5.7	83.6 ± 5.7	87.4 ± 5.7	86.5 ± 5.8	76.9 ± 7.5	72.7 ± 7.4	66.7 ± 8.1
Illinois	81.0 ± 4.4	92.4 ± 3.1	93.5 ± 2.9	76.0 ± 4.8	90.7 ± 3.4	79.3 ± 4.4	88.4 ± 3.4	92.9 ± 3.0	79.0 ± 4.8	73.2 ± 5.1	66.8 ± 5.1
IL-City of Chicago	78.7 ± 8.5	92.6 ± 5.3	94.5 ± 4.4	73.7 ± 9.2	90.1 ± 6.2	81.2 ± 7.4	91.3 ± 5.3	94.9 ± 4.3	76.8 ± 8.9	77.7 ± 8.9	64.5 ± 9.9
IL-Rest of State	81.7 ± 5.1	92.4 ± 3.7	93.2 ± 3.5	76.6 ± 5.5	90.9 ± 4.0	78.7 ± 5.2	87.5 ± 4.2	92.2 ± 3.6	79.6 ± 5.6	71.8 ± 6.1	67.4 ± 6.0
Indiana	83.1 ± 6.1	95.6 ± 3.3	93.7 ± 3.6	81.8 ± 6.0	94.6 ± 3.9	79.2 ± 7.2	93.0 ± 3.7	92.1 ± 4.3	84.2 ± 5.9	75.4 ± 7.1	72.3 ± 7.1
Iowa	83.8 ± 6.0	94.1 ± 3.8	93.1 ± 4.3	77.3 ± 7.1	92.5 ± 4.3	80.9 ± 6.2	91.3 ± 4.5	94.2 ± 3.8	84.5 ± 5.5	79.0 ± 6.7	70.1 ± 7.6
Kansas	81.3 ± 5.4	91.4 ± 3.6	92.7 ± 3.4	77.9 ± 5.5	91.4 ± 3.6	77.6 ± 5.8	87.6 ± 4.4	91.2 ± 3.7	83.9 ± 4.8	76.3 ± 5.8	69.8 ± 6.0
Kentucky	79.8 ± 5.8	92.4 ± 3.8	87.6 ± 4.9	71.6 ± 6.4	91.2 ± 3.9	78.9 ± 5.6	90.3 ± 4.2	88.2 ± 4.7	81.7 ± 5.5	71.0 ± 6.2	64.1 ± 6.6
Louisiana	82.2 ± 5.2	91.9 ± 3.5	91.5 ± 3.7	76.2 ± 5.8	93.2 ± 2.9	76.3 ± 5.7	87.6 ± 4.5	90.4 ± 3.8	78.5 ± 5.8	74.0 ± 6.1	68.3 ± 6.3
Maine	84.9 ± 5.4	95.7 ± 2.5	92.8 ± 3.9	83.4 ± 5.7	92.6 ± 3.5	81.4 ± 5.6	86.4 ± 5.3	89.8 ± 4.5	86.1 ± 5.2	75.7 ± 6.2	73.9 ± 6.6
Maryland	89.6 ± 3.6	97.0 ± 1.8	96.2 ± 2.2	84.4 ± 4.2	95.9 ± 2.1	80.6 ± 4.7	93.8 ± 2.6	96.2 ± 2.2	88.3 ± 3.8	83.9 ± 4.4	77.6 ± 4.8
Massachusetts	92.8 ± 4.1	98.3 ± 1.3	95.9 ± 3.0	93.5 ± 3.9	97.8 ± 1.6	87.4 ± 5.6	93.5 ± 3.4	97.5 ± 1.9	94.7 ± 3.3	90.7 ± 4.4	90.1 ± 4.4
Michigan	78.3 ± 5.9	90.4 ± 4.1	90.9 ± 4.0	73.8 ± 6.1	89.9 ± 3.9	78.2 ± 5.5	88.7 ± 4.4	91.3 ± 3.7	79.3 ± 5.6	74.4 ± 6.0	66.8 ± 6.3
Minnesota	83.7 ± 5.4	92.6 ± 3.9	90.9 ± 4.4	75.1 ± 6.3	95.1 ± 3.3	81.6 ± 5.9	89.7 ± 4.3	92.6 ± 3.7	82.4 ± 5.8	77.0 ± 6.2	69.2 ± 6.7
Mississippi	79.8 ± 6.6	90.8 ± 4.6	88.6 ± 5.0	74.5 ± 7.2	91.0 ± 4.3	82.6 ± 5.8	66.8 ± 7.7	89.0 ± 5.0	80.1 ± 6.6	62.2 ± 8.0	67.6 ± 8.0
Missouri	82.1 ± 4.8	92.4 ± 3.4	92.7 ± 3.3	79.3 ± 5.1	92.4 ± 3.4	84.8 ± 4.7	89.9 ± 3.5	92.5 ± 3.2	81.9 ± 5.3	79.8 ± 5.1	69.8 ± 5.9
Montana	73.8 ± 7.5	89.0 ± 4.9	85.3 ± 5.8	75.5 ± 7.1	88.4 ± 5.1	73.0 ± 7.0	79.8 ± 6.6	82.9 ± 6.1	73.1 ± 7.4	66.9 ± 7.6	60.4 ± 8.0
Nebraska	90.3 ± 4.0	93.9 ± 3.2	94.6 ± 3.2	68.8 ± 7.2	94.2 ± 3.7	81.3 ± 6.3	93.0 ± 3.4	94.0 ± 3.2	90.2 ± 4.0	81.4 ± 5.5	63.9 ± 7.5
Nevada	72.4 ± 6.9	85.8 ± 5.8	87.4 ± 5.5	71.9 ± 6.9	87.3 ± 5.5	75.9 ± 6.4	85.7 ± 5.7	87.4 ± 5.5	73.2 ± 6.7	65.4 ± 7.0	62.3 ± 7.1
New Hampshire	90.6 ± 4.0	96.2 ± 3.3	96.7 ± 2.6	86.2 ± 6.0	97.3 ± 2.1	79.7 ± 6.8	93.8 ± 3.9	94.6 ± 3.9	87.6 ± 5.8	81.8 ± 6.7	80.5 ± 6.7
New Jersey	86.9 ± 5.3	96.9 ± 1.9	90.4 ± 5.0	83.9 ± 5.8	92.8 ± 3.8	82.9 ± 5.5	88.4 ± 5.0	92.2 ± 4.4	82.0 ± 6.4	77.6 ± 6.9	64.8 ± 7.6
New Mexico	80.8 ± 5.1	91.1 ± 3.6	92.1 ± 3.4	81.4 ± 5.1	89.3 ± 4.1	72.6 ± 5.9	91.1 ± 3.6	92.2 ± 3.4	81.5 ± 5.4	77.4 ± 5.8	69.9 ± 6.1
New York	85.7 ± 3.9	93.3 ± 3.0	92.6 ± 2.8	80.9 ± 4.3	93.8 ± 2.6	73.3 ± 4.8	83.4 ± 4.0	92.4 ± 2.8	81.5 ± 4.2	76.1 ± 4.6	73.1 ± 4.7
NY-City of New York	82.3 ± 5.9	92.6 ± 4.1	90.7 ± 4.3	80.3 ± 6.0	92.4 ± 3.9	68.3 ± 6.7	78.7 ± 6.0	90.4 ± 4.2	76.5 ± 6.3	70.9 ± 6.9	68.2 ± 6.9
NY-Rest of State	88.6 ± 5.1	93.9 ± 4.2	94.3 ± 3.8	81.4 ± 6.0	94.9 ± 3.5	77.4 ± 6.8	87.3 ± 5.3	94.1 ± 3.8	85.5 ± 5.5	80.4 ± 6.2	77.2 ± 6.4

