



# COMPARING & COMMUNICATING VACCINATION COVERAGE ESTIMATES

From Immunization Information Systems,  
the National Immunization Survey, and Related Assessments

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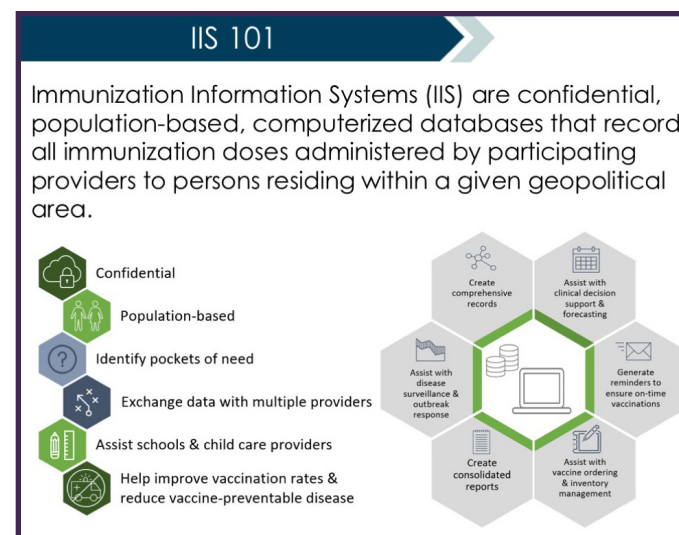
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## EXECUTIVE SUMMARY

When it comes to assessing or estimating vaccination rates or coverage, there are many sources available to immunization managers and programs. They range from national estimates from the U.S. Centers for Disease Control and Prevention (CDC) to assessments based on immunization information systems (IIS). IIS are confidential, population-based, computerized databases that record all immunization doses administered by participating providers to persons within a certain geographic area. As such, IIS are a valuable source of population-based vaccination data. Increasingly, IIS staff and immunization programs are called upon to use IIS data to produce vaccination coverage assessments for their jurisdictions and smaller geographic areas (such as a district or county). Many of the more mature IIS are already using their IIS data for this purpose. At the same time, the Centers for Disease Control and Prevention (CDC) oversees the National Immunization Survey (NIS). Since 1994, the NIS has produced annual national, state, and selected metropolitan area vaccination coverage estimates using a random digit dial survey methodology. Public health staff—especially from immunization programs and IIS—are frequently called upon to describe the results of the NIS as well as IIS-based and other coverage assessments. Results among the assessments often vary, and it can be challenging to explain the differences, especially to policy makers, journalists, and the public. This document was developed to provide background information on the common coverage assessments and to offer practical guidance for interpreting and communicating vaccination rates to three main audiences: senior public health leadership, legislators, and the media.

The target users for this guide are IIS and immunization program staff at the state or jurisdiction level. In addition, CDC staff and members of public health policy and advocacy groups, such as immunization coalitions, may find information in the guide helpful. The focus of this guide is on interpreting, comparing and communicating IIS-based and NIS vaccination coverage assessment results.

The first part of the guide provides details on important aspects of methodology as well as limitations and strengths of both the NIS and IIS approaches to vaccination coverage assessment. In addition to NIS- and IIS-based assessments, the guide briefly describes several other common coverage assessments. It also provides general tools that can be applied to all coverage assessments in determining their relevance, significance, and limitations. The second part of the guide covers process and methods for communicating assessment results to senior leadership, legislators, and media. The guide reviews principles of communication with an emphasis on using easy-to-understand language. Suggestions for message development include recommendations for key messages, talking points, graphs, and charts. Examples are provided. Finally, collaborative opportunities between the NIS and IIS for vaccination coverage assessments are described.



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## SECTION I: INTRODUCTION TO GUIDE

### BACKGROUND

Immunization program staff are frequently called upon to describe the results of various vaccination coverage assessments to public health leadership, legislators, and the media. Immunization Information System (IIS) staff also receive requests to explain coverage assessment results derived from the IIS. This frequently includes explaining the results of surveys, such as the National Immunization Survey (NIS), and comparing them to IIS-generated vaccination coverage results. This task can be challenging by itself, and challenges are compounded when other coverage assessments appear inconsistent with results from the IIS. Measurement of vaccination coverage is complex, and it is often difficult to understand and explain how well NIS, IIS, and other coverage assessment tools measure what is intended. Yet this understanding is critical to the appropriate interpretation of results.

AIRA supports IIS in their use of data for coverage assessments. AIRA's 2015-2020 Capacity Cooperative Agreement with the Centers for Disease Control and Prevention (CDC) includes identifying strategies that support the development and dissemination of methodologies for IIS-based coverage assessments.<sup>1</sup> Past AIRA efforts in this area have included the production of the [Analytic Guide for Assessing Vaccination Coverage Using an IIS](#)<sup>2</sup> and the subsequent [Practical Examples of IIS Population-Based Coverage Assessments](#).<sup>3</sup> Recently, AIRA members have requested assistance interpreting and comparing IIS and NIS coverage assessment results. In September 2016, AIRA's Assessment Steering Committee unanimously agreed to develop a guide that provides recommendations and practical strategies for communicating NIS, IIS and other coverage assessment results. This guide, titled *"Comparing and Communicating Vaccination Coverage Estimates from Immunization Information Systems, the National Immunization Survey, and Related Assessments"* (hereinafter referred to as the guide), has been created to provide clear guidance on the topic.

### PURPOSE

The purpose of this guide is to assist IIS and immunization program managers and staff in interpreting and communicating the results of NIS and IIS-based coverage assessments and, to a lesser extent, other related immunization coverage assessments. This guide is intended to be easy to read and to offer practical tips and tools that can be used to help explain vaccination coverage assessment results to decision makers, such as senior public health leadership and legislators, media, and other interested parties.

### TARGET AUDIENCE

The target users for the guide are IIS and immunization program staff at the state and local level. In addition, CDC staff and members of public health policy and advocacy groups, such as immunization coalitions, may find information in the guide helpful.

### PROCESS OF DEVELOPING THE GUIDE

To create this guide, AIRA assembled a workgroup of subject matter experts (SMEs) from the IIS and immunization program community, as well as CDC partners, public health consultants, and AIRA staff. (See list of participants in the [Acknowledgements](#) section.) With the support of a public health consultant and an AIRA project manager, the SME workgroup met via telephone once or twice a month from November 2016 through May of 2017 to share experiences and strategies related to this topic.

During the initial phase of the project, the consultant and AIRA staff gathered and reviewed existing materials describing NIS, IIS and other common sources of immunization coverage estimates. The workgroup contributed materials such as reports, graphs, and presentations relevant to the topic. They reviewed documents and made recommendations on strategies, tips, and tools to include in the guide. In addition, experts in the area of public health

<sup>1</sup> AIRA's Capacity Cooperative Agreement, Strategy 1b.

<sup>2</sup> AIRA. Analytic Guide for Assessing Vaccination Coverage Using an IIS. November 2015. <http://repository.immregistries.org/resource/analytic-guide-for-assessing-vaccination-coverage-using-an-iis/>.

<sup>3</sup> AIRA. Practical Examples of IIS Population-Based Coverage Assessments: An Addendum to the Analytic Guide for Assessing Vaccination Coverage Using an IIS. March 2017. <http://repository.immregistries.org/resource/practical-examples-of-iis-population-based-coverage-assessments/>.

communication were identified who provided feedback on the guide's communication recommendations.

The consultant drafted and revised the guide based on input and feedback from the workgroup, policy experts, and others. Finally, the document was reviewed by AIRA staff, the AIRA Board of Directors, and the IIS community, with the final version completed in June 2017.

## SCOPE OF GUIDE

The focus of this guide is on interpretation and communication of IIS-based and NIS vaccination coverage assessment results to senior public health leadership, legislators, and the media. The guide briefly describes several common coverage assessments in addition to NIS and IIS and provides tools for determining the relevance, significance, and limitations of population/geographic-based coverage assessments in general. Because this guide explores only population-based assessments, it does not include provider-based assessments, such as AFIX. Instruction on how to use an IIS to produce immunization coverage results is **out of scope** for this guide but is covered in AIRA's [Analytic Guide for Assessing Vaccination Coverage Using an IIS](#).

## NAVIGATION TIPS

It is not necessary to read this guide from front to back to get value from it. Depending on specific needs and interests, readers can easily skip around to the sections most relevant to them. Internal hyperlinks will aid readers to move to the desired pages. These clickable links also take readers to sections and subsections, as well as tables and figures within the guide. For example, links within [Table 1](#) connect to the specific coverage assessment of interest. Since NIS and IIS-based assessments are the guide's focus, their details are provided directly within [Section II](#), with information on methodology, interpretation of results, and strengths and weaknesses. Other assessments, such as the School Vaccination Assessment Program (SVAP) and the Pregnancy Risk Assessment Monitoring System (PRAMS), are described in [Appendix B](#). Readers who are already familiar with NIS and IIS-based assessment methodologies may

want to skip straight to Section III or IV. [Section III](#) provides guidance on developing communication messages. It includes a message template and examples and demonstrates how to tailor the message to the particular audience being addressed. Next, [Section IV](#) offers practical communication strategies, such as specific key points, messaging, and sample graphs that will help in developing messaging tools. [Section V](#) offers collaborative opportunities between the NIS and IIS for vaccination coverage assessments.

In addition to internal hyperlinks, the guide also provides links to external resources and their websites. Links are usually found in the footnotes or in [Appendix H](#)'s list of references. The appendices also include details on a variety of related topics, which are noted within the main narrative.

## SECTION II. DESCRIPTIONS OF COMMON VACCINATION COVERAGE ASSESSMENTS

This guide focuses primarily on National Immunization Survey (NIS) and IIS-generated coverage assessments. Other vaccination coverage assessments are described more briefly in [Appendix B](#). Click on the assessment name in the table below to go directly to its description.

**Table 1. Assessments Described in This Guide**

Assessment	Purpose	Groups Assessed	Vaccines Assessed
Described in Section II:			
<a href="#"><u>National Immunization Survey (NIS)</u></a>	Provides household, population-based, national, state and local area estimates	19-35 months 13-17 years 6 months-17 years (influenza only)	For 19- through 35-month-olds: All ACIP recommended vaccines for children birth-18 months  For 13- through 17-year-olds: Tdap, MenACWY, HPV, MMR, Hep B, Varicella  For all children 6 months through 17 years: Influenza
<a href="#"><u>Immunization Information Systems (IIS)-based Assessment</u></a>	Provides population-based estimates within a jurisdiction, with ability to measure performance or protection levels within a community	Any ages	Any vaccines
Described in <a href="#">Appendix B</a> :			
<a href="#"><u>Healthcare Effectiveness Data &amp; Information Set (HEDIS)</u></a>	Assesses quality of care of health insurance plans	Children who turned 2 years of age and adolescents who turned 13 years during assessment year and who are enrolled in the health plan	For 2-year-olds: All ACIP vaccines recommended for children birth through 18 months of age and received by 2nd birthday.  For 13-year-olds: MCV, Td/Tdap received by 13th birthday

<b><u>School Vaccination Assessment Program (SVAP)</u></b>	Assesses vaccination status of kindergarteners enrolled in public and private schools	Children entering kindergarten	MMR DTaP Varicella Polio Hep B Exemption status <i>Note: Requirements for school entry vary by state. Not all states report on all vaccines.</i>
<b><u>Behavioral Risk Factor Surveillance System (BRFSS)</u></b>	Collects behavioral health risk data at state and local level in order to target health promotion activities	Adults 18 years and above	Annually: Influenza & Pneumococcal HPV (optional module every year)  Alternating every 3rd year: Herpes Zoster Td/Tdap Place of influenza vaccination
<b><u>Internet Flu Panels</u></b>	Monitors health issues of special populations at the national level  Measures Influenza vaccination coverage of pregnant women and health care personnel	Pregnant women  Health care personnel	Influenza Tdap
<b><u>National Health Interview Survey (NHIS)</u></b>	Monitors health of U.S. population on range of health topics	Adults  Children	For adults: Influenza, Pneumococcal, Td/Tdap, Herpes Zoster, Hep A, Hep B, HPV  For children <18 years: Influenza only
<b><u>Pregnancy Risk Assessment Monitoring System (PRAMS)</u></b>	Assesses state-specific, population-based data on maternal attitudes and experiences	Pregnant women i.e., women who have had a recent live birth and are 2-4 months post partum	Influenza Tdap (optional for states)
<b><u>Minimum Data Set (MDS)</u></b>	Reports on clinical assessment, including vaccination status, of all residents in Medicare and Medicaid certified nursing homes (a federally mandated process)	Residents of nursing homes	Influenza Pneumococcal

## NATIONAL IMMUNIZATION SURVEY

**Background** – The NIS is a large, two-phase survey that produces annual estimates of vaccination coverage rates. It has included children 19 through 35 months of age since its inception in 1994.<sup>4</sup> (The 19- to 35-month NIS age cohort will be referred to as NIS-Child hereinafter.) Other age groups have been added over the years including teens 13 through 17 years (NIS-Teen) and influenza vaccinations for children 6 months through 17 years (NIS-Flu). Sponsored and directed by CDC’s National Center for Immunization and Respiratory Diseases (NCIRD), these surveys provide population-based, state, and select local area and territorial estimates of vaccination coverage among children and teens using a standard survey methodology. The NIS is defined as population-based because, through weighting adjustments of the survey sample, it is designed to represent the population.<sup>5</sup>

The family of NIS surveys are conducted by a survey organization under the direction of CDC.<sup>6</sup>

**Source of Data** – For NIS-Child and NIS-Teen, immunization records come from health care providers identified through a household contact from random digit dial surveys. For NIS-Flu, immunization histories are based on parent report.

**Methodology** – The surveys collect data from households through telephone interviews with parents or guardians. Landline and cell phone numbers are randomly selected and called to enroll an age-eligible child and/or teen from the household.<sup>7</sup> In households with an age-eligible child or teen, the respondents are asked to identify and give permission to contact their children’s vaccination providers. Later, these immunization providers are asked to submit the child’s vaccination record via a mailed immunization history questionnaire (along with a form documenting the parent or guardian’s consent). The questionnaire collects information on the types of vaccinations received, number of doses, and their dates of administration. Children are classified as being up to date based on the Advisory Committee on Immunization Practices (ACIP)-recommended number of doses for each vaccine.

The **NIS-Child** results for a given year are based on data collected for children who were 19 through 35 months at any time during each quarter of data collection. Thus, the range of birthdates for each annual estimate spans almost 2.5 years. After including time for analysis and release of results, the data may reflect vaccinations received from seven months to four years prior to results publication.

The **NIS-Teen** results for a given year are based on data collected for teens who were 13 through 17 years of age at any time during each quarter of data collection. Thus, the range of birthdates for each annual estimate spans approximately six years. For example, the 2015 survey included adolescents born between January 1997 and February 2003.<sup>8</sup> The NIS-Teen data could include vaccinations received six or more years prior to the release of results. See [Appendix C](#) for additional discussion of time lag.

The **NIS-Flu** assessment combines the responses collected from NIS-Child, NIS-Teen and the NIS-Childhood Influenza Module (CIM), which is conducted for households with children 6 through 18 months and 3 through 12 years for influenza vaccine only (i.e., age groups not included in the other two modules). The same influenza vaccination questions are asked throughout NIS-Child, NIS-Teen and NIS-CIM. Together these assessments are used to produce NIS-Flu, which assesses annual influenza vaccination coverage among children 6 months through 17 years at the national level, state level, select local levels, and in some U.S. territories. Unlike NIS-Child and NIS-Teen, the NIS-Flu estimates are based solely on the parent or guardian reported data, even for those children whose providers reported on other vaccines as part of NIS-Child and NIS-Teen.<sup>9, 10</sup>

4 For description of methodology over time, see Smith PJ, Hoaglin DC, Battaglia MP, et al. Statistical methodology of the National Immunization Survey, 1994–2002. Methodology for each year after 2002 is described in the annual data users guides, available online at <https://www.cdc.gov/vaccines/imz-managers/nis/data-tables.html>.

5 By comparison, IIS-based coverage assessments are population-based through capture of an (ideally) entire population group and analysis. Weighting adjustments are not required.

6 When this guide was released, the NIS was conducted by NORC at the University of Chicago, an independent research institution (<http://www.norc.org>) under contract with CDC. See <http://www.norc.org/Research/Projects/Pages/national-immunization-survey.aspx>.

7 Using a national dual landline and cellular list-assisted random digit dialed telephone survey methodology.

8 <https://www.cdc.gov/vaccines/imz-managers/nis/downloads/nis-teen-puf15-dug.pdf>

9 From “About the National Immunization Surveys” <https://www.cdc.gov/vaccines/imz-managers/nis/about.html#NIS-CIM>.

10 “Using parent-report influenza vaccination status for all ages allows more timely reporting of the past season’s estimates, and consistent approach to determining vaccination status across the age groups...” Personal communication, Jim Singleton, 1/17/17.

For children 19 through 35 months, the NIS national sample for 2015 had approximately 27,000 completed household interviews, with national coverage estimates based on a subsample of approximately 15,000 children with provider-based records.<sup>11</sup> For teens 13 through 17 years of age, the NIS national sample for 2015 included approximately 44,000 completed household interviews, with national coverage estimates based on a subsample of approximately 22,000.<sup>12</sup> At the state or jurisdiction level, 200-300 children are evaluated for NIS-Child, and 300-400 adolescents are evaluated for NIS-Teen.<sup>13</sup> Statistical methods are used to adjust for children whose parents refuse to participate, those who live in households without telephones, and those whose vaccinations cannot be obtained from providers.<sup>14</sup>

**Special considerations** – It is important to note that the coverage rates produced by NIS are *estimates*—often referred to as point estimates. Because a random sample of telephone numbers is taken, these rates have an associated statistical margin of error. Subtracting and adding the margin of error to the reported point estimate calculates the confidence interval (CI) for the point estimate. The CI reflects the expected range that the true rate would fall into most of the time (95% of the time in the case of NIS) if the survey had been replicated many times.<sup>15</sup> The larger the sample size, the narrower the CI and the more precise the point estimate. NIS estimates are typically published with margins of error or confidence intervals based on a 95% confidence level (explained in Footnote 17). Nationally, the total sample size is large enough to achieve a 1 to 2 percentage point margin of error. However, at the state level, the smaller sample size results in larger margins of error, e.g., 2 to 5 percentage points for MMR coverage and 4 to 9 percentage points for rotavirus vaccination coverage, in 2015.

An example from an NIS report will help illustrate these points about the impact of sample size and CI on the results. [Table 2](#) on the following page has been extracted from the October 2016 Morbidity and Mortality Weekly Report (MMWR) on 2015 Coverage Levels.<sup>16</sup>

11 <https://www.cdc.gov/vaccines/imz-managers/coverage/nis/child/tech-notes.html>

12 <https://www.cdc.gov/vaccines/imz-managers/nis/downloads/nis-teen-puf15-dug.pdf>

13 <https://www.cdc.gov/media/releases/2015/p0730-hpv.html>

14 A detailed description of the recent survey methodology and questionnaires is available at [www.cdc.gov/nchs/nis/data\\_files.htm](http://www.cdc.gov/nchs/nis/data_files.htm).

15 Note that this is strictly correct only if the only error in the survey was from random sampling. There are other systematic errors, e.g., from non-response bias and misclassification of vaccination status. For more information on random error and systematic error in the NIS, see [Appendix C](#).

16 CDC. Vaccination Coverage Among Children Aged 19–35 Months – United States, 2015. *MMWR Weekly* / October 7, 2016 / 65(39):1065–1071.

**Table 2. NIS 2015 Estimated Vaccination Coverage** (reproduced from Table 3, October 2016 MMWR)

Estimated vaccination coverage with selected individual vaccines and a combined vaccine series\* among children aged 19–35 months, overall and by U.S. Department of Health and Human Services (HHS) region and state and local area — National Immunization Survey, United States, 2015<sup>†</sup>

National, HHS region, state, and local area	Vaccine/Vaccine series					
	MMR (≥1 dose)	DTaP (≥4 doses) <sup>§</sup>	Hep B (birth dose) <sup>¶</sup>	HepA (≥2 doses)	Rotavirus**	Combined vaccine series
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
U.S. overall	91.9 (±0.8)	84.6 (±1.1)	72.4 (±1.4)	59.6 (±1.5)	73.2 (±1.4)	72.2 (±1.4)
HHS Region I	94.1 (±2.1)	88.9 (±2.7)	76.3 (±3.3)	65.4 (±3.9)	80.7 (±3.2)	77.8 (±3.3)
Connecticut	97.5 (±2.4)	90.8 (±4.5)	81.8 (±6.2)	72.0 (±7.3)	77.9 (±6.7)	80.6 (±6.0)
Maine	96.0 (±3.1)	92.0 (±5.0)	68.7 (±7.7)	53.8 (±8.3)	71.1 (±7.7)	71.8 (±7.9) <sup>††</sup>
Massachusetts	91.8 (±4.0)	87.2 (±5.1)	78.4 (±5.8)	65.7 (±6.9)	83.5 (±5.4)	78.5 (±6.0)
New Hampshire	93.4 (±3.9)	88.4 (±5.4)	72.0 (±7.0)	60.2 (±7.7)	80.9 (±6.2)	74.1 (±7.1)
Rhode Island	94.5 (±3.2)	90.5 (±4.1)	73.2 (±6.4)	65.1 (±6.9)	87.6 (±4.9)	77.2 (±6.0)
Vermont	95.5 (±2.7)	89.2 (±4.2)	49.4 (±6.7)	57.1 (±6.7)	72.7 (±6.2)	75.6 (±5.9)
HHS Region II	92.6 (±2.2)	88.1 (±2.7)	60.6 (±4.0)	53.4 (±4.1)	73.7 (±3.8) <sup>§§</sup>	73.4 (±3.7)
New Jersey	92.8 (±4.4)	89.8 (±4.8)	63.9 (±7.2)	58.3 (±7.4)	75.2 (±6.8)	76.5 (±6.5)
New York	92.5 (±2.6)	87.4 (±3.3)	59.0 (±4.7)	51.2 (±5.0)	73.0 (±4.5)	71.9 (±4.4)
City of New York	94.1 (±2.9)	85.5 (±5.0)	53.4 (±6.8)	47.8 (±6.9)	71.1 (±6.4)	68.2 (±6.5)
Rest of state (NY)	90.9 (±4.3)	89.2 (±4.3)	64.6 (±6.6)	54.6 (±7.2)	75.0 (±6.4)	75.7 (±6.1)

Notice the column headings of “% (95% CI).” The percentage in each column refers to the point estimate, and the parenthetical “95% CI” indicates the margin of error, expressed as a plus/minus number. To get the range within which the actual rate falls, the value in the CI column needs to be both added to and subtracted from the point estimate. Also, notice that the Combined Vaccine Series point estimate for the U.S. overall (top row) is **72.2%** plus or minus 1.4%, which gives a range of 70.8% to 73.6%. This means that 95% of the time, the actual vaccination rate in the U.S. is somewhere between 70.8% and 73.6%.<sup>17</sup> When we look at the Connecticut estimate of **80.6%** for the same vaccine series, we find that the 95% CI at  $\pm 6.0$  is much larger than the national level CI and creates a total span of 12 percentage points—from a possible low of 74.6% to a possible high of 86.6%.

Next, we will compare Connecticut to New Hampshire. New Hampshire’s point estimate is **74.1%**, 6.5 percentage points lower than Connecticut’s 80.6%. But New Hampshire’s CI of 7.1 produces a range of 67.0% to 81.2%. Thus, New Hampshire’s highest possible rate of 81.2% overlaps considerably with Connecticut’s range of 74.7% to 86.7% and is, in fact, slightly higher than Connecticut’s

point estimate. Because of the statistical uncertainty (i.e., sampling error) in the estimates, we cannot conclude that Connecticut’s true vaccination rate is higher than New Hampshire’s.

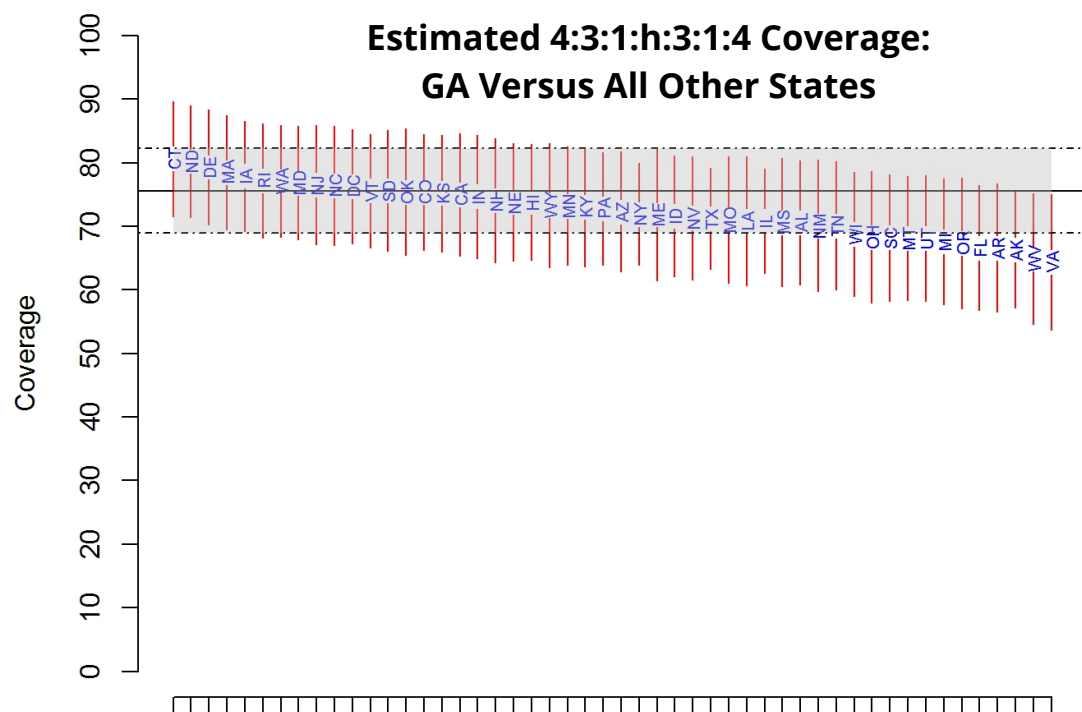
[Figure 1](#) on the next page also demonstrates the importance of considering confidence intervals as opposed to focusing solely on point estimates.<sup>18</sup>

17 That is to say: if we repeat the survey 100 times, we would expect the actual vaccination rate for the U.S. to fall between 70.8% and 73.6% 95 of those 100 times. For any particular point estimate, we do not know if its 95% confidence interval does actually contain the actual value (e.g., we don’t know if our survey estimate is one of the expected 95 out of 100 for which the actual estimate is within the interval or one of the expected 5 out of 100 for which it is not). (Jim Singleton, chief, Assessment Branch, ISD/NCIRD/CDC. Personal Communication, 1/17/17.)

18 Simpson D, Rodewald L, Barker L. What’s in a number? The use and abuse of survey data. *Am J Prev Med.* 2001; 20(4S):86-87.

Figure 1 compares all other states to Georgia's rate (as an example of what happens when you compare state rates.) Georgia's point estimate is represented in the graph by the solid horizontal line, while its margin of error is represented by the two dotted horizontal lines (upper and lower range limits). The vertical red lines represent each state's potential rate of coverage, i.e., confidence interval.

**Figure 1. Estimated 4:3:1:h:3:1:4 Coverage: Georgia Versus All Other States<sup>19</sup>**



For example, Arizona, which appears close to the center of the horizontal axis, has a range of values between 65% and 79%. In looking at all the states, i.e., all the red vertical lines, we can see that **all** overlap with Georgia's range of confidence interval values and only three do not overlap with Georgia's point estimate. It is possible that none are statistically different. What this tells us is that we need to use caution when interpreting point estimates, especially when comparing or attempting to rank states based on their coverage levels.<sup>20</sup>

No adjustment was made for multiple comparisons. Significance level for each comparison  $\alpha=0.05$ . 2015 National Immunization Survey. N = 15,167. The combined seven-vaccine series (4:3:1:h:3:1:4) includes  $\geq 4$  doses of DTaP,  $\geq 3$  doses of poliovirus vaccine,  $\geq 1$  dose of measles-containing vaccine, full series of Hib (3 or 4 doses, depending on product type),  $\geq 3$  doses of hepatitis B vaccine,  $\geq 1$  dose of varicella vaccine, and  $\geq 4$  doses of PCV.



Given the uncertainty arising from a sample-based assessment, we need to beware of drawing false conclusions especially when:

- Comparing a state's newest point estimate to the previous year's
- Comparing one state's coverage rate to another state's or to the national rate
- Ranking states based on their point estimates of coverage<sup>21</sup>

<sup>19</sup> Graph prepared by Philip J. Smith, Assessment Branch, ISD/NCIRD/CDC. February 2017.

<sup>20</sup> When comparing vaccination coverage rates from the NIS across states, if the confidence intervals do not overlap, then they are statistically different. But if the confidence intervals do overlap, further statistical analysis is needed to definitely make the determination of statistical difference. (Jim Singleton, 1/17/17, personal communication.)

<sup>21</sup> Barker et al. Ranking states' immunization coverage: an example from the National Immunization Survey. Statist. Med. 2005; 24: 605–613.

## IMMUNIZATION INFORMATION SYSTEM COVERAGE ASSESSMENTS

**Background** – Most IIS are lifespan systems containing vaccination records for all ages. The goal of the IIS is to maintain a complete, consolidated vaccination record for every individual in its jurisdiction. As population-based systems, IIS contain a wealth of data that can be used to determine vaccination coverage rates in a variety of ways for any age group and any vaccines. Many factors influence how an IIS designs an assessment, with specific decisions needed to determine methods for calculating both numerators and denominators. AIRA's [Analytic Guide for Assessing Vaccination Coverage Using an IIS](#) offers practical suggestions on designing coverage assessments through an IIS. See the flow chart in [Appendix E](#) for key decision points to use when developing a population-based coverage assessment.

**Source of data** – IIS are populated by medical records data submitted by health care providers. Most IIS also collect birth data, and often death data, from their local or state vital statistics offices. Health plans often provide claims data with immunization encounters, and some IIS accept school immunization records.

**Methodology** – There is no single methodology used to produce coverage assessments from IIS since the purpose of an assessment will define the method used. Specifically, it is important to determine at the very beginning of the process whether the purpose is to measure the *level of protection* in the community or to measure *performance*. A protection-based vaccination assessment typically places individuals in the numerator who are up to date through either the routine or the catch-up schedule, as well as those who have acquired immunity through prior disease. A performance-based vaccination coverage assessment, on the other hand, typically examines the timeliness of immunizations in order to determine how well a provider, group of providers, or community has performed in getting vaccinations to children on time. In this case, the assessment may define up-to-date status as on-time completion of the recommended routine schedule and exclude from the numerator those who are up to date (UTD) via the catch-up schedule. It also

might exclude individuals with medical contraindications from both numerator and denominator since it would not be medically appropriate to vaccinate these individuals. Assessment design decisions are further described in the [Analytic Guide](#), including decisions on denominator selection (e.g., whether IIS-based or census-based).

**Special Considerations** – In order for coverage results among IIS to be comparable to each other, the design of the assessments should be considered. Although the design may vary, conclusions may still be drawn as long as the limitations and biases of each are understood. The parameters that should be examined include:

- Definition of the cohort
  - age range
  - time point or time period of assessment
  - contraindications considered
  - exclusion criteria (e.g., address outside target area, deceased status)
- Vaccination criteria
  - valid doses only or all doses regardless of validity of dose
  - recommended routine schedule only or catch-up schedule with fewer doses
  - vaccine types
  - compliance by age or date
  - immune status considered as equivalent to vaccination or not (i.e., immunity indicated by history of disease, as in the case of chickenpox, or by lab test for certain other diseases)

If the desire is to compare results with other states, IIS programs should consider other issues that affect results. One such issue is data quality. The degree of data accuracy, completeness, and timeliness impacts assessment results and varies from one IIS to another.<sup>22</sup> For example, some IIS have more issues with duplicate patient and/or vaccination records, others with completeness of reporting. Timeliness of immunization reporting to an IIS also varies and can affect coverage results. Overall completeness of records in

<sup>22</sup> See more about IIS data quality in [Appendix D](#).

the IIS, at both the population and vaccination level, may depend on the age of the IIS, the proportion of participating providers, local requirements for reporting to the IIS, and the reliability/capacity of providers to submit high-quality, complete vaccination and demographic information. Identifying individuals who have moved out of the geographic area remains challenging for many IIS, and there is variation in how each IIS manages and flags these individuals. Each IIS is unique in the type and quality of data it captures, and for this reason, comparing IIS assessments can be difficult. Nonetheless, because most IIS datasets are based on the total population (as opposed to samples) with immunization records continually updated, IIS data can be valuable in producing timely and accurate vaccine coverage estimates.

## COMPARING ATTRIBUTES OF NIS AND IIS

The methodologies used for NIS and IIS-based assessments are very different. We must understand how the differences affect the results in order to compare the two. The table on the following page describes some of the attributes of each assessment.

**Table 3. Comparing Attributes of Childhood Vaccination Coverage Assessments<sup>23</sup>**

	National Immunization Survey (NIS)	Immunization Information Systems (IIS)
Who is responsible for the assessment?	<ul style="list-style-type: none"> <li>Centers for Disease Control and Prevention (CDC)</li> </ul>	<ul style="list-style-type: none"> <li>State/Local Department of Health</li> </ul>
Who is assessed?	<ul style="list-style-type: none"> <li>Random telephone sample of U.S. children age 19 through 35 months, 13 through 17 years, and for influenza vaccination, 6 months through 17 years</li> </ul>	<ul style="list-style-type: none"> <li>Ability to run assessments for any age group with records in the IIS</li> </ul>
How are the rates generated?	<ul style="list-style-type: none"> <li>State-level rates based on surveyed sample of 200-400 children 19 through 35 months of age or 13 through 17 years of age</li> <li>Uses a standard survey methodology with weighting adjustments designed to represent the population</li> </ul>	<ul style="list-style-type: none"> <li>Calculations based on IIS records of all children within a selected age range with active records in the IIS ("active" as defined by the IIS—not deceased, still living in jurisdiction)</li> <li>Denominator based on IIS population or on census data or other external source</li> </ul>
Are there differences in vaccine coverage definitions?	<p>There can be differences in how the two data sources define coverage with Hib (Haemophilus influenzae type b), varicella (chickenpox), and PCV (pneumococcal conjugate vaccine), as well as with any series that includes these vaccines. The definition of doses counted as fulfilling the vaccination requirement is different. NIS counts all doses, whether or not they meet ACIP age/interval requirements for validity, whereas an IIS can choose to include or exclude invalid doses depending on the purpose of the assessment.</p> <p>Note: an IIS has the capability of matching the parameters of its assessment to those of the NIS if so desired.</p>	
	<ul style="list-style-type: none"> <li>The full series of Hib vaccine contains either 3 or 4 doses, depending on the vaccine brand</li> </ul>	<ul style="list-style-type: none"> <li>Up-to-date (UTD) Hib status can include 1, 2, 3, or 4 doses depending on the vaccine brand and age at first dose</li> </ul>
	<ul style="list-style-type: none"> <li>Varicella coverage unadjusted for history of disease in NIS-Child. NIS-Teen reports rates that include those with a history of chickenpox in the numerator</li> </ul>	<ul style="list-style-type: none"> <li>Varicella coverage able to be adjusted to take history of disease into account</li> </ul>
	<ul style="list-style-type: none"> <li>UTD PCV status requires at least 4 doses</li> </ul>	<ul style="list-style-type: none"> <li>UTD PCV status can be 1, 2, 3, or 4 doses depending on age at first dose</li> </ul>
	<ul style="list-style-type: none"> <li>Vaccine series definitions for 4-3-1-3-1-4 (and other variations) incorporate the specifications above</li> </ul>	<ul style="list-style-type: none"> <li>Vaccine series definitions for 4-3-1-3-1-4 (and other variations) incorporate the specifications above</li> </ul>



NIS counts all doses, whether or not they meet ACIP age/interval requirements for validity, whereas an IIS can choose to include or exclude invalid doses depending on the purpose of the assessment.