	≥4 DTaP[§]	≥3 Polio[¶]	≥1 MMR**	Hib-FS[††]	≥3 HepB[¶¶]	HepB Birth Dose	≥1 HepA	≥1 Var***	≥4 PCV[†††]	Rotavirus	4:3:1:3*:3:1:4[§§§]
North Carolina	87.3 ± 4.1	95.6 ± 2.3	95.4 ± 2.3	84.4 ± 4.5	94.8 ± 2.7	83.6 ± 4.8	89.7 ± 3.9	95.9 ± 2.1	88.6 ± 4.0	82.2 ± 5.0	76.8 ± 5.4
North Dakota	79.1 ± 7.6	91.9 ± 4.6	89.1 ± 6.0	79.7 ± 7.7	92.7 ± 4.3	83.1 ± 7.0	86.3 ± 6.6	87.3 ± 6.2	79.3 ± 7.8	79.2 ± 7.3	73.1 ± 8.3
Ohio	83.8 ± 4.2	91.9 ± 3.0	91.0 ± 3.2	79.0 ± 4.7	92.1 ± 2.9	83.4 ± 4.3	86.9 ± 4.0	89.8 ± 3.6	83.9 ± 4.3	78.0 ± 4.9	72.6 ± 5.1
Oklahoma	84.4 ± 5.7	93.7 ± 3.3	91.8 ± 4.2	81.3 ± 5.6	91.8 ± 3.8	79.0 ± 6.2	90.8 ± 4.4	90.5 ± 4.7	84.5 ± 5.4	77.4 ± 6.2	72.2 ± 6.8
Oregon	80.2 ± 6.7	91.7 ± 4.7	88.7 ± 5.2	77.5 ± 6.8	89.8 ± 5.0	80.3 ± 7.3	88.1 ± 5.3	89.5 ± 5.0	78.2 ± 6.8	69.8 ± 7.5	68.0 ± 7.6
Pennsylvania	81.0 ± 4.6	91.5 ± 3.3	89.7 ± 3.6	79.7 ± 4.7	90.4 ± 3.6	81.6 ± 5.1	87.5 ± 3.9	90.4 ± 3.4	83.2 ± 4.9	82.8 ± 4.2	71.3 ± 5.6
PA-Philadelphia County	81.9 ± 6.0	89.4 ± 4.7	91.0 ± 4.2	77.3 ± 6.3	91.3 ± 4.3	83.0 ± 5.5	88.6 ± 4.5	90.8 ± 4.3	80.4 ± 6.0	77.7 ± 6.4	69.6 ± 7.1
PA-Rest of State	80.8 ± 5.3	91.8 ± 3.8	89.5 ± 4.1	80.2 ± 5.4	90.2 ± 4.2	81.4 ± 5.9	87.4 ± 4.6	90.4 ± 3.9	83.7 ± 5.6	83.7 ± 4.8	71.6 ± 6.5
Rhode Island	89.9 ± 3.8	96.2 ± 2.7	94.8 ± 3.1	86.3 ± 4.5	97.5 ± 1.9	85.9 ± 4.2	93.8 ± 3.1	95.4 ± 3.0	89.7 ± 4.0	85.6 ± 4.5	79.4 ± 5.1
South Carolina	86.3 ± 5.4	91.4 ± 4.6	91.7 ± 4.4	75.1 ± 6.5	93.3 ± 4.3	79.3 ± 6.1	87.8 ± 5.3	91.0 ± 4.4	86.1 ± 5.5	81.0 ± 5.9	72.3 ± 6.6
South Dakota	76.5 ± 7.6	90.3 ± 5.3	92.2 ± 4.1	81.5 ± 6.7	92.2 ± 4.6	79.4 ± 7.2	90.5 ± 4.3	91.0 ± 4.6	80.4 ± 7.3	76.5 ± 8.0	68.6 ± 8.2
Tennessee	82.1 ± 5.8	94.5 ± 3.2	92.7 ± 3.6	73.1 ± 6.5	93.8 ± 3.3	73.8 ± 6.5	92.0 ± 3.7	92.4 ± 3.9	82.6 ± 5.8	75.2 ± 6.3	62.7 ± 7.0
Texas	83.0 ± 5.4	91.1 ± 4.3	93.3 ± 3.5	79.7 ± 5.8	91.2 ± 4.0	84.1 ± 4.6	92.2 ± 3.7	93.6 ± 3.5	83.3 ± 5.5	74.0 ± 6.4	70.6 ± 6.4
TX-Bexar County	81.7 ± 6.6	87.8 ± 5.5	89.1 ± 4.9	79.5 ± 6.6	87.8 ± 5.2	74.6 ± 7.4	89.9 ± 4.7	89.6 ± 4.9	72.1 ± 7.8	71.3 ± 8.0	64.2 ± 8.3
TX-City of Houston	80.1 ± 7.5	92.9 ± 4.8	89.3 ± 5.5	80.3 ± 7.3	90.0 ± 5.4	76.3 ± 8.1	89.6 ± 5.6	90.7 ± 5.0	81.5 ± 7.2	73.1 ± 9.1	70.8 ± 8.5
TX-Rest of State	83.5 ± 6.6	91.1 ± 5.2	94.2 ± 4.2	79.7 ± 7.1	91.7 ± 4.8	86.1 ± 5.4	92.8 ± 4.5	94.3 ± 4.2	84.5 ± 6.6	74.4 ± 7.8	71.1 ± 7.8
Utah	85.6 ± 4.3	92.2 ± 3.2	90.9 ± 3.5	82.5 ± 4.6	90.3 ± 3.8	83.3 ± 4.6	90.6 ± 3.7	90.1 ± 3.6	84.3 ± 4.7	77.8 ± 5.4	74.7 ± 5.5
Vermont	88.6 ± 4.8	95.4 ± 3.0	95.8 ± 2.8	85.7 ± 5.2	94.8 ± 3.3	80.1 ± 5.6	90.7 ± 4.1	94.2 ± 3.1	89.5 ± 4.3	83.7 ± 5.0	79.7 ± 5.9
Virginia	79.9 ± 5.6	90.2 ± 4.5	87.2 ± 5.0	75.3 ± 5.9	89.9 ± 4.3	72.8 ± 6.2	86.4 ± 5.0	89.3 ± 4.6	79.3 ± 5.7	74.1 ± 6.1	70.5 ± 6.1
Washington	83.5 ± 4.6	92.1 ± 3.3	91.6 ± 3.1	82.6 ± 4.8	90.6 ± 3.5	81.3 ± 4.9	91.7 ± 3.4	92.7 ± 2.9	83.5 ± 4.5	76.5 ± 5.2	74.5 ± 5.4
West Virginia	82.8 ± 5.5	93.2 ± 3.6	92.2 ± 4.2	81.8 ± 5.5	92.3 ± 3.9	81.0 ± 5.9	90.6 ± 4.4	91.4 ± 4.3	81.4 ± 5.7	74.9 ± 6.7	71.1 ± 6.4
Wisconsin	83.3 ± 5.6	90.4 ± 4.4	88.6 ± 4.8	75.5 ± 6.5	92.6 ± 3.7	81.4 ± 6.0	85.1 ± 5.4	88.9 ± 4.8	84.4 ± 5.5	77.9 ± 6.3	71.3 ± 6.7
Wyoming	81.9 ± 6.1	93.1 ± 3.8	93.2 ± 3.7	80.2 ± 6.3	92.8 ± 3.6	73.5 ± 7.3	87.7 ± 5.1	92.1 ± 4.1	79.4 ± 6.4	76.2 ± 6.7	68.3 ± 7.5
U.S. Virgin Islands	54.4 ± 17.7	85.5 ± 11.3	80.8 ± 13.1	63.6 ± 16.7	86.4 ± 11.2	62.2 ± 17.8	74.7 ± 16.6	81.3 ± 13.0	61.8 ± 17.8	50.4 ± 18.3	32.6 ± 15.1
Guam	46.2 ± 13.6	63.5 ± 13.4	72.4 ± 12.1	44.4 ± 13.7	64.6 ± 12.9	83.7 ± 9.4	66.0 ± 12.9	70.0 ± 12.3	48.9 ± 13.8	44.8 ± 11.9	34.7 ± 13.6
Puerto Rico	66.2 ± 7.0	78.8 ± 6.3	76.1 ± 6.4	59.5 ± 7.4	77.4 ± 6.3	76.5 ± 6.3	78.2 ± 6.2	80.6 ± 5.8	64.1 ± 7.1	59.9 ± 7.3	50.0 ± 7.4