<sup>23</sup> Adapted from Minnesota Department of Health Immunization Program document "About Childhood Immunization Rates from NIS and MIIC, August 2015."

	National Immunization Survey (NIS)	Immunization Information Systems (IIS)
How accurate are the rates?	<ul style="list-style-type: none"> <li>Each rate is a point estimate accompanied by a 95% confidence interval. The size of the confidence interval affects accuracy of point estimate</li> <li>Confidence intervals are wide at the state level due to small sample size</li> <li>Besides statistical uncertainty (random error), accuracy also affected by non-random sources of error<sup>24</sup></li> </ul>	<ul style="list-style-type: none"> <li>Calculations based on IIS records of all children in the selected age range in the IIS, essentially a “census” or total population approach (no confidence intervals needed)</li> <li>Accuracy depends on:               <ul style="list-style-type: none"> <li>Degree of health care provider participation in IIS—voluntary in many states and some providers may not participate</li> <li>Reliability of providers in reporting every dose—even in states that require participation</li> <li>Ability of IIS to identify children who have moved out of state, who should not be in the numerator or denominator</li> <li>Ability of IIS to obtain data from bordering states where some resident children may receive care</li> <li>Success of IIS in identifying and resolving duplicate records</li> </ul> </li> </ul>
How current are the rates?	<ul style="list-style-type: none"> <li>NIS surveys conducted throughout the calendar year, and results released within 7-10 months after the end of the calendar year of data collection</li> <li>Rates reflective of immunization practices 2 to 4 years in the past for NIS-Child and longer for NIS-Teen</li> </ul>	<ul style="list-style-type: none"> <li>IIS rates calculated for persons of a given age as of the assessment date used (with results quickly available)</li> <li>Timeliness of the records dependent on how quickly providers submit vaccination records—states with high percentage of “real-time” HL7 data exchanges more likely to have very current records. High percentage of vaccination events received by IIS within 30 days of administration.</li> </ul>

<sup>24</sup> See [Appendix C](#) for discussion of sampling and systematic errors in the NIS.

	National Immunization Survey (NIS)	Immunization Information Systems (IIS)
Strengths	<ul style="list-style-type: none"> <li>• National-level vaccination coverage estimates produced</li> <li>• Survey administered in all state immunization program jurisdictions and select local and territorial jurisdictions</li> <li>• Vaccinations verified by providers (except for influenza vaccination coverage estimates from NIS-Flu, which relies on parent-report)</li> <li>• Estimates based on a standard methodology used across jurisdictions from year to year</li> <li>• National estimates with low standard errors, providing accountability for federal and state investments in immunization programs, progress toward national Healthy People 2020 objectives, and data for action at national and state levels</li> <li>• Analysis available by age, state, territories, and some local areas</li> <li>• Additional sociodemographic variables available at national level (but limited at local level), including race/ethnicity, WIC participation status, poverty status, health care provider type, health insurance status, VFC status, mother's characteristics (race/ethnicity, level of education), and rural versus urban residence</li> </ul>	<ul style="list-style-type: none"> <li>• Entire population within IIS included—not a sample, no random error</li> <li>• Vaccinations reported by providers and other reliable sources (e.g., claims data, vital statistics)</li> <li>• Data all in one place—coverage assessments able to be run at any time</li> <li>• Sub-analysis often available by county and other geographic subdivisions, and other demographic variables, as available in the IIS</li> <li>• Data timeliness and completeness increasing with EHR data exchange</li> <li>• Cost-effective, once design and programming have been done</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Results somewhat dated, reflecting immunization practices 2-4 years prior to publication date of rates</li> <li>• Standard error wide at state level—results open to misinterpretation when comparing state to state, year to year, or ranking states based on a point estimate only</li> <li>• Non-random error potentially causing results to be several percentage points too low or too high</li> <li>• All doses counted toward meeting completeness—including invalid doses (in routine CDC reports. (Note: estimates based on valid doses have potential to be computed from NIS but not currently routinely reported by CDC)</li> <li>• Costly at federal level and costly for jurisdictions to add sub-areas of interest to the NIS</li> </ul>	<ul style="list-style-type: none"> <li>• No standard IIS coverage assessment protocol among IIS, and variability in data quality—resulting in rates not directly comparable state to state and national estimates not feasible</li> <li>• Data quality issues possibly affecting accuracy of results and comparability among jurisdictions</li> <li>• Improving data quality over time makes it difficult to interpret trends in vaccination coverage in some IIS</li> <li>• Many IIS have difficulty determining individuals who have moved out of jurisdiction, which usually makes rates appear lower</li> <li>• Sub-analysis of specific sociodemographic groups may not be possible (due to lack of required data elements)</li> </ul>

## SECTION III. DEVELOPING COMMUNICATION MESSAGES

Most local and state public health agencies have offices and staff specifically dedicated to communicating with the media and/or



**TIP:** Become familiar with your agency's published writing guidelines.

elected officials. These staff have expertise in communications and often have guidelines and protocols for use agency-wide. IIS and immunization program staff should—and usually do—work closely with these offices in the role of subject matter experts. Although they may not be directly responsible for the final communication product, IIS and immunization staff should provide content and context to the communication specialists for any vaccination coverage results to be shared externally. In some cases, the IIS/immunization program staff may develop and finalize material. This section of the guide is designed to provide communication guidelines, recommendations, and suggestions that IIS and immunization program staff can put to use.

The process for creating a message goes through the stages of:

### Planning and Organizing

- analyze the task at hand, identify the communication objective, define the context, choose the content
- define and understand the audience
- determine the methods and media to be used

### Writing and Editing

- use plain-language principles and methods to convey the message
- write the message and edit the message

### Reviewing

- review and revise the message

## PLANNING AND ORGANIZING

### Analyze task/identify objective/define context/choose content

The first step in crafting a message is to analyze the task at hand. This means acquiring a thorough understanding of the coverage assessment results at the very beginning of the process. As previously noted in this guide, purpose and methodology can differ significantly among assessments and can greatly influence coverage results. Thus, it is prudent to consider a number of factors related to the accuracy and precision of the results and their immediate relevance to the goals of the immunization program.<sup>25</sup> IIS and program staff may need to consult with a statistician or epidemiologist to fully understand the results, which may require a significant amount of effort and time. The details can be complex yet are important for a correct understanding of the results.

To evaluate the coverage assessment results, the set of questions below will be helpful. A more detailed template of these questions is provided in [Appendix G](#). These questions can be applied to a single assessment to gain a deeper understanding of its results or to two or more assessments to determine their comparability. Answers to many of these questions can be found in [Section II](#) and [Appendix B](#) as they pertain to the specific assessments described in this guide.

- What was the purpose of the assessment?
- Who was assessed?
- How were data collected?
- How were rates generated?
- How was vaccine coverage defined?
- How valid and precise are the results?
- How recent are the results? Do they reflect clinical practice that occurred within a recent time period?


<sup>25</sup> In this guide, we use the term "precision" to describe how consistently results are produced; we use "accuracy" to describe how well the results reflect reality (i.e., with little error). A vaccination assessment that produces precise results yields similar findings when repeated multiple times; an assessment that produces accurate results correctly reflects actual vaccination rates.

Having answered these questions, the reader will be prepared to discern critical components from the minor details. The primary objectives for the message can then be defined, along with the overall context and content.


**Define and understand the audience**

Next, it is important to identify the audience to be addressed. It is important to clarify why the targeted audience(s) would be interested in vaccination rates (e.g., based on past use or experience), and how/why vaccination coverage estimates could help them. In this section, we discuss the specific needs of three audiences: senior leadership, legislators, and media. The following three tables offer guidelines for communicating with these audiences. These guidelines can be further tailored by readers to meet the needs of a specific community.


**Table 4a. Communicating with Senior Leadership/Decision Makers**

 <b>Guidelines and formats for communications to senior leadership:</b>	<b>What senior leaders expect in your communication to them:</b>
<ul style="list-style-type: none"><li>• Plain language in simple fact sheet form with key findings and explanation of the rates</li><li>• Visuals such as charts/graphs to display rates over time and by geography as available and appropriate</li><li>• Comparison of the state rates to U.S. rates and a description of statistically significant changes</li><li>• Regular briefings on vaccination coverage data before it is released to external partners, the media, and the public highlighting changes in coverage or any geographic areas of low or high coverage</li><li>• Discussion of how the data and public health action will be presented externally</li></ul>	<ul style="list-style-type: none"><li>• Clear, concise, and accurate data and messages based on science</li><li>• Data and background with language to explain to the media and legislators what the rates mean</li><li>• Clear descriptions of impacts on the community’s health, noting health disparities where relevant</li><li>• Policy and/or financial implications</li><li>• Comparison to other states’ results, especially neighboring states</li><li>• Comparison to previous years, as well as possible reasons for change</li><li>• Comparison of NIS results to IIS results where relevant, as well as reasons for differences</li><li>• Clear call to action</li></ul>

**Table 4b. Communicating with Legislators/Elected Officials**

 <b>Guidelines and formats you use to communicate to legislators:</b>	<b>What legislators expect in your communication to them:</b>
<ul style="list-style-type: none"> <li>• Key findings with main points stated first</li> <li>• Plain language in simple fact sheet form—brief, concise, factual</li> <li>• Visuals such as charts/graphs as available and appropriate</li> <li>• High-level summary of the vaccination rates and simple explanation, including why immunizations are important</li> <li>• Links to websites with additional details</li> </ul> <p><i>Note: communications with state or federal legislators/elected officials often go through the public health agency's legislative liaison, an executive office, or some other entity.</i></p>	<ul style="list-style-type: none"> <li>• Simple, quick bullets—clear, concise, and accurate data and messages based on science</li> <li>• Messages that relate to their specific communities</li> <li>• Information on how the data link to the health of their constituents</li> <li>• Clear call for legislators to take action (if action is called for)</li> <li>• Possible policy and/or financial implications</li> <li>• The impact of not doing anything (if rates are low)</li> </ul>

**Table 4c. Communicating with Media**

 <b>Guidelines and formats you use to communicate to the media:</b>	<b>What the media expects in your communication to them:</b>
<ul style="list-style-type: none"> <li>• Prepared messages and summary of data with key findings and main points stated first, in simple fact sheet form</li> <li>• Press release and media advisory headlines that frame the findings in a way that suggests a story and would attract news media interest</li> <li>• Story ideas: Is it a success story or an alert? How can the numbers be linked to people or individuals affected by the results?</li> <li>• Visuals such as charts/graphs as available and appropriate</li> <li>• High-level summary of the immunization rates and simple explanation, including why immunizations are important</li> <li>• Links to websites with additional details</li> <li>• Press releases if appropriate</li> <li>• Sample press releases for local public health to use if appropriate</li> <li>• Multimedia—short articles with accompanying digital media: audio, podcasts, videos, websites</li> <li>• Social media posts based on specific messaging with links to websites for more details</li> </ul> <p><i>Note: communications with media often go through the agency's communications office, which works closely with the immunization program to put the data and key points into a news release format. However, questions from media are often directed to the program.</i></p>	<ul style="list-style-type: none"> <li>• Clear, concise, accurate, and current data and messages based on science</li> <li>• Information they can use to create short sound bites for the public to consume (an angle)</li> <li>• Clear call to action</li> <li>• Data localized to their market as well as comparison to other states and communities</li> <li>• Age-specific data trends over time</li> <li>• Gaps/disparities—if known, why and what is being done to address gaps</li> <li>• Reasons behind changes in data</li> <li>• Impact to state or specific communities</li> <li>• Quotes from key personnel</li> <li>• Designated spokesperson/people for follow-up questions</li> </ul>

## Determine communication methods and format to be used

Methods for communicating the message will depend on the audience and the purpose. Informal communications with senior leadership, for example, may consist of an in-person discussion along with a short, written document containing key points and graphs. Communication with legislators may be more formal with a presentation of slides, main points and simple graphs. With the media, an assortment of methods and communication tools may be used, including social media, press releases, and website material. The urgency of the message will also determine the method used. For example, a measles outbreak in an area with low MMR coverage rates may require a variety of strategies to get wide-spread attention.

## WRITING AND EDITING THE MESSAGE

With the purpose, context, content and audience defined, the actual creation of the message can begin.

### Plain language

Knowledge of “plain language” principles is essential for public health professionals. Plain language is defined as communication the intended audience can understand the first time they read or hear it. Language that is plain to one set of readers may not be plain to others.<sup>26</sup> Plain language is clear and concise, uses short sentences and common words, and is focused on the needs and attributes of the audience.

Basic rules of plain language include using language the audience can easily understand, writing in a conversational style, using the active voice, organizing and filtering content with the readers’ needs in mind, and using reader-friendly formatting so that the document *looks* easy to read.<sup>27</sup> More details on plain language principles and



Written material is in plain language if the audience can:

- Find what they need
- Understand what they find
- Use what they find to meet their needs

strategies can be found in [Appendix F – Quick Reference Guide for Improving Readability](#). Several additional resources are listed in [Appendix H – References](#).

### Organizing the message

Key points for messages should be arranged logically with the main point at the top. The main point can be an overview of the results along with differences or changes in trends and possible reasons for changes.

- For example, the main point for NIS results could include changes from year to year and differences in coverage for different vaccines.
- For IIS results, the overview could also include provider participation levels, data completeness, and systemic changes such as expanded immunization practice (e.g., pharmacies now giving vaccinations).

After the main point, the message should include a call to action (if applicable), followed by background information and additional details. Related items and information should be grouped together. Numbers and visuals can be used as long as they are simple to understand. Headings, lists, and tables should be included with a specific purpose in mind. Most importantly, the writer should only include information the reader needs to know.<sup>28</sup> Finally, it is important to remember that written words take on a life of their own, and words should be chosen carefully with that in mind.

<sup>26</sup> <http://www.plainlanguage.gov/whatisPL/index.cfm>

<sup>27</sup> PRISM Readability Toolkit. Seattle: Group Health Center for Health Studies; p7 <https://www.kpwwashingtonresearch.org/about-us/capabilities/research-communications/prism/>.

<sup>28</sup> Minnesota Department of Health (MDH). Writing in Plain Language: Simple Tips for Communicating Complex Stuff.

## Reviewing the message

After the message has been developed, it is important to take time to do a final review:

- Put the message down for a while to bring a fresh perspective for the final review.
- Read it aloud.
- Ask a colleague to review it, especially someone unfamiliar with the content, who can identify issues with terminology and wording.
- If possible, partner with a communications specialist.<sup>29</sup>

## Messaging template

The flow of information in a key messages document could look like this:

### Key Points

- **State overall results/main point.**
- **Describe caveats to main point.**
- **Describe main takeaway point.** Example: Thanks to high childhood vaccination coverage, most vaccine-preventable diseases are at record low levels. It is crucial to maintain these rates in order to keep outbreaks from happening.

### Call to Action

- **Clearly state** the action desired of your target audience.

### Details and Background Information

- **Provide additional details** that are important to the overall message and that elaborate on the key points, starting with the most important.
- **Provide simple points** on the source of the data, the method used to derive the rates, and any important considerations about the data or methodology that may have affected the results.
- **Offer resources** for additional information—websites, points of contact.

<sup>29</sup> Adapted from Dayton, A. How to Report What you do to your leadership. Presentation at the AIRA Regional Meeting, Oklahoma City, Okla. March 1, 2017.

Example of how one message may change based on the audience

*Example Scenario:*

The state’s IIS recently ran a state-wide vaccination coverage assessment for 2-year-olds, with results available by county. The results showed a continuing trend of significantly lower vaccination rates for XYZ County than the rest of the state. The coverage rate for 4 doses of DTaP were especially low. The immunization program is concerned because of previous pertussis outbreaks in this county over the past three years.

Example Messaging:

Key Messages



Senior Leadership

- DTaP coverage for 2-year-olds is low in XYZ County, according to a recent assessment conducted by our IIS. XYZ County shows a DTaP coverage rate of 65% compared to 84% statewide. Other counties show a coverage rate of 77% to 87% for DTaP.
- We have seen an increasing number of pertussis cases in this county over the past three years. Last year there were 126 confirmed cases of pertussis in XYZ County, 75 of them in children younger than 12 months, with 10 hospitalizations.
- From school vaccination reports, we know that there is a higher percentage of philosophical exemptions for DTaP in XYZ County than in other counties.






Legislators/Elected Officials

- Vaccines work, and overall, 71% of the young children in our state are protected from vaccine-preventable disease. However, public health is concerned that communities with low vaccination rates are at increased risk of vaccine-preventable disease outbreaks.
- XYZ County has especially low rates for the DTaP vaccine, the vaccine that protects against diphtheria, tetanus, and pertussis—more commonly known as whooping cough.
- Over the past three years, there have been pertussis outbreaks in this county and a lower number of cases in neighboring communities.
- There is increased risk of another pertussis outbreak because some parents are choosing not to vaccinate their children.



Media

- Vaccines have been proven to be safe and save lives. Overall, 71% of children in our state are protected from vaccine-preventable disease. However, XYZ County has especially low vaccination rates for DTaP, the vaccine that protects against diphtheria, tetanus, and pertussis—more commonly known as whooping cough.
- Two years ago, there was a pertussis outbreak in XYZ County, with 126 cases, mostly in infants, and 10 hospitalizations. Pertussis is a serious disease and can be potentially fatal, especially in infants.
- In XYZ County, there is an increased risk of another pertussis outbreak because some parents are choosing not to vaccinate their children.