[*] Estimates presented as point estimate (%) ± 95% Confidence Interval half width. Estimate=NA (Not Available) if the unweighted sample size for the denominator was < 30, or (CI half width)/Estimate > 0.588, or (CI half width) >10.

[†] Children in the 2023 NIS-Child were born between January 2020 through May 2022. Vaccination coverage estimates include only children who had adequate provider-reported immunization records.

[§] 4 or more doses of diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed, diphtheria and tetanus toxoids and pertussis vaccine, or diphtheria and tetanus toxoids vaccine adsorbed (DTaP/DTP/DT).

[¶] 3 or more doses of any poliovirus vaccine.

** 1 or more doses of measles-mumps-rubella vaccine

[††] 4 or more doses of Haemophilus influenzae type b (Hib) vaccine of any type or 2 doses of Hib of Merck types followed by 1+ dose of Hib of any type.

[¶¶] 3 or more doses of hepatitis B vaccine.

*** 1 or more doses of varicella at or after child's first birthday, unadjusted for history of varicella illness.

[†††] 4 or more doses of pneumococcal conjugate vaccine (PCV).

[§§§] 4+ diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed, diphtheria and tetanus toxoids and pertussis vaccine, or diphtheria and tetanus toxoids vaccine adsorbed (DTaP/DTP/DT); 3+ poliovirus vaccine; 1+ measles-containing vaccine (MCV); full series Haemophilus influenzae type b conjugate vaccine (Hib), i.e., 3 or 4 doses depending on type of vaccine received; 3+ hepatitis B vaccine (Hep B); 1+ varicella at or after 12 months of age; and 4+ pneumococcal conjugate vaccine (PCV).