	 Senior Leadership	 Legislators/Elected Officials	 Media
Call to Action	<p>Data are presented to facilitate discussion on action needed to mitigate risk of another outbreak. One possible course of action is a public awareness campaign to promote vaccination with DTaP for young children and Tdap for older children and adults. This would require additional resources to conduct the campaign. When the campaign launches, we will measure DTaP uptake regularly through the IIS to measure improvement moving forward.</p>	<p>To reduce the number of cases and mitigate the spread to other communities, we plan to develop a public awareness vaccination campaign. The primary message will be to assure parents that vaccines are safe and prevent serious disease and death. We want you to be informed about this and share information with your constituents as appropriate.</p>	<p>Parents should talk to their doctor about vaccines and ensure children are fully vaccinated. Parents may also visit XYZ County’s local health department for more information and to receive vaccinations. [Provide contact information.]</p>
Additional Details	<p>Statewide coverage for the 4-3-1-3-3-1-4 series is 71%, according to data from the IIS, compared to 70% one year ago. This is consistent with the NIS, which for 2015 calculated our state rate at 75% (within the margin of error). NIS data were also consistent for our DTaP coverage at 85%. County level data are not available from NIS. [Provide a map that displays county-level coverage rates for the series and for DTaP and a chart that displays trends in coverage rates at the state level over the past five years.]</p>	<p>Please contact Ms. Program Manager for more information. [Provide website, social media accounts and one sheet with basic data on vaccination rates and previous outbreaks.]</p>	<p><i>Personal Story:</i> Mrs. Mary Doe is a teacher and mother in XYZ County. Her youngest son, Oliver, was hospitalized with pertussis at 3 months old during the outbreak two years ago. Oliver spent 10 days in the intensive care unit with complications from pertussis including a lung infection with difficulty breathing. Mrs. Doe has since become a local advocate for vaccinations, and a detailed account of her story is available on our website. Please contact Ms. Program Manager for more information from the health department. [Provide website, social media accounts, one sheet with basic data on vaccination rates and previous outbreaks, and quotes from key public health personnel and community leaders.]</p>

## SECTION IV. PRACTICAL STRATEGIES FOR COMMUNICATING NIS AND IIS RESULTS WITH EXAMPLES

### COMMUNICATING NIS RESULTS

Immunization programs receive NIS results from CDC in advance of publication. This gives public health agencies an opportunity to review their state or jurisdiction-level results and prepare messaging ahead of time. Staff can be proactive by evaluating the NIS results and developing key message points. The evaluation should include attention to:

- The NIS margin of error for the particular state/jurisdiction.
- Trends over time and their statistical significance rather than the latest results only.
- Specific work that was done to improve coverage rates during the assessment period, which occurred several years in the past.
- Changes to school or childcare requirements that may have occurred during the assessment period.
- Any other external conditions that may have had an impact on rates, such as vaccine shortages.

In addition, the messaging should avoid focusing on the ranking of states, while at the same time prepare staff to address related questions. A review of the confidence intervals discussion in [Section II](#) will assist with this.

Once the evaluation of results has been completed, key messages should be widely distributed among staff so all are ready to answer questions that arise, although often questions will be referred to the identified spokesperson.

#### Key messages for NIS

Messages should include key findings from the current year's assessment. For example, the following points can be used as a template for state/local message development:

#### Key points for vaccination coverage among children 19-35 months – 20[xx]

- According to the 20[xx] NIS, coverage for childhood vaccines in [state/jurisdiction] remains high overall. The percentage of children who received no vaccinations remained at less than [x%].
- While [state/jurisdiction] coverage was [high, low, stable] for most vaccines routinely recommended for young children, we still have opportunities for improvement.
  - There continues to be [higher, lower, similar] coverage for some vaccines recommended during the second year of life.
  - Among children living below the federal poverty level [or another sociodemographic factor], vaccination coverage was [higher, lower, similar] for many routinely recommended childhood vaccines.
  - There were differences in coverage between children living in [rural and urban] areas for some vaccinations.
- Thanks to high childhood vaccination coverage, most vaccine-preventable diseases are at record low levels. It is crucial to maintain these rates in order to keep outbreaks from happening.
- [Name of entity—state or local health department] encourages parents to give their children the best protection from [x] vaccine-preventable diseases like measles and chickenpox by ensuring that their children are vaccinated according to the recommended immunization schedule by their second birthday.



Use these bullet points to develop your own key points. Modify to fit YOUR state or jurisdiction's results.

## Graphical representation

Public health senior leadership usually want more detail on numbers and trends than do the other two target audiences (media and legislators). Refer to [Table 4a](#) in [Section III](#) for details on senior leadership needs. The following example from Michigan ([Figure 2](#)) displays rates in a way that senior leadership may appreciate. It displays Michigan NIS coverage estimates over time in comparison to U.S. rates. The U.S. point estimates are indicated by the solid blue line. The Michigan point estimates are represented by the numbers within each blue box. The upper and lower frame of each box represents the 95% confidence intervals, thus showing the possible range of the actual rates. For example, in 2015, Michigan's point estimate was 67.6%, but the 95% confidence interval produced a range of 60.3% to 74.9%. The U.S. point estimate was a little over 70%.

Although appropriate for public health leadership, [Figure 2](#) might not be intuitive for many groups. The confidence intervals and the combining of a line graph with a bar chart could be too much detail for legislators and the media. A simpler portrayal from Colorado is shown on the following page.

**Figure 2. NIS Coverage Estimates 4:3:1:3:3:1:4 Michigan Compared to U.S.**

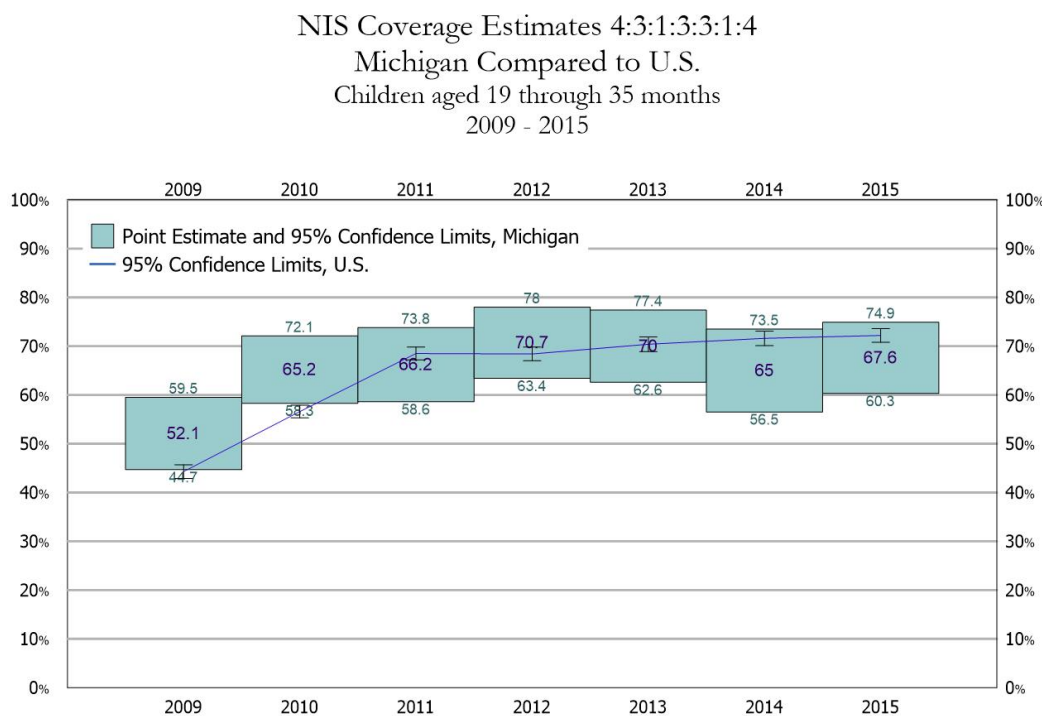


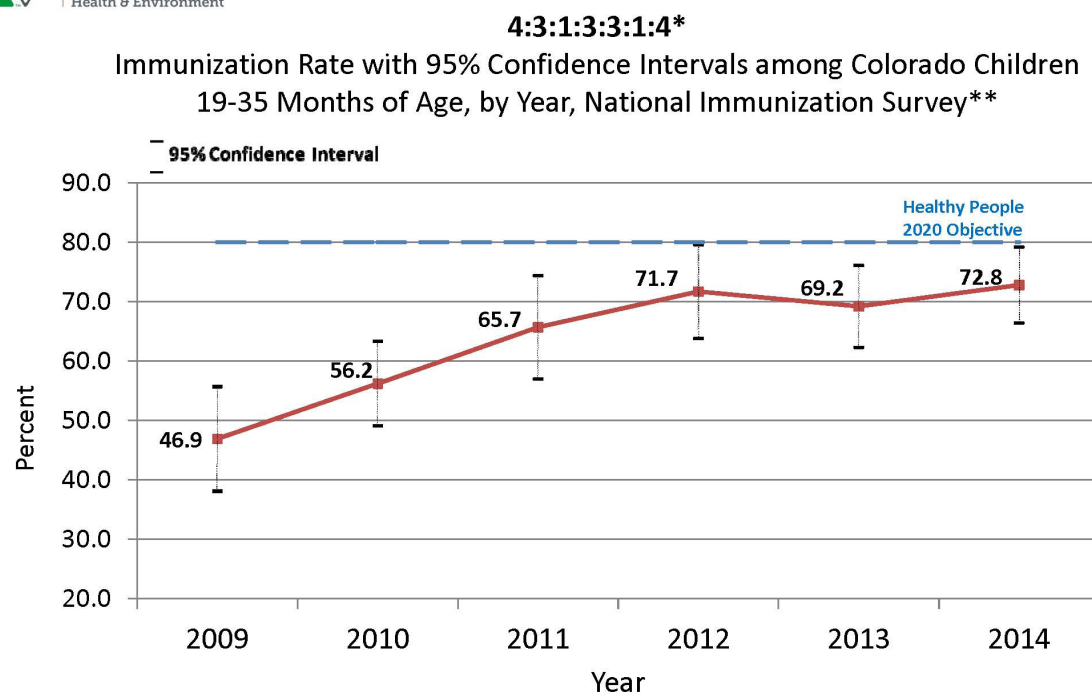
Figure 3 displays the effect of confidence intervals by using vertical lines that intersect with the point estimates, while eliminating the actual numerical values. It also compares rates to the 2020 Healthy People objectives, i.e., the 80% target coverage rate indicated by the dotted blue line at the top of the graph.

Yet even this simpler portrayal may cause confusion among non-public health professionals since it still displays confidence intervals. The double asterisk at the bottom of the graph notes that the 2014 rate is significantly higher than the 2009 and 2010 rate. Perhaps for the media and legislators, this simple point is all that needs to be made, i.e., that significant progress has been made over the previous five years.

**Figure 3. 4:3:1:3:3:1:4 Immunization Rate with 95% Confidence Intervals Among Colorado Children 19-35 Months of Age, by Year, National Immunization Survey**



COLORADO  
Department of Public  
Health & Environment



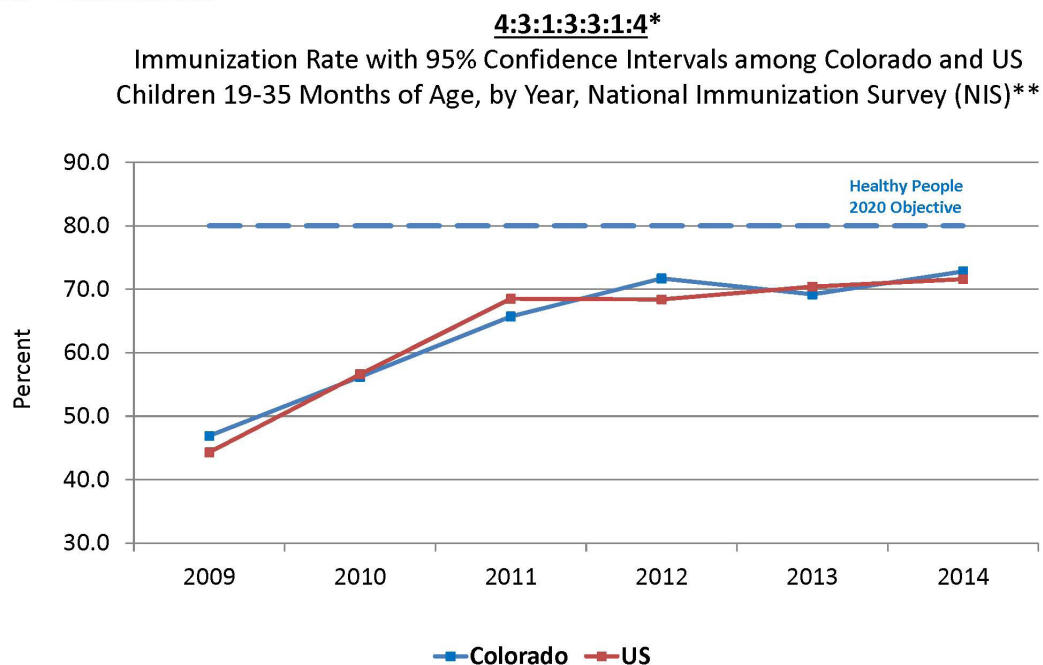
\*4+ DTaP, 3+ polio, 1+ MMR, 3 or 4 doses Hib, depending on vaccine type, 3+ HepB, 1+ varicella, and 4+ P

\*\*The 2014 rate is significantly higher than the 2009 and 2010 rate.

For an even simpler graphical presentation, [Figure 4](#) below presents another option.

Note that [Figure 4](#) compares the state rates to the national rates and to the Healthy People 2020 objectives without addressing confidence intervals. If the confidence intervals make no difference to overall trends, then this type of graph may suffice quite well.

**Figure 4. 4:3:1:3:3:1:4 Immunization Rate Among Colorado Children 19-35 Months of Age, by Year, National Immunization Survey (no confidence interval displayed)**



\*4+ DTaP, 3+ polio, 1+ MMR, 3 or 4 doses Hib, depending on vaccine type, 3+ HepB, 1+ varicella, and 4+ PCV

\*\*There is no difference between the Colorado and National rate.

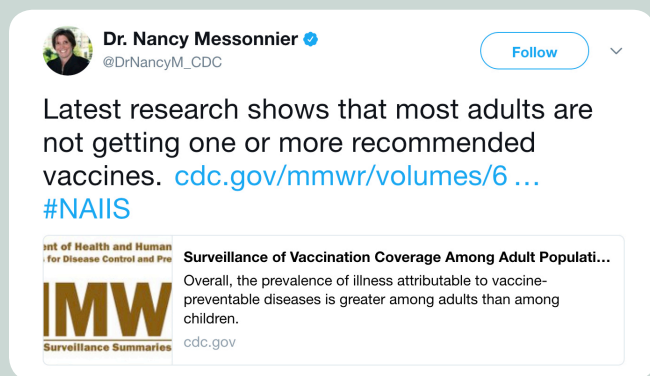
## Interactive website for viewing CDC data

Interactive charts and graphs are available on the CDC website with specific “VaxView” pages for childhood, teen, adult, school, and influenza vaccination data.<sup>30</sup> These pages allow the user to link to data organized by variables. The user can view the data through interactive maps, trend lines, and bar charts.<sup>31</sup> Immunization program and IIS staff may find it helpful to use some of these CDC tools as links or references in their messaging.



## SOCIAL MEDIA

Social media can be used for public health campaigns and have the advantage of tailored messaging at low cost and large reach.<sup>32</sup>



## COMMUNICATING IIS COVERAGE RATES

The decision to share IIS-based coverage rates externally depends on a number of factors, including the overall goal of the communication. It also depends on levels of provider participation and data completeness. For example, in a less mature IIS with lower participation and a large gap between NIS and IIS rates, it would

not be appropriate to present the IIS as an assessment of true vaccination coverage rates. However, IIS rates should be shared with senior management and other internal agency staff as a measure of IIS progress. If progress is slow and hampered by jurisdiction level rules and policies, public health leadership can be helpful in pursuing policy changes. If provider participation is an issue, leadership may also help with advocacy and recruitment.

In determining whether to share IIS rates more widely, IIS staff should first evaluate the IIS' level of data quality. Data quality encompasses completeness, accuracy, and timeliness of data. Generally, we can assert that data quality is enhanced when an IIS:

- Receives data from vital records.
- Has strong provider participation (especially if a high proportion of providers submit data in real-time thus improving timeliness of records).
- Has been collecting data for a number of years.
- Has a strong system for deduplicating patient and vaccination records.
- Has a strong system for flagging patients who have moved out of the area.
- Has data exchange with neighboring states.
- Has policies to increase data quality, including mandated provider reporting and opt-out rules (as opposed to an opt-in state that requires parent/patient consent to submit data to the IIS).

The accuracy of an IIS-based coverage calculation depends on how well the IIS performs in the areas noted above. The vaccination coverage assessment should be done in a way that minimizes bias arising from data quality issues. For example, varying levels of bias may be introduced when using a census population or an IIS population as the denominator. For a more complete discussion

<sup>30</sup> The VaxView website allows you to select the age group you want to view and go to the interactive site selected: <https://www.cdc.gov/vaccines/vaxview/index.html>.

<sup>31</sup> This link takes you directly to the 2013 through 2015 Childhood interactive site: <https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/7-series/trend/index.html>.

<sup>32</sup> Gough A et al. Tweet for Behavior Change: Using Social Media for the Dissemination of Public Health Messages. JMIR Public Health Surveill 2017;3(1):e14. DOI: 10.2196/publichealth.6313.

of IIS-based vaccination coverage methods and the pros and cons of denominator selection, please refer to AIRA's [Analytic Guide for Assessing Vaccination Coverage Using an IIS](#).