[¶¶¶] U.S. national estimates exclude U.S. territorie

Appendix E: Trends in NIS-Child Response Rates and Vaccination Coverage Rates, 1995-2023

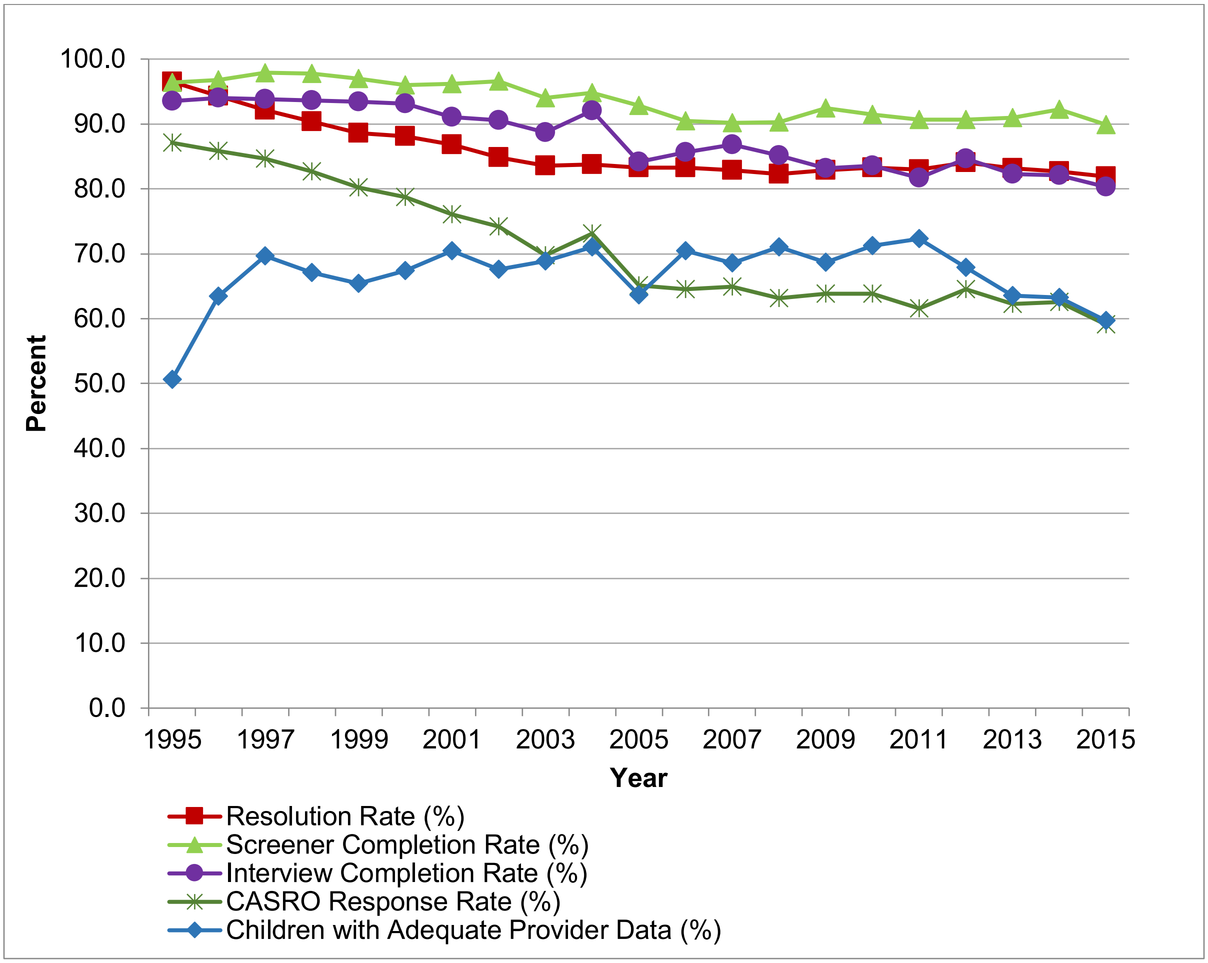
Table E.1: Key Indicators* from Landline Sample Household and Provider Data Collection by Survey Year, National Immunization Survey - Child, 1995-2017†

Survey Year	Resolution Rate (%)	Screener Completion Rate (%)	Interview Completion Rate (%)	CASRO Response Rate (%)	Children with Adequate Provider Data (%)
1995	96.5	96.4	93.5	87.1	50.6
1996	94.3	96.8	94.0	85.8	63.4
1997	92.1	97.9	93.8	84.6	69.7
1998	90.4	97.8	93.6	82.7	67.1
1999	88.6	97.0	93.4	80.2	65.4
2000	88.1	96.0	93.1	78.7	67.4
2001	86.8	96.2	91.1	76.1	70.4
2002	84.8	96.6	90.6	74.2	67.6
2003	83.6	94.0	88.7	69.8	68.9
2004	83.8	94.8	92.0	73.1	71.0
2005	83.3	92.8	84.2	65.1	63.6
2006	83.3	90.5	85.6	64.5	70.4
2007	82.9	90.2	86.8	64.9	68.6
2008	82.3	90.3	85.1	63.2	71.0
2009	82.9	92.4	83.2	63.8	68.7
2010	83.3	91.5	83.6	63.8	71.2
2011	83.0	90.7	81.7	61.6	72.3
2012	84.1	90.7	84.6	64.5	67.9
2013	83.2	91.0	82.3	62.3	63.5
2014	82.7	92.2	82.1	62.6	63.3
2015	81.9	89.9	80.3	59.1	59.7
2016	81.6	88.4	77.2	55.7	58.6
2017	80.8	84.4	76.1	51.9	57.2

* For the definition of the key indicators see Table 1 of NIS-Child Data User's Guide for the survey year of interest.

† Excludes U.S. territories.

Figure E.1: Trends in Landline Sample Key Indicators from Household and Provider Data Collection by Survey Year, National Immunization Survey - Child, 1995-2017*



* Excludes U.S. territories.

Figure E.1 provides a graphical representation of the data contained in Table E.1. It shows how selected landline sample key indicators from the household and provider data collection performed throughout the years, from 1995 to 2017. (The NIS utilized a single-frame cellular phone design beginning in 2018.) We observe that the trend in the data collection rates was downward, with the exception of the percentage of children with adequate provider data, which had been essentially flat from 1997-2012, but also trended downward from 2013-2017. Note that this chart reflects the landline sample only.

Table E.2: Key Indicators* from Cellular Phone Sample Household and Provider Data Collection by Survey Year, National Immunization Survey - Child, 2011-2023†

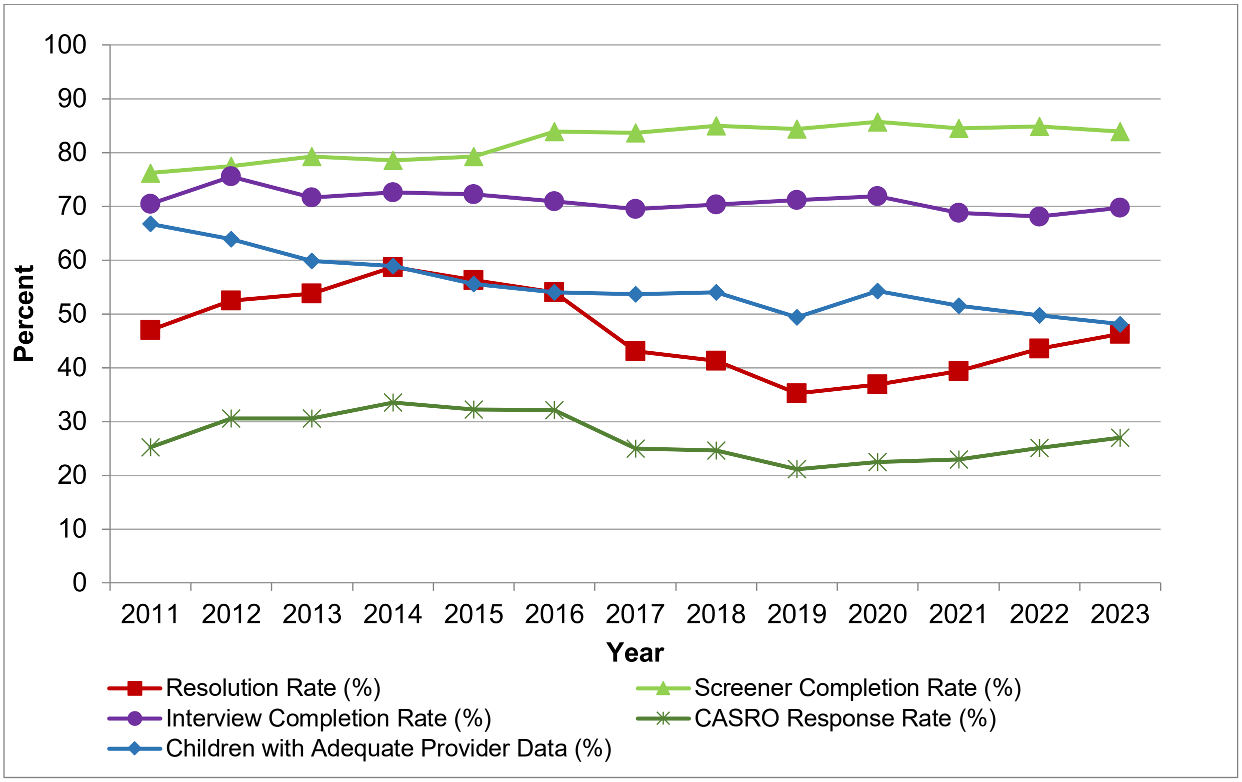
Survey Year§	Resolution Rate (%)	Screener Completion Rate (%)	Interview Completion Rate (%)	CASRO Response Rate (%)	Children with Adequate Provider Data (%)
2011	47.0	76.2	70.4	25.2	66.7
2012	52.4	77.5	75.5	30.6	63.9
2013	53.8	79.3	71.6	30.5	59.8
2014	58.7	78.5	72.6	33.5	58.9
2015	56.3	79.3	72.2	32.2	55.5
2016	54.0	83.9	70.9	32.1	54.0
2017	43.0	83.7	69.5	25.0	53.6
2018	41.2	84.9	70.3	24.6	54.0
2019	35.2	84.4	71.1	21.1	49.4
2020	36.8	85.7	71.8	22.5	54.2
2021	39.4	84.5	68.8	22.9	51.5
2022	43.5	84.8	68.1	25.1	49.7
2023	46.2	83.9	69.7	27.0	48.1

*For the definition of the key indicators see Table 1 of NIS-Child Data User's Guide for the survey year of interest.

† Excludes U.S. territories.

§ Cellular phone sample was added to the NIS-Child in 2011.

Figure E.2: Trends in Cellular Phone Sample Key Indicators from Household and Provider Data Collection by Survey Year, National Immunization Survey - Child, 2011-2023*



* Excludes U.S. territories.

Figure E.2 provides a graphical representation of the data contained in Table E.2. It shows how selected cellular phone sample key indicators from the household and provider data collection performed from 2011 to present. We observe that the rates since the inception of the cellular phone sample were fairly flat from 2011 to 2016, with the exception of the percent of children with adequate provider data, which fell throughout this period. There was a decline in the resolution rate beginning in 2017, leading to a decline in the CASRO response rate, but both have been gradually rising again since 2019.

The response rate is the number of households with a completed household interview divided by the estimated number of eligible households in the sample. Within each sample type (landline or cellular phone), the number of eligible households was estimated using the CASRO assumptions; these assumptions are that the rate of households among the unresolved telephone numbers is the same as the observed rate of households among the resolved telephone numbers, and the rate of eligible households among unscreened households is the same as the observed rate of eligible households among screened households. Under these assumptions, within each sample type the CASRO response rate is equal to the product of the resolution rate, the screener completion rate, and the interview completion rate. For the combined samples, we have defined the CASRO response rate as the total number of households with a completed interview divided by the estimated total number of eligible households across both sample types, where the estimated total number of eligible households is equal to the sum of the estimated number of eligible households in the landline sample (using CASRO assumptions) and the estimated number of eligible households in the cellular phone sample (using CASRO assumptions). Table E.3 presents the CASRO response rate calculated in this way for the combined landline and cellular phone samples, by survey year, and Figure G.3 presents a graphical representation. Because the CASRO response rate is lower for the cellular phone sample than for the landline sample, the CASRO response rate for the combined landline and cellular phone samples was lower in years with a larger cellular phone sample and higher in years with a smaller cellular phone sample.