**TIP:** Please refer to the [Analytic Guide to Assessing Vaccination Coverage Using an IIS](#) for details.

### Key messages for IIS-based assessments

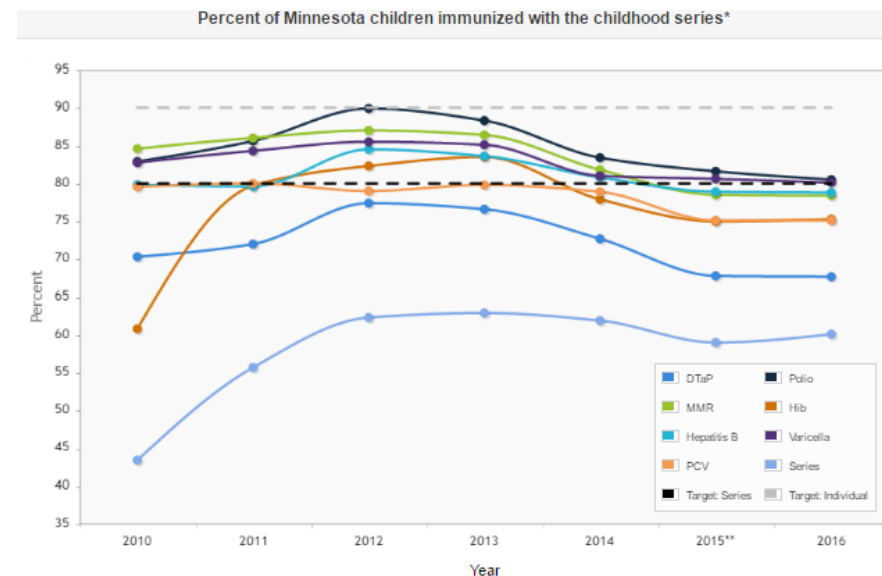
Key messages will be specific to the state or local area. They may include reference to the impact of state laws and requirements, as well as the maturity of the IIS and other attributes listed in [Table 3](#). Distributed materials may include the following notes, adapted to the specific state or local area:<sup>33</sup>

- Data is based on the information reported to the IIS.
- The number of providers reporting to the IIS may vary by geographic area.
- Lower provider participation results in missing immunization records, which impacts the results.
- Areas with smaller populations may see greater fluctuations in their rates because smaller changes can more significantly impact rate calculations.

### Graphical representation

[Figure 5](#) is an example from Minnesota of a line chart reflecting rates among children 24 through 35 months old over time derived from its IIS, the Minnesota Immunization Information Connection (MIIC).<sup>34</sup>

**Figure 5. Individual Vaccine and Series Coverage Line Chart from Minnesota**



Notes: Data are for children ages 24-35 months. "Series" includes all seven vaccinations listed on this chart. Healthy People 2020 goals call for 90% coverage among young children for individual immunizations and 80% coverage for the series.

\*MIIC-based immunizations rates.

\*\*In 2015, there was a change in methodology for calculating up-to-date rates. Please see [What is the source of the data?](#) for more information.

This graph uses a separate line color to denote individual vaccine coverage rates over time, with comparison to the Healthy People 2020 goals for the combined series rate (the 80% dashed line) and to the individual vaccine coverage rates (the 90% dashed line). In looking at [Figure 5](#), we can see that all the vaccines experienced some degree of decline in 2015. Staff were careful to provide an explanatory footnote. As denoted by the double asterisk in the graph footnote, "In 2015, there was a change in methodology for calculating up-to-date rates." This web-based graph allows us to click on a link for more information, where we find that the denominator previously included only children ages 24-35 months with two or more non-influenza vaccinations on their IIS record. (The numerator included all children in this denominator who were up to date at time of analysis.) Beginning in 2015, the denominator was changed to include all children aged 24-35 months in the IIS, not just those with

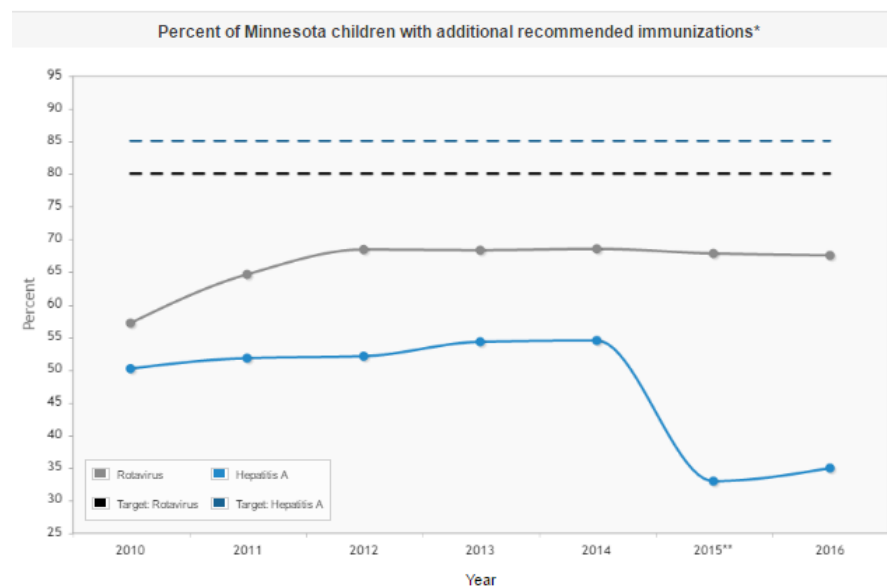
<sup>33</sup> Adapted from *Interpreting CIIS County Level Immunization Rates*, Colorado Department of Public Health and Environment, June 2016. Provided by Heather Roth, CIIS Manager, 11/29/16.

<sup>34</sup> Childhood Immunization in Minnesota. Chart titled *Percent of Minnesota children immunized with the childhood series*. Retrieved from [https://apps.health.state.mn.us/mndata/immunization\\_basic#percentseries](https://apps.health.state.mn.us/mndata/immunization_basic#percentseries) on 5/23/17.

immunization events. This very important change increased the size of the denominator and increased the number of children with fewer than two immunizations on their record, thus reducing the coverage level.

The following graph in [Figure 6](#), also from MIIC, displays coverage of two vaccines—rotavirus and Hepatitis A—not included in the previous routine series graph. Because only two vaccines are included in this graph, it is clearer, cleaner, and easier to read than the previous one.<sup>35</sup>

**Figure 6. Individual Vaccine Line Graph from Minnesota**



Notes: Data are for children ages 24-35 months.

\*Rotavirus and Hepatitis A are not currently part of the childhood immunization series.

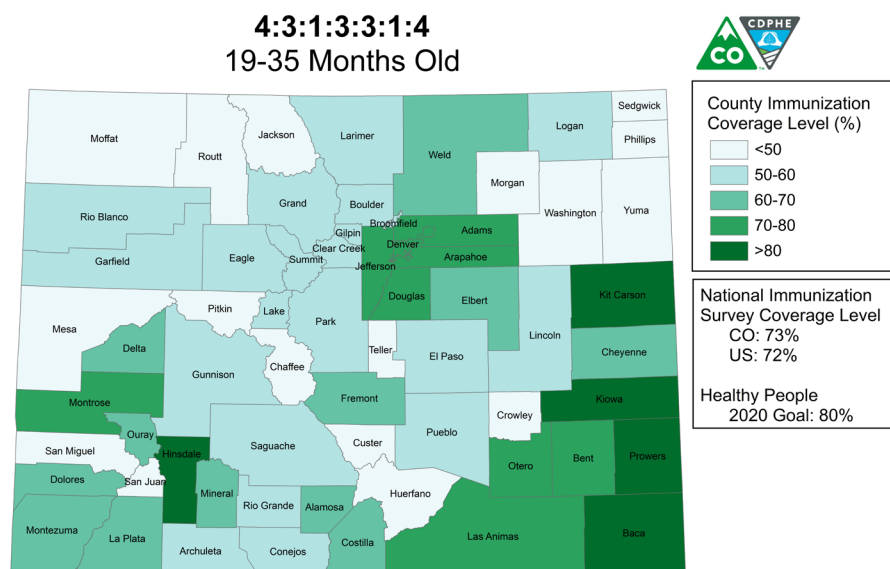
\*\*In 2015, there was a change in methodology for calculating up-to-date rates. Please see [What is the source of the data?](#) for more information.

<sup>35</sup> Ibid.

## Geographic representation

Maps can increase familiarity and make data more personal, compared to graphs. Maps make it easy to see at a glance how a specific community is doing. Local coverage rates displayed on a map can be especially valuable to local public health officials. In cases where some counties have much lower coverage rates than others, listing data caveats right on the page is helpful. For example, provider participation can vary significantly by local area. Where an IIS is mature, sharing maps with the wider audience—legislators and media—may be appropriate. In the following example from Colorado, counties have been categorized by a percentage range rather than a specific percentage point.<sup>36</sup> Because IIS provider participation varies among the counties, this map is not shared with media, and a number of points about the data are included with the map, as listed in [Figure 7](#) below.

**Figure 7. Map of County Immunization Coverage Level (example from Colorado)**



Date Created: June, 2016  
Data Source: Colorado Immunization Information System

In distributing the map to local public health agencies, the Colorado Immunization Information System (CIIS) provides guidance on interpretation of the rates. In addition to the general caveats listed in this guide's subsection [Key messages for IIS-based assessments](#), CIIS provides the following messages to its county public health agencies:<sup>37</sup>

- Most counties do not have all providers reporting to CIIS, so it is likely that the immunization rates generated out of CIIS underestimate the actual county rates.
- Counties with smaller populations may see greater fluctuations in their rates because smaller changes can more significantly impact rate calculations.
- When analyzing geographic areas with small populations, rates can vary or fluctuate widely.
- HPV rates are particularly unstable because of small numbers.

These examples of key points from Colorado can be modified to the needs of other IIS as they consider disseminating local results.

<sup>36</sup> Interpreting CIIS County Level Immunization Rates, Colorado Department of Public Health and Environment. June 2016.  
Provided by Heather Roth, CIIS Manager, 11/29/16.

<sup>37</sup> Ibid.

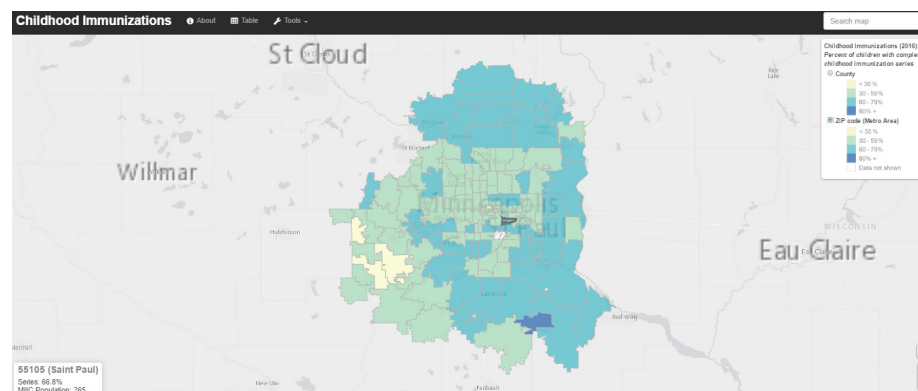
## Interactive websites for viewing IIS data

Some IIS have created interactive webpages that viewers can use to view and assess IIS assessment results in different ways. For example, Minnesota's Public Health Data Access Portal for immunizations<sup>38</sup> provides an interactive way to review results. Clicking on the "About the Data" tab takes us to answers for questions such as:

- [\*What do these data tell us?\*](#)
- [\*How can we use these data?\*](#)
- [\*What can these data not tell us?\*](#)<sup>39</sup>

Clicking on the "Explore Data" tab takes us to a state map view where we can click on specific counties or zip codes in the metro area to see rate details. The following screenshot shows color-coded rates by zip code in the Minneapolis-St. Paul metropolitan area.

**Figure 8. Childhood Immunizations: Zip Code View**



## COMPARING AND COMMUNICATING NIS AND IIS RESULTS

In the previous two sections, we have explored how to communicate the results of the NIS and IIS-based rates, each on its own. Now we will address comparing results of the two very different methods, as well as how and when to communicate the respective rates.






A review of the methodology of the NIS compared to IIS will be helpful to the development of communication tools. [Table 3](#) in [Section II](#) provides a comparison of NIS and IIS assessment methodologies, processes, and results. It could also be helpful to ask an epidemiologist or IIS technical staff to develop a query that applies NIS parameters to the IIS database. In this way, the IIS can be used to produce results that are more comparable to the NIS—i.e., using the same definitions and parameters. More discussion of this approach is found in [Section V](#). In addition, comparing results to other assessments, such as the School Vaccination Assessment Program, can produce interesting insights within a larger context.

[Table 5](#) on the following page provides suggestions for messaging when comparing NIS to IIS-based results.

<sup>38</sup> <https://apps.health.state.mn.us/mndata/immunization>

<sup>39</sup> [https://apps.health.state.mn.us/mndata/immunization\\_metadata](https://apps.health.state.mn.us/mndata/immunization_metadata)

**Table 5. Comparing Rates of NIS and IIS<sup>40</sup>**

Coverage Assessment Results: Comparing NIS and IIS	Possible Reasons for Results	Possible Messaging	Audience		
			Senior Management	Legislators	Media
NIS and IIS match = IIS rates are within the NIS confidence intervals.	<ul style="list-style-type: none"> <li>IIS has complete, accurate, timely data.</li> </ul>	<ul style="list-style-type: none"> <li>Both NIS and IIS agree that rates have (improved, stayed the same, declined) over the past x years.</li> <li>Increasing provider participation and improved data quality in the IIS make the IIS a valuable resource for local area analysis.</li> <li>Local area results available from IIS show pockets of need in x communities for xyz vaccines, for these age groups.</li> </ul>			
NIS and IIS are significantly (i.e., statistically) different = IIS rates are higher if above the upper limit of confidence interval.	<ul style="list-style-type: none"> <li>IIS results might reflect more recent practice, and vaccination rates might have changed since time period covered by latest NIS.</li> <li>NIS may under-estimate coverage by several percentage points because all vaccinations may not have been documented in the survey.</li> </ul>	<ul style="list-style-type: none"> <li>As more providers participate in IIS, we are able to get more accurate, up-to-date, and localized results.</li> <li>Over time, IIS rates have increased and more closely match NIS rates, reflecting an increase in provider participation, and/or enhanced data quality.</li> </ul>		*	*
NIS and IIS are significantly (i.e., statistically) different <sup>41</sup> = IIS rates are lower if beneath the lower limit of confidence interval.	<ul style="list-style-type: none"> <li>IIS data are incomplete—missing some of the population, missing vaccinations.</li> <li>IIS data contain duplicate/fragmented records.</li> </ul>	<ul style="list-style-type: none"> <li>As more providers participate in IIS, we are able to get more accurate, up-to-date, and localized results.</li> </ul>		*	*

<sup>40</sup> We make the assumption here that the IIS is using a method that minimizes typical biases, such as duplicate records and unidentified individuals who have moved out of area (MOGE). Using a census denominator can minimize this bias. When an IIS is mature, has few unresolved duplicates, and has a good system for documenting MOGE individuals, then an IIS denominator is reasonable. Also, in some cases, the IIS population may be more accurate than the census, especially when the population is shrinking or growing more rapidly than can be reflected in census data.

<sup>41</sup> A caveat is that for a few states in one data year, the NIS CI might not contain the true rate, but we don't know which states those are.

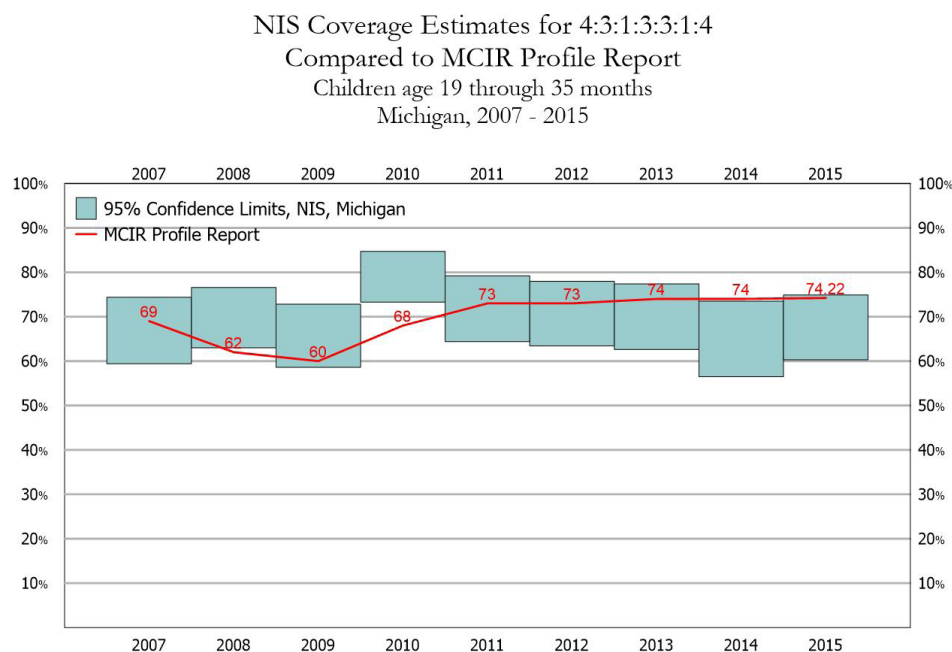
*\* Because of the complexity of explaining NIS and IIS-based assessment results, we do not recommend sharing and comparing NIS and IIS results with legislators or the media unless there is a specific reason to do so. Thus, "possible messages" aren't included in these sections.*

## Key messages

Key messages should include differences or changes in trends and possible reasons for changes. For IIS results, this could include provider participation levels, data completeness, changes in school/childcare requirements, changes in immunization data sharing laws, and expanded immunization practice (e.g., pharmacies or other organizations).

Refer to [Table 3](#) for more background on differences in methodology and definitions that may impact differences in rates.

**Figure 9. NIS Coverage Estimates for 4:3:1:3:3:1:4 Compared to MCIR Profile Report**<sup>42</sup>



<sup>42</sup> Graph provided by Rachel Potter, Vaccine-Preventable Disease Epidemiologist, Division of Immunization, Michigan Department of Health and Human Services. Personal communication, 11/29/16.

## Graphical representation comparing NIS and IIS results

A variety of graph types can be used to compare the results of different assessments. It is important to remember the audience and the purpose of the message when choosing how to display the data. Here we present a few different types of graphs and charts that may be helpful, along with suggested key messages for each.

[Figure 9](#) displays a floating bar chart. Notice that it shows a bar or block for the NIS rate—it does not show the precise point estimates. For each year, it displays a bar within which the true coverage rate lies. That is, it shows the range of possible values for the rates based on the confidence intervals. It also contains a red line representing the IIS-generated coverage levels. The red line intersects with most of the bars (except in 2010), indicating that the IIS rate is usually within the NIS confidence level. This type of graph is appropriate to share with senior leadership and internal or external experts who have an interest in seeing how the IIS is performing.