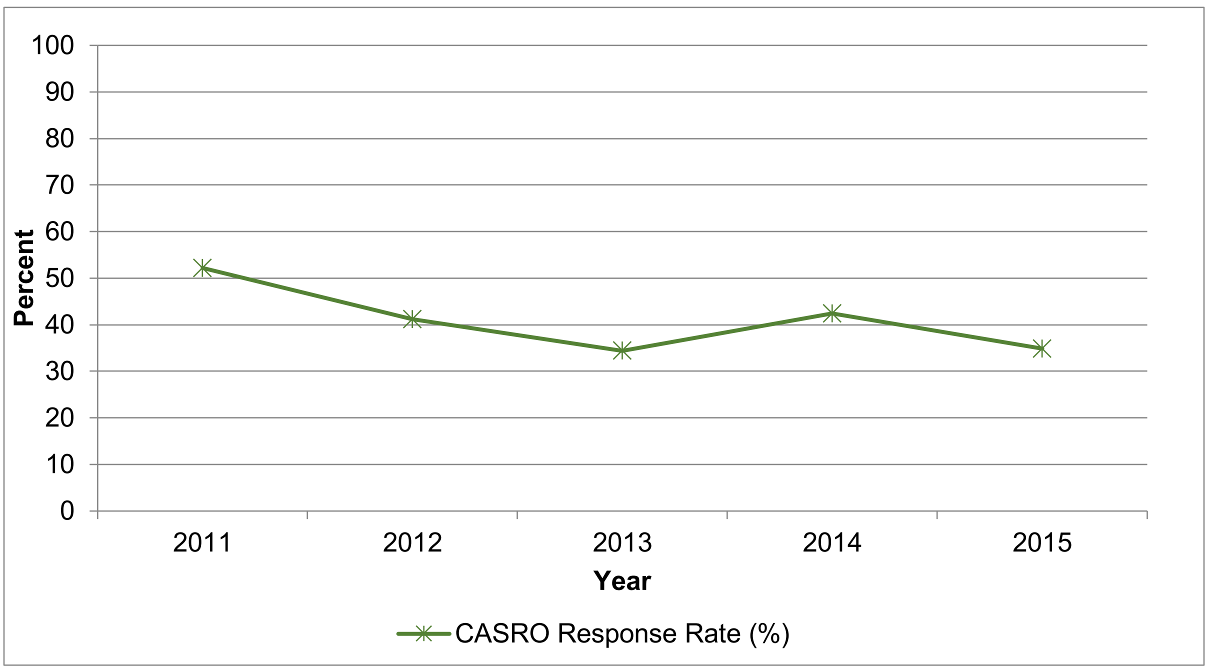
Table E.3: CASRO Response Rate for the Combined Landline and Cellular Phone Samples by Survey Year, National Immunization Survey - Child, 2011-2017*

Survey Year†	CASRO Response Rate (%)
2011	52.2
2012	41.2
2013	34.4
2014	42.5
2015	34.9
2016	33.9
2017	26.1

* Excludes U.S. territories.

† Cellular phone sample was added to the NIS-Child in 2011. The NIS-Child transitioned from a dual-frame landline and cellular phone RDD sample design to a single-frame cellular phone RDD sample design beginning in 2018.

Figure E.3: Trend in CASRO Response Rate for the Combined Landline and Cellular Phone Samples by Survey Year, National Immunization Survey - Child, 2011-2017*



* Excludes U.S. territories.

Table E.4: Vaccine-Specific Coverage Levels Among Children Age 19-35 Months in the United States by Survey Year, National Immunization Survey - Child, 1995-2023*

Survey Year†	4+ DTaP	3+ Polio	1+ MMR	3+ Hib§	3+ Hep B	1+ Varicella¶	4+ PCV	4:3:1**	4:3:1:3††
1995	78.4	87.8	89.8	91.2	67.9	N.A.	N.A.	76.0	73.7
1996	81.1	91.0	90.6	91.4	81.8	12.0	N.A.	78.4	76.4
1997	81.5	90.7	90.4	92.5	83.6	25.8	N.A.	77.9	76.2
1998	83.9	90.8	92.0	93.4	87.0	43.2	N.A.	80.6	79.2
1999	83.3	89.6	91.5	93.5	88.1	57.5	N.A.	79.9	78.4
2000	81.7	89.5	90.5	93.4	90.3	67.8	N.A.	77.6	76.2
2001	82.1	89.4	91.4	93.0	88.9	76.3	N.A.	78.6	77.2
2002	81.6	90.2	91.6	93.1	89.9	80.6	N.A.	78.5	77.5
2003	84.8	91.6	93.0	93.9	92.4	84.8	N.A.	82.2	81.3
2004	85.5	91.6	93.0	93.5	92.4	87.5	N.A.	83.5	82.5
2005	85.7	91.7	91.5	93.9	92.9	87.9	53.7	83.1	82.4
2006	85.2	92.8	92.3	93.4	93.3	89.2	68.4	83.1	82.2
2007	84.5	92.6	93.2	92.6	92.7	90.0	75.3	82.8	80.1
2008	84.6	93.6	92.1	90.9	93.5	90.7	80.1	82.5	79.6
2009	83.9	92.8	90.0	83.6	92.4	89.6	80.4	81.5	73.4
2010	84.4	93.3	91.5	90.4	91.8	90.4	83.3	82.0	78.8
2011	84.6	93.9	91.6	94.0	91.1	90.8	84.4	82.6	81.9
2012§§	82.5	92.8	90.8	93.0	89.7	90.2	81.9	80.5	80.0
2013	83.1	92.7	91.9	92.8	90.8	91.2	82.0	81.5	81.1
2014	84.2	93.3	91.5	92.6	91.6	91.0	82.9	82.6	82.0
2015	84.6	93.7	91.9	93.2	92.6	91.8	84.1	83.2	82.6
2016	83.4	91.9	91.1	91.6	90.5	90.6	81.8	81.9	81.2
2017	83.2	92.7	91.5	91.8	91.4	91.0	82.4	81.7	80.9
2018	83.8	93.6	92.1	91.6	92.1	92.0	83.3	82.5	81.7
2019	83.3	92.3	91.3	90.9	91.3	90.9	82.5	82.3	81.7
2020	84.2	93.9	92.9	92.4	92.8	92.7	83.2	83.3	82.8
2021	84.4	93.8	92.1	92.6	93.2	91.6	84.6	83.3	82.8
2022	84.5	93.5	93.0	92.4	92.9	92.6	83.9	83.6	83.2
2023	82.2	91.9	91.1	90.5	91.3	90.9	81.4	81.4	80.8

* Excludes U.S. territories.

† Prior to 2011, estimates are single-frame, landline-sample estimates. From 2011-2017, estimates are dual-frame (landline plus cellular phone) estimates. From 2018 onward, estimates are single-frame, cellular phone estimates.

§ Beginning in 2009, the number of doses required to be up-to-date on Hib depends on the manufacturer of the vaccine. However, the figures shown here refer to 3 or more doses of Hib vaccine regardless of manufacturer.

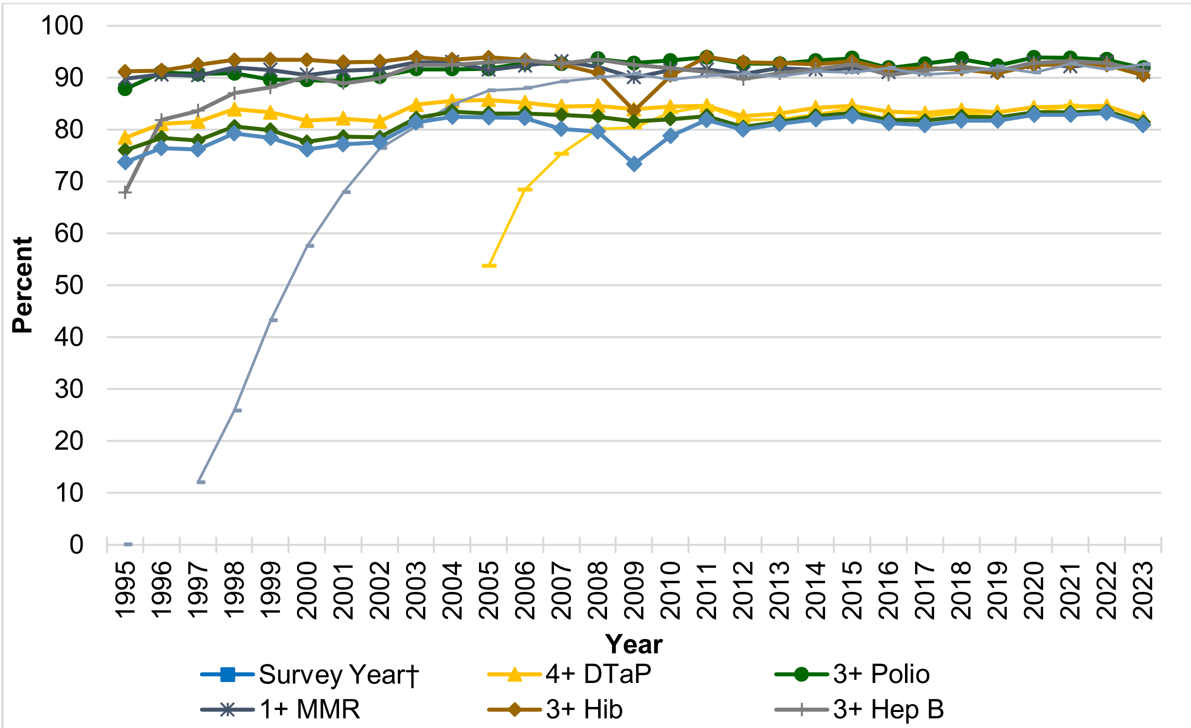
¶ Varicella was added to the NIS-Child in 1996.

** Four or more doses of DTaP, three or more doses of poliovirus vaccine, and one or more doses of MCV.

†† Four or more doses of DTaP, three or more does of poliovirus vaccine, one or more doses of MCV, and three or more doses of Hib.

§§ Revised definition of adequate provider data (APD) implemented.

Figure E.4: Trends in Vaccine-Specific Coverage Levels among Children 19 through 35 Months of Age in the United States by Survey Year, National Immunization Survey - Child, 1995-2023*†¶



* Excludes U.S. territories.

† Prior to 2011, estimates are single-frame, landline-sample estimates. From 2011-2017, estimates are dual-frame (landline plus cellular phone) estimates. From 2018 onward, estimates are single-frame, cellular phone estimates.

¶ Revised definition of adequate provider data (APD) implemented in 2012.

Figure E.4 provides a graphical representation of the data contained in Table E.4. It displays the trend in vaccine-specific coverage levels among children aged 19 through 35 months from 1995 to present. We observe that the trend in the vaccination coverage levels is stable or slightly upward for the longer-established vaccines, while the early trends for new vaccines are strongly upward. Note that this chart reflects the landline sample prior to 2011, the dual-frame sample in 2011-2017, and the single-frame cellular phone sample thereafter. For more information on interpreting trends in vaccination coverage, see online reports at https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-vax-trends-2012-2016.html.