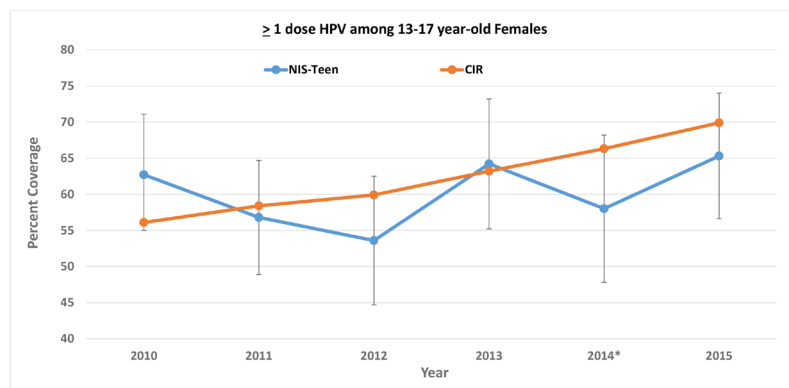
### Key messages:

- Overall, the IIS results and the NIS results have been relatively close, especially in the most recent five years.
- The big jump in the 2009 to 2010 NIS data suggests that either there was a big increase in vaccination rates or a sampling error is exaggerating the change.
- Although the 2010 IIS data point is below the 2010 NIS data point, they both show an increase from 2009, evidence that the true vaccination rate did increase.
- The IIS rate might be more stable than the NIS rate, especially during later years. This also demonstrates the fact that the NIS has sampling errors, and small shifts should not be over-interpreted.
- The MCIR is a mature IIS with a very high level of provider participation.

Figure 10 below presents an example from the New York Citywide Immunization Registry (CIR) comparing HPV rates in the IIS to the NIS. This line graph displays the NIS point estimates and confidence intervals in comparison to the IIS rates over a six-year period. When the NIS-Teen coverage rate for New York City showed a decline in 2012, CIR staff were confident, based on CIR data, that true coverage had not declined and had continued to increase. They concluded that the observed decline was due to the statistical variability of the NIS-Teen estimates. Similarly, when the NIS rate appeared to jump by 10 percentage points from 2012 to 2013, the CIR continued to show an even, steady rise. Once again, they concluded the NIS change was due to statistical variability.<sup>43</sup>

**Figure 10. Monitoring Uptake of Vaccines: Comparison of NIS and CIR Estimates**

HPV Vaccine Initiation: Comparison of National Immunization Survey and Citywide Immunization Registry Data, New York City



Data sources: NYC DOHMH Citywide Immunization Registry; CDC, NCRID 2010-2015 National Immunization Survey - Teen

\* In 2014, NIS-Teen implemented a revised methodology for defining adequate provider data

#### Key messages:

- The IIS rates maintain a steady increase over the six years covered in this graph.
- NIS-Teen estimates fluctuate noticeably over the years.
- Confidence intervals for the NIS-Teen are wide, and the NIS fluctuations do not appear to be statistically significant for most years.
- The IIS rates remained within the NIS-Teen confidence intervals throughout the period of NIS rate fluctuation.
- When the NIS rate appeared to jump by 10 percentage points from 2012 to 2013 and then decline the next year, the IIS continued to show an even, steady rise.
- The CIR is a well-populated, mature IIS that includes a high level of completeness for teen records.

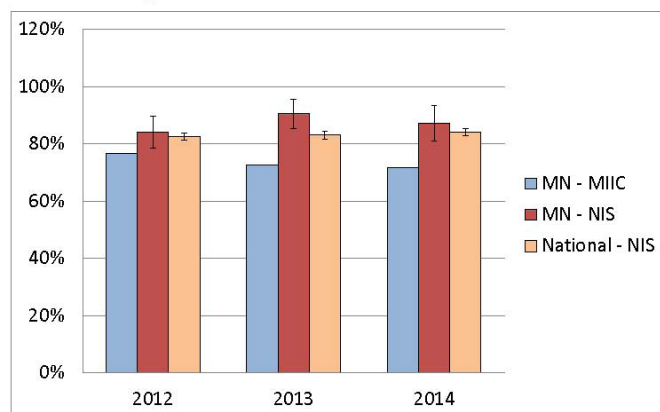
<sup>43</sup> Graph provided by Jane Zucker, Bureau of Immunization, New York City Department of Health and Mental Hygiene. Personal communication, 4/14/17.

Figure 11 is a bar chart that displays immunization rates over time for DTaP vaccine. This chart compares the Minnesota IIS (MIIC)-generated results to NIS results for the nation and for Minnesota.<sup>44</sup> The confidence intervals for the MN-NIS and the National-NIS are indicated by the thin vertical black line at the top of the red and pink columns. This format is easy to understand at a glance, and the brief summary below each chart ensures the reader receives the message.

**Figure 11. Minnesota IIS and NIS DTaP Immunization Rates Over Time**

### DTaP

Percent of children with 4 or more doses of diphtheria, tetanus, and pertussis vaccine (4+ DTaP)



According to the NIS, DTaP coverage in Minnesota is higher than the national average and remains consistent. MIIC DTaP coverage rates are consistent, but remain lower than the NIS rates.

### Key messages:

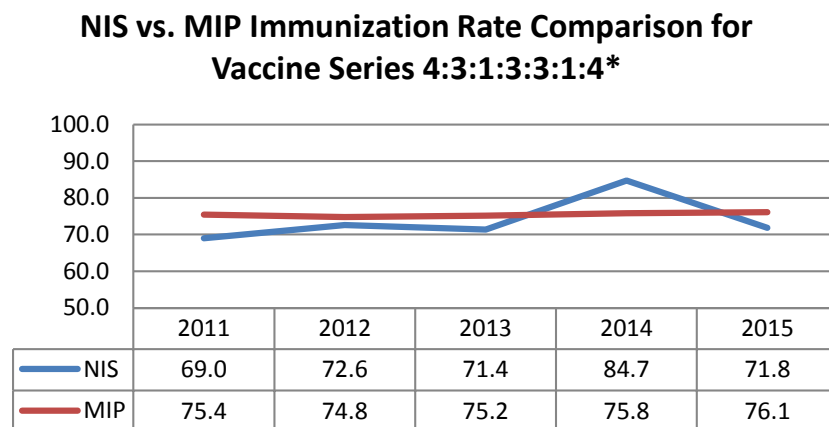
- NIS coverage rates for DTaP in Minnesota fluctuate somewhat from year to year, but changes do not appear to be statistically significant; point estimates for each year are within the confidence intervals for the other years.
- NIS national coverage rates are very stable with little fluctuation and are somewhat lower than the NIS Minnesota rates. However, the difference between NIS national and NIS state does not appear to be statistically different except possibly in 2013. (Note the confidence interval lines do not appear to overlap in 2013.)
- The IIS coverage rates are consistent and consistently lower than the NIS rates.
- All three measures for the three years fall short of the Healthy People 2020 objective of 90% coverage for this vaccine with the exception of the 2013 Minnesota rate, which may meet this objective.

<sup>44</sup> Minnesota Department of Health, Immunization Program. Childhood Immunization Coverage Over Time. <http://www.health.state.mn.us/divs/idepc/immunize/stats/coverdatatime.pdf>

Figure 12 provides an example of a line graph created by the Maine Immunization Program (MIP) that compares NIS results for the state with IIS-based results. Similar to Minnesota's approach, Maine includes a short text summary of the comparison in the footnote below the graph.

The text accompanying the Maine graph provides additional information on the methodology, enabling the graph itself to remain simple while including key points on confidence intervals and margin of error.<sup>45</sup>

**Figure 12. NIS and Maine Immunization Program Vaccine Coverage Comparison<sup>46</sup>**



**Key messages:**

- IIS rates are very stable over the five-year period, showing little fluctuation.
- NIS coverage rates show a sharp increase from 2013 to 2014, then a sharp decrease from 2014 to 2015, statistically significant changes.
- NIS has a much smaller sampling size resulting in a larger margin of error and rate fluctuations year to year.

\*Vaccine Series: 4DTaP:3IPV:1MMR:3Hib:3HepB:1Var:4PCV

Trend is based on the larger sample size MIP uses to determine immunization rates. These rates have remained constant for the past five years, within 1.3%. NIS has a much smaller sampling size resulting in a larger margin of error and inconsistencies year to year, the largest being a rate change of 13.3% in 2014, a significant statistical difference.

- The 2015 NIS sampling size for Maine included 221 children. The MIP quarterly rate released during the same month (October 2016) included 9,996 children.
- NIS sample represents 0.02% of the 2 year old population in Maine. MIP quarterly rates represent 76.6% of the same population.
- Based on the sampling size (smallest in the nation) NIS coverage estimates include a 7.9% margin of error.
- NIS rates are retrospective, released 10 months after these children were in the 24-35 month old cohort. MIP quarterly rates are reflective of the children in the state who are currently 24-35 months, real time up-to-date information.

<sup>45</sup> Maine Center for Disease Control & Prevention, received by personal communication from Tonya Philbrick, 12/22/16.

<sup>46</sup> Ibid.

## THE BIG PICTURE

So far, we have focused on communications related to specific and current vaccination coverage rates. As we continue our work to reduce cases of vaccine-preventable disease, we must keep the big picture as the focus of all communications with our key external audiences. Vaccination was one of public health's great achievements of the 20th century. Thanks to high national levels of childhood vaccination coverage, most vaccine-preventable diseases are at record low levels and less than 1% of all children receive no vaccines before the age of five<sup>47</sup>. While vaccination is a public health success story that should be recognized and celebrated, the work is ongoing. The need to both improve and maintain vaccination coverage rates continues.

Childhood vaccination coverage levels for individual vaccines are at 90% or higher for the most part. This is the level needed to provide herd (community) immunity. However, the current rates for the combined series (4-3-1-3-3-1-4) indicate that there is a larger group of children at risk because they are missing one or more vaccines.<sup>48</sup> The 2015 combined series rate of 72.2% shows we still have work to do to reach the Healthy People 2020 goal of 80%. And even as rates approach the 80% level, we must remember that each year the work starts over again to protect the four million babies born annually in the U.S. Each child born is vulnerable to vaccine-preventable diseases that continue to circulate. Importation of disease from around the world presents an ongoing challenge for public health workers and clinicians.<sup>49, 50</sup>

Vaccination coverage assessment results should be shared in a way that emphasizes the overall value of vaccination and the importance of continuing vigilance. We can frame a community's current coverage rates to draw attention to low vaccination rates and/or to recognize improvements. At the same time, it is important to describe the ongoing actions needed to maintain good immunization practices.

47 CDC. Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015. MMWR Morb Mortal Wkly Rep, October 7, 2016; 65(39):1065–1071. [https://www.cdc.gov/mmwr/volumes/65/wr/mm6539a4.htm?s\\_cid=mm6539a4\\_w](https://www.cdc.gov/mmwr/volumes/65/wr/mm6539a4.htm?s_cid=mm6539a4_w).

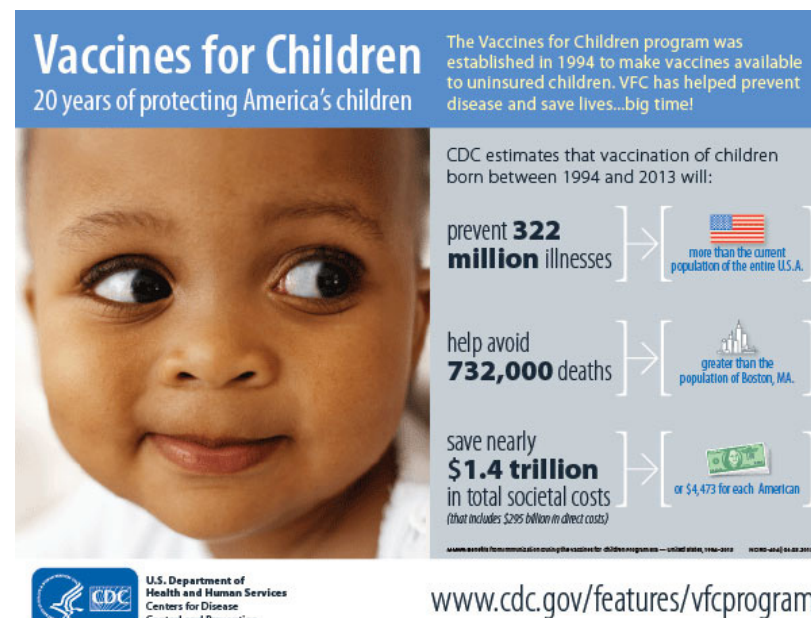
48 See Glossary in Appendix A for definition of the 4-3-1-3-3-1-4 series.

49 Benefits from Immunization During the Vaccines for Children Program Era — United States, 1994–2013. Weekly MMWR. April 25, 2014 / 63(16):352–355. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6316a4.htm>.

50 Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Dietz V. Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015. MMWR Morb Mortal Wkly Rep 2016;65:1065–1071. DOI: <http://dx.doi.org/10.15585/mmwr.mm6539a4>.

## Examples of maintaining the big picture

Providing data in an easy-to-understand image, this infographic clearly describes how the Vaccines for Children program has had a tremendous impact on protecting children by preventing disease and saving lives.



These tweets highlight the positive impact of vaccines by describing how they prevent dangerous diseases.



## SECTION V. OTHER NIS–IIS INITIATIVES

### NIS-IIS MATCH PROJECT

CDC offers an opportunity to states and jurisdictions to match IIS to NIS samples at the child level. The NIS-IIS Match Project compares vaccination histories in an IIS to those collected during the NIS provider record check for children in the NIS sample. It is offered annually for NIS-Child and NIS-Teen. The match process helps the IIS determine if they are missing some of the population and/or some vaccinations.<sup>51, 52</sup> Likewise, it provides information to CDC on vaccination records that may be missing in the NIS.

### IIS-BASED METHODS FOR GENERATING COMPARISONS WITH NIS

As discussed in detail throughout this guide, differences in vaccination coverage estimates from the NIS and IIS can be difficult to interpret, and it is generally assumed that differences in methodologies account for some of the variation. An unbiased comparison of the two data sources is desired in order to assess completeness of the IIS data. Therefore, in order to reduce some methodological differences, CDC launched the NIS-IIS Simulation Project to develop methods that “replicate” or approximate the NIS in the entire IIS population.<sup>53</sup> This project compares the findings with more traditional point-in-time techniques described in AIRA’s *Analytic Guide* in order to assess the strengths and limitations of the alternative techniques. The objectives are to:

- Develop and test approaches for generating IIS-based coverage estimates that are comparable to NIS.
- Minimize data collection/analysis differences wherever possible.
- Provide evidence-based guidance to all immunization programs using tested methodologies.
- Allow programs to generate comparable estimates in a timely manner at reduced cost.

The IIS Sentinel Sites participated in the initial study, and results are expected in late 2017.

### INTEGRATING IIS AND NIS FOR NATIONAL AND STATE LEVEL VACCINATION COVERAGE ASSESSMENT

Both NIS and IIS-based assessments strive to produce accurate vaccination coverage results. The efforts described above are examples of collaborative opportunities that will enhance the capabilities and capacity of both and will be seeds for further integration between IIS data and the NIS. As IIS become increasingly robust, the value of using IIS for coverage assessments also increases. IIS data could eventually be used as part of the NIS sample or replace the NIS telephone sampling methods entirely, resulting in significant cost savings.<sup>54</sup>

51 Singleton, J et al. Understanding the National Immunization Survey (NIS) and its Relationship with Immunization Information Systems (IIS) – a Budding Romance? Presented at the AIRA National Meeting, Chicago, Ill. 4/12/17.

52 For more information on the NIS-IIS Match project, visit <https://www.cdc.gov/vaccines/programs/iis/activities/nis-study.html> or contact [iisinfo@cdc.gov](mailto:iisinfo@cdc.gov).

53 Zell E, Pabst L, Greby S, Hill H, Elam-Evans L. Comparing National Immunization Survey (NIS) and Immunization Information Systems (IIS) Vaccine Coverage Estimates. Presentation to Sentinel Sites 11/3/16.

54 Ormson, E, Singleton J. Evaluating the Feasibility of Using IIS as a Sample Frame for the NIS, Presented at AIRA National Meeting, Chicago, Ill. 4/12/17. [http://repository.immregistries.org/files/resources/5900dfea22d31/aira\\_2017\\_5c\\_evaluating\\_the\\_feasibility\\_of\\_using\\_iis\\_as\\_a\\_sample\\_frame\\_for\\_the\\_nis\\_norc\\_e\\_zell.pdf](http://repository.immregistries.org/files/resources/5900dfea22d31/aira_2017_5c_evaluating_the_feasibility_of_using_iis_as_a_sample_frame_for_the_nis_norc_e_zell.pdf).

## SECTION VI. CONCLUSION

This guide describes the NIS and IIS-derived coverage assessments, their differences, and their complementary roles in providing vaccination coverage data. The NIS and IIS, as well as the other assessments described in [Appendix B](#), use different methodologies and data sources in the calculation of coverage rates. To interpret the results, key questions about each assessment must be answered. [Appendix G](#) includes a template of questions that can be used to uncover and compare the strengths, limitations, and differences of each method.

The analysis and interpretation of coverage assessment results must occur prior to communication planning. Once the significance of the results is clearly understood, IIS and immunization program staff can determine the key messages to promote. The communication plan should consider the different needs and expectations of varying audiences. Using a key message template such as the one provided in this guide can help in creating an effective message that is concise and easy to understand. Visual aids, such as graphs, charts, and maps, can also assist in conveying the key messages and need to be designed with the target audience in mind. This guide provides real-life examples of visual aids that may serve as prototypes for the IIS community to consider.

The future holds considerable opportunity for IIS to play an ever more active role in the assessment of state and local vaccination coverage rates. We encourage IIS staff to use AIRA's [Analytic Guide for Assessing Vaccination Coverage Using an IIS](#) to develop coverage assessments. We also encourage IIS staff to explore opportunities to use their data for comparison with other coverage assessments, such as the NIS. As described in [Section V](#), opportunities to collaborate with CDC on NIS-related projects are expected to increase. Participating in these projects will help further the utility of IIS as a primary public health tool in the prevention of vaccine-preventable diseases.