Appendix F: Vaccine Type Codes

Table F.1: 2023 NIS-Child Vaccine Type Codes

Vaccine Code	Description
03	DTaP/DTP/DT-containing, unknown type
04	DTaP/DTP/DT-only
07	DTaP-Hib
08	DTaP-HepB-IPV
20	OPV
21	IPV
22	Polio-containing, unknown type
30	Measles-mumps-rubella
31	Measles-only
32	Measles-mumps
33	Measles-rubella
43	HepB-Hib
44	Hib-only, unknown type
60	HepB-only
70	Pneumococcal conjugate, unknown type
71	Pneumococcal polysaccharide
72	Pneumococcal-containing, unknown type
73	Pneumococcal conjugate-7
74	Pneumococcal conjugate-13
75	Pneumococcal conjugate-15
76	**Pneumococcal conjugate-20**
CM	**COVID-19 (Moderna)**
CP	**COVID-19 (Pfizer)**
CX	**COVID-19, unknown type**
D3	DTaP-IPV-Hib
D4	DTaP-IPV-Hib-HepB
FL	Seasonal influenza, unknown type
FM	Seasonal influenza spray
FN	Injected seasonal influenza
HB	HepB-containing, unknown type
HG	Hib-only (GSK)
HI	Hib-containing, unknown type
HM	Hib-only (Merck)
HS	Hib-only (Sanofi)
HY	Hib-MenCY
MM	Measles-containing, unknown type
RG	Rotarix (GSK)

Vaccine Code	Description
RM	Rotateq (Merck)
RO	Rotavirus-containing, unknown type
VA	Varicella-containing, unknown type
VM	MMR-varicella
VO	Varicella-only

Appendix G: Key NIS-Child Response Rates by Area

Table G.1: Key Indicators* for the Cellular Phone Sample by Estimation Area, National Immunization Survey - Child, 2023

Area	Resolution Rate (%)	Screener Completion Rate (%)	Interview Completion Rate (%)	CASRO Response Rate (%)	Children with Adequate Provider Data (%)
U.S. National†	46.2	83.9	69.7	27.0	48.1
Alabama	51.3	84.2	62.4	26.9	48.2
Alaska	55.1	82.1	78.8	35.6	60.8
Arizona	40.3	86.0	63.9	22.2	44.4
Arkansas	53.5	83.0	69.6	30.9	48.2
California	41.3	86.0	64.9	23.1	40.5
Colorado	40.8	87.4	69.4	24.7	45.2
Connecticut	34.9	81.3	73.0	20.7	49.1
Delaware	42.8	82.6	65.5	23.1	44.4
District of Columbia	44.3	81.9	75.2	27.3	40.1
Florida	37.7	80.2	72.0	21.7	45.5
Georgia	42.8	79.0	72.2	24.4	50.3
Hawaii	36.4	83.0	62.0	18.7	44.1
Idaho	38.5	83.4	78.4	25.2	51.2
Illinois	49.6	85.3	65.2	27.6	44.6
IL-City of Chicago	49.4	83.6	64.5	26.6	43.7
IL-Rest of State	49.7	86.0	65.6	28.0	45.0
Indiana	47.7	86.0	65.9	27.0	49.6
Iowa	51.5	86.3	77.4	34.4	53.3
Kansas	48.8	84.6	72.3	29.9	54.7
Kentucky	47.1	83.5	71.7	28.2	49.7
Louisiana	51.4	82.1	66.3	28.0	42.9
Maine	42.3	85.8	69.0	25.0	52.2
Maryland	44.8	82.7	74.6	27.7	49.6
Massachusetts	48.8	86.9	64.1	27.2	50.7
Michigan	54.4	83.9	74.8	34.2	52.9
Minnesota	41.7	87.9	68.6	25.1	47.3
Mississippi	51.5	80.0	65.8	27.1	46.6
Missouri	48.6	83.9	77.1	31.5	53.9
Montana	42.5	84.8	69.1	24.9	48.0
Nebraska	45.9	85.5	73.3	28.7	57.9
Nevada	39.4	82.5	66.9	21.7	48.0
New Hampshire	44.1	84.3	67.3	25.0	49.5

Area	**Resolution Rate (%)**	**Screener Completion Rate (%)**	**Interview Completion Rate (%)**	**CASRO Response Rate (%)**	**Children with Adequate Provider Data (%)**
New Jersey	45.1	84.9	59.9	22.9	41.6
New Mexico	42.6	84.8	73.1	26.4	48.8
New York	44.6	83.8	67.3	25.2	44.9
NY-City of New York	37.5	78.7	66.5	19.6	43.5
NY-Rest of State	47.0	86.3	68.5	27.8	46.9
North Carolina	42.5	84.6	68.9	24.8	48.0
North Dakota	49.5	82.4	76.7	31.3	42.4
Ohio	46.7	81.8	77.4	29.5	51.5
Oklahoma	51.6	84.9	69.5	30.5	45.4
Oregon	41.9	88.2	71.0	26.2	50.7
Pennsylvania	45.2	83.6	65.3	24.7	45.9
PA-Philadelphia County	45.0	80.9	64.8	23.6	45.7
PA-Rest of State	45.6	86.9	66.4	26.3	46.0
Rhode Island	39.1	79.9	74.6	23.3	55.7
South Carolina	44.5	85.2	63.7	24.2	43.6
South Dakota	51.9	82.2	74.5	31.7	49.6
Tennessee	44.2	81.1	72.1	25.8	49.7
Texas	43.0	83.1	63.3	22.6	40.3
TX-Bexar County	39.5	82.9	62.9	20.6	42.3
TX-City of Houston	44.3	82.7	62.5	22.9	39.6
TX-Rest of State	45.5	84.4	66.0	25.3	39.6
Utah	40.9	83.3	81.4	27.8	56.3
Vermont	39.3	76.8	78.1	23.6	62.8
Virginia	45.0	87.1	68.3	26.8	44.8
Washington	36.9	82.3	78.2	23.8	55.7
West Virginia	56.3	84.2	63.7	30.3	44.5
Wisconsin	46.7	86.1	72.1	29.0	47.0
Wyoming	59.7	76.3	75.4	34.4	57.3
Puerto Rico	50.4	88.3	62.8	27.9	32.7
U.S. Virgin Islands	60.6	81.2	53.9	26.5	37.1
Guam	39.2	75.0	47.4	14.0	41.8

* For the definition of the key indicators see Table 1 of NIS-Child Data User's Guide.

† Excludes U.S. territories.