## APPENDIX A. GLOSSARY AND ACRONYMS

### GLOSSARY

**4-3-1-3-3-1-4** - Primary vaccination series for children typically completed between 15 and 19 months of age. Series is comprised of 4 DTaP, 3 Polio, 1 MMR, 3 Hib, 3 Hep B, 1 VAR, and 4 PCV.

**Accuracy** – As used in this guide in reference to coverage assessment results, accuracy means that the value of the parameter being measured (e.g., vaccine coverage level) has little random or systematic error.

**Catch-up Schedule** – For persons aged 4 months through 18 years who start vaccinations late or who are more than one month behind, the catch-up schedule provides information on minimum interval and minimum age, and for some vaccines, fewer doses are required.

**Cohort** – Part of the population (individuals) within given parameters.

**Confidence Interval** – For a particular sampling method, the range of values that would result if the data collection had been repeated many times. For a 95% confidence interval, if the sampling method is repeated many times, the true value would fall within this interval at least 95% of the time. The true value is either in this interval or not in this interval.

**Confidence Limits** – The end points (i.e., the minimum and maximum values) of a confidence interval.

**Contraindications** – A patient medical condition that precludes a patient from receiving one or more vaccinations that may increase the chance of a serious adverse event.

**Data Quality Accuracy** – In relation to an IIS, **accuracy** encompasses the concept that data recorded in the IIS should accurately reflect an individual's demographic information and match exactly what happens in a clinical encounter, whether or not it is clinically appropriate.

**Data Quality Completeness** – In relation to an IIS, **completeness** encompasses the concepts that information submitted to the IIS should contain the minimum/mandatory set of data items and all individuals in the jurisdiction should have a record in the IIS that contains all vaccinations administered to the individual.

**Date Quality Timeliness** – In relation to an IIS, **timeliness** encompasses the concept that data should be reported and recorded in the IIS, as well as be available to users, in a timely manner.

**Deduplication** – Patient-level deduplication is the process of determining if similar patient records in the IIS represent the same patient and, if they do, consolidating the records. Vaccination-level deduplication is the process of determining if similar vaccinations on a patient's IIS record represent the same vaccination event and, if they do, merging, correcting, or deleting one of the vaccines.

**Healthy People 2020** – Healthy People provides science-based, 10-year national objectives for improving the health of all Americans. It establishes benchmarks and monitors progress over time in order to: encourage collaboration across communities and sectors, empower individuals toward making informed health decisions, and measure the impact of prevention activities. Contains specific vaccination-related objectives.

**Exclusion Criteria** – Reasons for excluding individuals from a coverage assessment, pre-determined in the development phase of the assessment. Examples of exclusion criteria include patients who are deceased, have moved out of state, or have medical contraindications.

**Exemptions** – Non-medical reasons that exclude a patient from vaccinations (e.g., religion, philosophical reasons, parent preference).

**Immune Status** – Immunity to a certain disease due to previous history of disease. Can be indicated by lab tests, or in the case of some diseases such as varicella, reported history of disease is accepted. In many jurisdictions, individuals with this type of immunity are not required to receive the vaccination for the disease.

**Margin of Error** – The range of values above and below the sample statistic (e.g., the point estimate), per confidence interval.

**Point Estimate** – A statistic that is a single value calculated from sample data. It is an estimate of the true value if you were to count every member in the population.

**Population-based assessment** – An assessment designed to represent the population through data capture and analysis for the full population (as with census or IIS data) or for surveys such as NIS through using a sample frame that covers most of the target population, randomly selects units from the sampling frame, and uses weighting adjustments to account for incomplete sample frame and possible nonresponse bias.

**Precision** – As used in this guide, precision describes how consistently results are produced across multiple measurements. Estimates with little random error are precise. For estimates from surveys such as the NIS, precision is measured by the width of the 95% confidence interval of the estimate, which takes into account the random error expected if the NIS survey had been repeated multiple times. A narrower confidence interval means more precision.

**Random Digit Dialing** – A set of techniques for drawing a random sample of households from the source material, i.e., the set of telephone numbers that comprise the sample frame.

**Routine Schedule** – ACIP recommendations on the use of routinely recommended vaccines for children and adolescents aged 18 years or younger who stay on schedule. See catch-up schedule for children and adolescents who start vaccinations late or fall behind.

**Sentinel Sites** – Sentinel sites are a subset of IIS that partner with NCIRD to track patterns in immunization practices and assess vaccination coverage in their sentinel site geographic regions. CDC provides competitive supplemental cooperative agreement funds to these IIS that have achieved high data quality standards to use their IIS for program evaluation and vaccine use assessments. For more information on sentinel sites, see <https://www.cdc.gov/vaccines/programs/iis/activities/sentinel-sites.html>.

**Standard Error** – A statistical term that measures the accuracy with which a sample represents a population.

**Up to Date (UTD)** – Patient is current on vaccinations, meeting ACIP recommendation for age, intervals and other requirements.

**Vaccination Coverage** – A rate describing the frequency at which vaccination events occur in a defined population. The components of a vaccination coverage rate are the numerator, the denominator, and the specified time period in which immunization events can occur.

## ACRONYMS

**ACIP** – Advisory Committee on Immunization Practices

**AIM** – Association of Immunization Managers

**AIRA** – American Immunization Registry Association

**ASTHO** – Association of State and Territorial Health Officials

**BRFSS** – Behavioral Risk Factor Surveillance System

**CDC** – Centers for Disease Control and Prevention

**CI** – Confidence Interval

**FERPA** – Family Educational Rights and Privacy Act

**HEDIS** – Healthcare Effectiveness Data and Information Set (conducted by National Committee for Quality Assurance)

**HHS** – Health and Human Services (federal agency)

**IIS** – Immunization Information System

**IISAR** – Immunization Information System Annual Report (conducted by CDC)

**ISD** – Immunization Services Division (CDC)

**MMWR** – Morbidity and Mortality Weekly Report (published by CDC)

**NCIRD** – National Center for Immunization and Respiratory Diseases (CDC)

**NCQA** – National Committee for Quality Assurance

**NHIS** – National Health Interview Survey

**NIS** – National Immunization Survey

**NIS-Child** – National Immunization Survey of vaccination levels in children 19 through 35 months of age (as used in this guide)

**NIS-CIM** – National Immunization Survey Childhood Influenza Module for children 6-18 months and 3-12 years of age

**NIS-Flu** – National Immunization Survey of influenza vaccination coverage levels in children and teens 6 months through 17 years of age that combines the responses collected from NIS-Child, NIS-Teen, and the NIS-Childhood Influenza Module (CIM)

**NIS-Teen** – National Immunization Survey of vaccination levels in teens 13 through 17 years of age

**NORC** – An independent research institution at the University of Chicago (<http://www.norc.org>)

**PRAMS** – Pregnancy Risk Assessment Monitoring System

**UTD** – Up to Date (for vaccinations as recommended by ACIP)

## APPENDIX B. DESCRIPTION OF OTHER IMMUNIZATION ASSESSMENTS

This guide has focused primarily on National Immunization Survey (NIS) and IIS-generated coverage assessments. However, other vaccination coverage assessments are sometimes referenced and compared to IIS-generated results. Most familiar to the IIS community are the Healthcare Effectiveness Data and Information Set (HEDIS) and the School Vaccination Assessment Program (SVAP). Other health assessments that include vaccinations and that may be encountered are: the Behavioral Risk Factor Surveillance System (BRFSS), Internet Panels, the National Health Interview Survey, Pregnancy Risk Assessment Monitoring System (PRAMS), and Minimum Data Set (MDS).

These are described below to assist IIS and immunization program staff who need a quick explanation of these assessments.

### HEALTH CARE EFFECTIVENESS DATA AND INFORMATION SET (HEDIS)

**Background** – HEDIS is part of a suite of quality standard and performance measures developed by the National Committee for Quality Assurance (NCQA) for a broad range of health care entities. It is used by more than 90% of America's health plans to measure performance on important dimensions of care and service. Childhood and adolescent immunization status are two of 81 measures.

**Purpose** – HEDIS helps employers assess the quality of care provided by the health insurance plans they offer; consumers are also occasionally provided with these data. In the area of immunizations, HEDIS falls into the category of performance-based assessment in that it does not allow for the catch-up schedule and children must meet the number of doses required by the routine immunization schedule.

**Source of data** – HEDIS uses two sources of data for measurement calculations. One is administrative data—claims or encounter data submitted from the health care provider to the health plan. The other source is medical record data which is abstracted from a random sample of member medical records. The term “hybrid data” is used in HEDIS to refer to a combination of administrative data and a sample of medical record data to capture services rendered but not reported to the health plan through claims data. Some IIS provide data to health plans for their HEDIS measures, which is considered equivalent to medical record data.

**Methodology** – The denominator is the eligible population enrolled in the health plan. For the childhood measure, it includes children who turned 2 years of age during the measurement year. For the adolescent measure, it includes those who turned 13 years of age during the measurement year. In addition, the children must have been continuously enrolled in the plan for 12 months prior to the second birthday (for childhood measure) or prior to the 13th birthday (for adolescent measure)—except that a gap of up to 45 days during that year may be allowed. Also, there is an option to exclude from the denominator children who had a contraindication for a specific vaccine by their second birthday.

**Numerator** – For 2-year-olds, rates are calculated for each individual vaccine and nine separate combination rates by the second birthday. For 13-year-olds, rates are calculated for one meningococcal conjugate (MCV) and one Tdap or Td dose by the 13th birthday. As of 2017, HEDIS has added the HPV vaccine for teens and the combination series of meningococcal, Tdap, and HPV and removed Td from the schedule.<sup>55</sup> To be considered complete, the CDC/ACIP recommended immunization schedule is followed. For 2-year-olds, 4 DTaP, 3 IPV, 1 MMR, 3 Hib, 3 Hepatitis B, 1 Varicella, 4 PCV, 1 hepatitis A, 2 or 3 rotavirus (depending on product used) and 2 influenza doses are required—all by the second birthday.<sup>56</sup> A child who is UTD via the catch-up schedule does not meet the requirements.

<sup>55</sup> Summary Table of Measures, Product Lines And Changes, HEDIS 2017. <http://www.ncqa.org/Portals/0/HEDISQM/HEDIS2017/HEDIS%202017%20Volume%20List%20of%20Measures.pdf?ver=2016-06-27-135433-350>.

<sup>56</sup> <https://www.ncqa.org/Portals/0/Childhood%20Immunization%20Status.pdf>.

The numerator includes children with evidence of disease for certain vaccines. For MMR, hepatitis B, varicella, and hepatitis A, children with the following are included in the numerator:

- Evidence of the antigen or combination vaccine, or
- Documented history of the illness, or
- A seropositive test result for each antigen

**Limitations** – HEDIS varies from CDC recommendations in a couple of ways: those who need fewer doses because of a late start or because they aged out of needing the full series of a particular vaccine are not considered UTD and thus do not appear in the numerator. In addition, “grace periods” are not recognized. (A dose received within the four-day grace period is considered valid by ACIP.) That is, a dose received too early but within the four-day grace period is not included in the numerator. Results may not be representative at a jurisdictional level because of demographic differences in the population served by individual health plans—e.g., differences between Medicaid and commercial plans and different geographic areas served.

**Strengths** – The source of HEDIS data is sound: medical records and claims/encounter data. HEDIS’s strong, consistent methodology used across health plans nationwide makes it a useful and generally reliable tool in comparing health plans.<sup>57</sup> According to a study comparing 2009 HEDIS and 2009 NIS data, HEDIS childhood immunization measures overall are accurate and useful, with a caution that certain immunizations (e.g., hepatitis B, pneumococcal conjugate) and certain children (e.g., those with a single overdue immunization) are more prone to HEDIS misclassification.<sup>58</sup>

## SCHOOL VACCINATION ASSESSMENT PROGRAM (SVAP)

Each school year, school nurses, other school personnel, and/or health department staff check the vaccination and exemption status

of kindergarteners enrolled in public and private schools as required by state law or regulation. State and local immunization programs measure vaccination coverage among children entering kindergarten annually. This may be done for every student or for a sample of students. Federally funded immunization programs (e.g., states, territories, jurisdictions) are required to collect and report their kindergarten vaccination data annually to CDC. CDC uses the data reported by states for children in kindergarten to assess vaccination coverage for vaccines routinely recommended at ages 4-6 years. CDC also uses the data to monitor progress toward the 2020 objectives for vaccine coverage among kindergarteners.<sup>59</sup>

**Purpose** – School vaccination assessments at the state and local levels allow immunization programs to identify schools and communities where focused action could improve vaccination coverage to ensure that more children are protected by vaccines. Immunization programs can use the data to monitor grace period/provisional enrollment levels in addition to vaccination coverage and exemptions. Programs can also use the results to work with schools with higher grace period or provisional/conditional enrollment rates to ensure all kindergartners receive recommended vaccinations and are protected from vaccine-preventable diseases.

**Source of Data** – States use a range of data sources to assess vaccination coverage, depending on state laws and requirements. Most rely on an immunization record form provided by parents upon school enrollment of their children. Provider verification is typically required, but some states accept parent report. Some states allow, or even encourage, the schools to view IIS records to obtain the needed data.

**Methodology** – The methodology varies because of differences in state mandates, data reported, and available resources. During the 2015-16 school year, among the 51 programs reporting data, 32 used a census method (i.e., included all public and private schools and all children within the schools); 10 used a sample; three used a voluntary school response; and six used a mix of sampling methods.<sup>60</sup> State and local areas set the vaccination requirements. School-level data are reported to the health department. Aggregate

<sup>57</sup> <http://www.ncqa.org/hedis-quality-measurement>

<sup>58</sup> Accuracy and Usefulness of the HEDIS Childhood Immunization Measures.

David G. Bundy et al. *Pediatrics* 2012 Apr; 129(4): 648–656.

<sup>59</sup> Healthy People 2020 Objectives – See IID 10.4. <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>.

<sup>60</sup> See Table 1 footnote in Vaccination Coverage Among Children in Kindergarten – United States, 2015–16 School Year, MMWR, Weekly / October 7, 2016 / 65(39):1057–1064. <https://www.cdc.gov/mmwr/volumes/65/wr/mm6539a3.htm>.

data are then reported to CDC for public and private schools. Data for home schooled students are not routinely reported to CDC.<sup>61</sup> The types of exemptions allowed vary by jurisdiction.

**Limitations** – Comparability among states is limited because of variations in state requirements. In addition, school assessments may not be representative of all kindergarteners in the jurisdiction due to data collection methodologies that miss some schools or students or assess vaccination status at different times. Some states do not require provider confirmation, and vaccination history may be based solely on parent report. State-specific interpretations of the Family Educational Rights and Privacy Act (FERPA) sometimes restrict the kind of data a school can supply and may limit how the health department chooses to collect the data. Finally, actual vaccination coverage, exemption estimates, or both might be under- or over-estimated because of improper or absent documentation.

**Strengths** – Estimates provided by states to CDC for kindergarten students are the only current source of data from all states on vaccination coverage and exemption rates for this population. States can use the data to identify schools or communities with lower vaccination coverage, higher exemption rates, or with a big gap between the proportion documented as unvaccinated minus the proportion with an exemption. If wide data collection is achieved, these data can be helpful in visualizing both immunization coverage rates and exemption rates across a jurisdiction, either by school district or by county. If methodology remains consistent from year to year, the data can also be used to compare performance over time and to devote resources to struggling areas of the state.

## BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM (BRFSS)

BRFSS is an ongoing state-based monthly telephone survey which collects information on chronic health conditions, risk behaviors, and use of preventive services, from randomly selected people ≥18 years old among the U.S. population. Established in 1984 with

15 states, BRFSS now collects data in all 50 states as well as the District of Columbia and three U.S. territories. BRFSS completes more than 400,000 adult interviews each year, making it the largest continuously conducted health survey system in the world.<sup>62</sup>

**Purpose** – The vaccination-related component of BRFSS includes influenza vaccine coverage rates for individuals aged 18 years and over. It also includes pneumococcal vaccine coverage rates for individuals aged 65 and over, as well as for individuals 18-64 years of age with conditions placing them at increased risk for pneumococcal disease. These two vaccines are considered “core” and are measured every year. CDC/NCIRD/ISD also sponsors rotating vaccine questions in the core survey on a three-year alternating basis: Td/Tdap, herpes zoster, and place where influenza vaccination received. These questions, as well as an adult HPV vaccination module, are sponsored by ISD as optional modules during years when they are not in the core survey.

CDC analyzes data from the NIS-Flu and the BRFSS to estimate influenza vaccination coverage from the previous influenza season for national, state, and select local areas and territories. Coverage estimates are presented by age group, race/ethnicity, and month of vaccination with additional information for adults with certain medical conditions (e.g., asthma, diabetes, heart disease, chronic obstructive pulmonary disease, or cancers other than skin cancer) that put them at higher risk for influenza-related complications.

**Methodology** – Similar to NIS, the BRFSS currently samples from landline and cell telephone lists and uses a random digit dial survey methodology. BRFSS respondents are asked if they have received an influenza vaccine in the past 12 months, and if so, in which month and year. This information is self-reported and not verified by medical records. Results are weighted and analyzed using statistical software to account for the complex survey design. Influenza vaccination coverage estimates are calculated for each influenza season, using data from October of one year through June of the next year.<sup>63</sup> Differences between groups and between 2014-15 and 2015-16 seasons were determined using t-tests with significance

61 <https://www.cdc.gov/vaccines/imz-managers/coverage/schoolvaxview/data-reports/coverage.html>

62 <https://www.cdc.gov/brfss/index.html>

63 See <https://www.cdc.gov/mmwr/preview/mmwrhtml/ss6204a1.htm> for the MMWR surveillance summary on CDC's influenza vaccination coverage assessments.

at  $p < 0.05$ .<sup>64</sup> Adult vaccination coverage estimates from BRFSS and other sources are reported on the CDC AdultVaxView website,<sup>65</sup> and influenza vaccination coverage estimates from BRFSS and other data sources are at FluVaxView.<sup>66</sup>

**Limitations** – Vaccination status is based on self-report and not validated with medical records. Response rates for NIS-Flu and BRFSS surveys have been low, and a non-response bias may remain even after weighting adjustments. The number of persons vaccinated has been overestimated in the past when the number of people reporting vaccination has been higher than doses distributed. Some state-specific estimates have large confidence intervals and may not be reliable.<sup>67</sup>

**Strengths** – BRFSS provides a standard methodology that is used in every state. It has been in existence for over 30 years and results can be compared over time.

## INTERNET FLU PANELS – ADULT SPECIAL POPULATIONS

CDC uses Internet panel surveys to monitor health issues of special populations at the national level, including pregnant women and health care personnel. Internet panel surveys include questions related to attitudes about vaccination, health factors related to vaccinations, and influenza vaccinations.

**Purpose** – The purpose of Internet flu panels is to estimate and monitor influenza vaccination coverage among U.S. health care personnel and among pregnant women (two separate surveys).

**Source of Data** – Survey of opt-in Internet users.

**Methodology – Health care personnel:** In the 2015-16 influenza season, 2,258 health care personnel were surveyed to provide

estimates of influenza vaccination coverage among health care personnel. Similar surveys have been conducted since the 2009-10 influenza season. Health care personnel were recruited from two preexisting national opt-in Internet sources: Medscape, a medical website managed by WebMD Health Professional Network, and general population Internet panels operated by Survey Sampling International (SSI). Responses were weighted to the distribution of the U.S. population of health care personnel by occupation, age, sex, race/ethnicity, work setting, and census region. Because the study sample was based on health care personnel from opt-in Internet panels rather than probability samples, no statistical tests were performed. A change was considered as an increase or decrease when there was at least a 5 percentage point difference between estimates; estimates with smaller differences were considered similar.<sup>68</sup> **Pregnant women:** Women aged 18-49 years who reported being pregnant at any time since a particular date were eligible to participate in the survey. Participants were recruited from a preexisting, national, opt-in, general population Internet panel operated by SSI, which provides panel members with online survey opportunities in exchange for nominal incentives. Pregnant women panelists were recruited through (1) an email invitation sent to female panel members aged 18-49 years living in the United States, and (2) a message on the panel website inviting panel members to answer a series of screening questions and, if eligible, to take the survey.<sup>69</sup> The denominator for each survey is based on the number of survey respondents, using survey weights derived for each survey respondent. The numerator is the number of respondents who answered that they did receive an influenza vaccine during the previous influenza season.

**Limitations – Health care personnel:** The study used a nonprobability sample of volunteer health care personnel members of Medscape and SSI Internet panels. Vaccination status was self-reported. Coverage findings from Internet survey panels have differed from population-based estimates from the National Health Interview Survey in past influenza seasons. **Pregnant women:** Vaccination status was self-reported. The survey did not include women without Internet access. As an opt-in survey, estimates

64 <https://www.cdc.gov/flu/fluview/coverage-1516estimates.htm>

65 <https://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/>

66 <https://www.cdc.gov/flu/fluview/>

67 <https://www.cdc.gov/flu/fluview/coverage-1516estimates.htm>

68 CDC. Influenza Vaccination Coverage Among Health Care Personnel – United States, 2015–16 Influenza Season. MMWR Weekly / September 30, 2016 / 65(38):1026–1031.

69 Influenza Vaccination Coverage Among Pregnant Women – United States, 2014–15 Influenza Season, MMWR Weekly; September 18, 2015 / 64(36):1000–1005. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6436a2.htm>

might be biased if a woman's decision to participate in this particular survey were related to receipt of vaccination.

**Strengths** – Internet panel surveys provide a useful surveillance tool for timely early season and post-season evaluation of influenza vaccination coverage as well as vaccination-related knowledge, attitude, practice, and barrier data among health care personnel and pregnant women.<sup>70</sup>

**Note:** CDC also conducts a rapid influenza vaccination coverage survey in the general adult population in November each year to provide preliminary early-season coverage estimates at the national level for reporting during National Influenza Vaccination Week, usually the first week of December. See description at <https://www.cdc.gov/flu/fluview/nifs-estimates-nov2016.htm>.

## THE NATIONAL HEALTH INTERVIEW SURVEY (NHIS)

The NHIS has been used to monitor the health of the nation since 1957. The NHIS is a large-scale household interview survey of a statistically representative sample of the U.S. civilian non-institutionalized population. Interviewers visit 35,000-40,000 households across the country and collect data about 75,000-100,000 individuals. NHIS data are collected on a broad range of health topics.<sup>71</sup>

**Purpose** – The main objective of the NHIS is to monitor the health of the U.S. population through the collection and analysis of data on a broad range of health topics, with results on health status and health care access used by policy makers to determine needs for health services. Results are also used to monitor progress toward Healthy People 2020 objectives—e.g., influenza vaccine.

**Source of Data** – Personal household interviews are conducted by the U.S. Census Bureau under the direction of the National Center for Health Statistics (NCHS), a part of CDC.

**Methodology** – The NHIS uses in-person interviews to collect information on health and health care for all eligible members of the sampled households. Information on adult vaccinations is self-reported by one randomly sampled adult within a family, except in rare cases when the selected adult is physically or mentally incapable of responding. Information on child vaccinations, e.g. influenza, is provided by a knowledgeable adult household member. Depending on age and risk factors, respondents were asked questions about the following vaccines: Influenza, Pneumococcal, Td/Tdap, Shingles (Zoster), Hepatitis A, Hepatitis B, HPV. These vaccinations were assessed annually through 2017, with vaccinations to be assessed starting in 2018 yet to be determined.

**Limitations** – Vaccines are not provider-verified.

**Strengths** – Uses a large sample. Provides national-level data on several adult immunizations not otherwise available. Has higher response rates than telephone surveys and includes households with no telephone service.

## THE PREGNANCY RISK ASSESSMENT MONITORING SYSTEM (PRAMS) – FLU AND TDAP

PRAMS is a surveillance project of the CDC and state health departments. Developed in 1987, PRAMS collects state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after pregnancy. PRAMS surveillance currently covers about 83% of all U.S. births.<sup>72</sup>

**Purpose** – PRAMS data are used to identify groups of women and infants at high risk for health problems, to monitor changes in health status, and to measure progress toward goals in improving the health of mothers and infants. The overall purpose of PRAMS is to plan and review programs and policies aimed at reducing health problems among mothers and babies.

**Data Source** – The PRAMS sample of women who have had a recent live birth is drawn from each state's birth certificate file, with a sample size of 1,300 to 3,400 women per state per year. Women

70 Influenza Vaccination Coverage Among Health Care Personnel – United States, 2014–15 Influenza Season MMWR Weekly, September 18, 2015 / 64(36);993-99 <http://www.cdc.gov/flu/fluview/hcp-ips-nov2014.htm>.

71 <http://www.cdc.gov/nchs/nhis.htm>

72 <https://www.cdc.gov/prams/index.htm>

from some groups are sampled at a higher rate to ensure adequate data are available in smaller but higher-risk populations.

**Methodology** – Selected women are first contacted by mail. If there is no response to repeated mailings, women are contacted and interviewed by telephone. Data collection procedures and instruments are standardized to allow comparisons between states. A wealth of demographic and medical information is collected through the state's vital records system. The availability of information for all births is the basis for drawing stratified samples and for generalizing results to the state's entire population of births.<sup>73</sup>

**Vaccines Assessed** – The influenza vaccine question is required for all states. The Tdap question is optional at the state's discretion. Other vaccines may be added by individual states. **Numerators** – Influenza Question: "During the 12 months before the delivery of the new baby, did you get a *flu* shot?" If the answer is either "yes, before my pregnancy" or "yes, during my pregnancy," the respondent is asked to provide the month and year of vaccination.<sup>74</sup> Tdap Question: "Did you receive a *Tdap* vaccination *before, during or after* your most recent pregnancy?" Respondents answering yes are not asked for the date of vaccination but are asked to select from *before, during, after, or don't know*.<sup>75</sup>

**Denominators** – Calculated by summing up the survey weights assigned to each survey respondent.

**Limitations** – Self-report, no provider or medical record confirmation, relatively long lag time from data collection to data availability. Analysis of long-term trends is limited due to change in wording over time.

**Strengths** – A standardized data collection methodology allows for comparisons among states and for optimal use of the data for single-

state or multistate analysis. Each state also has the opportunity to customize some portions of it to tailor the procedures to the needs of the state. Typically, the annual sample is large enough for estimating statewide risk factor proportions within 3.5% at a 95% confidence level.

## MINIMUM DATA SET (MDS) – NURSING HOME DATA FOR INFLUENZA AND PNEUMOCOCCAL

The Minimum Data Set (MDS) is part of the federally mandated process for clinical assessment of all residents in Medicare- and Medicaid-certified nursing homes. This process provides a comprehensive assessment of each resident's functional capabilities and helps nursing home staff identify health problems.<sup>76</sup> MDS assessments are required for residents on admission to the nursing facility, periodically, and on discharge. All assessments are completed within specific guidelines and time frames. MDS information is transmitted electronically by nursing homes to the national MDS database at the Centers for Medicaid and Medicare Services (CMS).

**Purpose** – To help CDC and CMS monitor progress toward the Healthy People 2020 influenza and pneumococcal objectives, this assessment estimates the annual seasonal influenza vaccination and the annual pneumococcal polysaccharide vaccination (PPV) rates of institutionalized adults aged 18 years and older in long-term care facilities or nursing homes certified by the Centers for Medicare & Medicaid Services (CMS).<sup>77, 78</sup>

**Methodology** – Conducted by individual staff of CMS-certified nursing homes. The *influenza* vaccination numerator includes all those from the denominator population as calculated by certain pre-established parameters who were reported to have received an influenza vaccination in any assessment between Oct. 1 and June 30. The vaccination status was based on information from the MDS questions. Residents with a "yes" on an assessment are counted as vaccinated for that influenza season. **Numerator:** All those who were reported to have received an influenza vaccination

<sup>73</sup> <https://www.cdc.gov/prams/methodology.htm>

<sup>74</sup> <https://www.cdc.gov/prams/pdf/phase-7-core-questions-508.pdf>

<sup>75</sup> <https://www.cdc.gov/prams/pdf/phase-7-standard-questions-508.pdf>

<sup>76</sup> <https://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/Minimum-Data-Set-3-0-Public-Reports/index.html>

<sup>77</sup> Methodology for Estimating Influenza Vaccination Coverage, Monitoring the Healthy People 2020 Objective, January 2015.

<sup>78</sup> Methodology for Estimating Pneumococcal Vaccination Coverage, Monitoring the Healthy People 2020 Objective. Acumen LLC, January 2015.

in any assessment between Oct. 1 and June 30. **Denominator:** All institutionalized adults aged 18 years and older in long-term care facilities or nursing homes certified by CMS who had resident assessments conducted with a target date between Oct. 1 and March 31.

The **PPV** numerator includes all those from the denominator population as calculated by certain pre-established parameters who were reported to be vaccinated with PPV at any assessment in that year or **any prior year**. Residents with a “yes” on an assessment are counted as vaccinated for that year and **all** subsequent years.

**Numerator:** All those who were reported to have received the pneumococcal vaccination in any assessment in the calendar year or in any earlier year. **Denominator:** All institutionalized adults aged 18 years and older in long-term care facilities or nursing homes certified by CMS who had resident assessments conducted with a target date in the calendar year.

**Limitations** – Results may vary in accuracy depending on the familiarity and diligence of the nursing home staff in completing the questionnaires, as well as the possibility of inaccurate data entry.

**Strengths** – Vaccination status determined by medical record review or directly questioning residents or their caretakers. Represent a census of all residents of CMS-certified nursing homes during the year of interest.<sup>79</sup> MDS is electronically submitted to CMS only after each staff person providing information has signed off and after a registered nurse has signed the entire assessment, stating that the information is true and correct to the best of his or her knowledge.<sup>80</sup>

<sup>79</sup> <https://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/data-reports/nursing-home/trend/index.html>

<sup>80</sup> Dodson, D. MDS: A Primer for Research Uses, PASRR Technical Assistance Center. January 2016. [http://www.pasrrassist.org/sites/default/files/attachments/Dodson\\_MDS\\_for\\_Data\\_Users\\_January2016.pdf](http://www.pasrrassist.org/sites/default/files/attachments/Dodson_MDS_for_Data_Users_January2016.pdf).

## APPENDIX C. ADDITIONAL INFORMATION ON NIS

### LAG TIME BETWEEN VACCINATION EVENTS AND PUBLICATION OF NIS RESULTS

**Lag time for NIS-Child:** Estimates from the NIS-Child for a given year are based on data collected for children throughout that calendar year who were 19 through 35 months old at any time during each quarter of data collection. Thus, the range of birth dates of children included in annual estimates spans almost two and a half years (e.g., for the assessment conducted in 2015, children were born from January 2012 through May 2014). Analysis and release of vaccination coverage estimates usually take about seven months from the end of the data collection year. This means the coverage estimates reflect vaccinations received anywhere from seven months to more than four years prior to release of results. For example, in the 2015 NIS-Child, children could have received a hepatitis B birth dose two and a half to four and a half years prior to publication. A fourth dose of DTaP could have been received between 18 and 30 months prior. With these dates and age ranges in mind, NIS-Child results can, on average, be interpreted as approximating the vaccination status of children who were 24 months of age at midyear of the data collection period.

**Lag time for NIS-Teen:** Teens 13-17 years old could have received the 11- to 12-year-old vaccinations anywhere from one to six years prior to the survey. To better assess what is happening at 11-12 years of age, CDC has published HPV vaccination rates before the 13th birthday stratified by annual birth cohort nationally and for several combined birth years by state.<sup>81</sup>

### RANDOM ERROR AND SYSTEMATIC ERROR IN THE NIS

**Random Error:** In examining [Table 2. NIS 2015 Estimated Vaccination Coverage](#), we see that the U.S.'s overall combined series point estimate in 2015 was 72.2% with a 95% confidence interval of +/- 1.4%, for an estimated range of 70.1% to 73.1%. That means that, if we repeat the survey 100 times, we would expect the actual vaccination

rate for the U.S. to fall within that range 95 of those 100 times. For any particular point estimate, we do not know if its 95% confidence interval does actually contain the actual value (e.g., we don't know if our survey estimate is one of the expected 95 out of 100 for which the actual estimate is within the interval or one of the expected 5 out of 100 for which it is not).<sup>82</sup>

**Systematic Error:** In addition to random error arising from sampling, other systematic sources of potential error in the NIS may be just as important as random error in the NIS. These include: (1) source population does not completely cover the target population (households with no landline or cell phones are excluded); (2) non-response bias (children from responding households and providers may have different vaccination coverage than children in selected households that did not participate in the survey or for which adequate provider data was not collected); and (3) errors in measurement of vaccination status. Survey weighting aims to mitigate the first two sources of error. To assess the effect of all these sources of possible bias on NIS estimates, CDC has developed a "total survey error" model. A brief description can be found in the 2015 data users guides for NIS-Child and NIS-Teen.<sup>83</sup>

### NIS COUNTY LEVEL ESTIMATES

CDC has periodically developed county-level estimates from the NIS. In order to be included in the assessment, counties need to meet a minimum sample size. In the 1998-2008 time period, 257 out of the 3,141 counties in the U.S. met the sample size requirement for one or more of the assessed periods.<sup>84</sup> At the time of this guide's publication, CDC was planning to distribute updated county-level results from the NIS in late 2017. Comparing these NIS estimates to IIS county-level coverage will help assess usefulness and validity of the NIS county estimates. Depending on feedback from the states, CDC will consider updating these estimates every one or two years.

<sup>81</sup> Personal communication from Jim Singleton, chief, Assessment Branch, ISD/NCIRD/CDC, 1/17/17.

<sup>82</sup> Ibid.

<sup>83</sup> NIS | Data, Tables and Documentation | National Immunization Surveys | Vaccines | CDC <https://www.cdc.gov/vaccines/imz-managers/nis/downloads/nis-puf15-dug.pdf>.

<sup>84</sup> MMWR – <https://www.cdc.gov/mmwr/pdf/ss/ss6004.pdf>.

## APPENDIX D. DATA QUALITY IMPROVEMENT FOR IIS

IIS have great potential to provide valuable information on vaccination coverage rates. As the data in an IIS becomes complete, so too does that IIS's capacity to provide granular level data that can hone in on pockets of need for specific vaccines, age groups, and geographic areas. This capacity is dependent on sound data quality processes that address accuracy, completeness, and timeliness. Efforts to identify and remove duplicate records are an important part of the process. Also essential is the identification and deactivation of records of those who have moved out of the jurisdiction. AIRA and CDC have developed several guides to assist in IIS data quality improvement. The following MIROW best practice mini-guides provide useful information in this area and can assist IIS in developing methods and protocols to improve data quality.<sup>85</sup>

- [\*Management of Patient Active/Inactive Status in Immunization Information Systems\*](#)
- [\*Vaccine Level Deduplication in Immunization Information Systems\*](#)
- [\*Improving the Quality of Data Entering the IIS\*](#)
- [\*Data Quality Assurance in Immunization Information Systems: Selected Aspects\*](#)

Another useful document is CDC's [\*Immunization Information Systems Patient-Level De-Duplication Best Practices\*](#) document. It provides best practice guidelines for common deduplication practices to improve data quality and the usefulness of IIS data.<sup>86</sup> Also helpful is the AIRA [\*Data Validation Guide for the IIS Onboarding Process\*](#), published in February 2017, which provides practical guidance on data quality measures to implement in an IIS while bringing new data interfaces on board.<sup>87</sup> Similar AIRA guides are in process: one that addresses the ongoing data validation of incoming data and a second to evaluate the quality of data at rest within the IIS.

Tracking the progress of an IIS over time is valuable for determining when IIS data are complete enough to produce useful coverage rates. These efforts can include:

- Measuring and tracking the number and proportion of vaccination providers participating and actively submitting data to the IIS.
- Measuring and tracking the number of children with complete immunization records in the IIS (i.e., who are up to date with their vaccines).
- Comparing the number of individual records in the IIS by age group to census data age group numbers.
- Comparing IIS coverage level results to NIS and other assessments as a proxy for completeness.

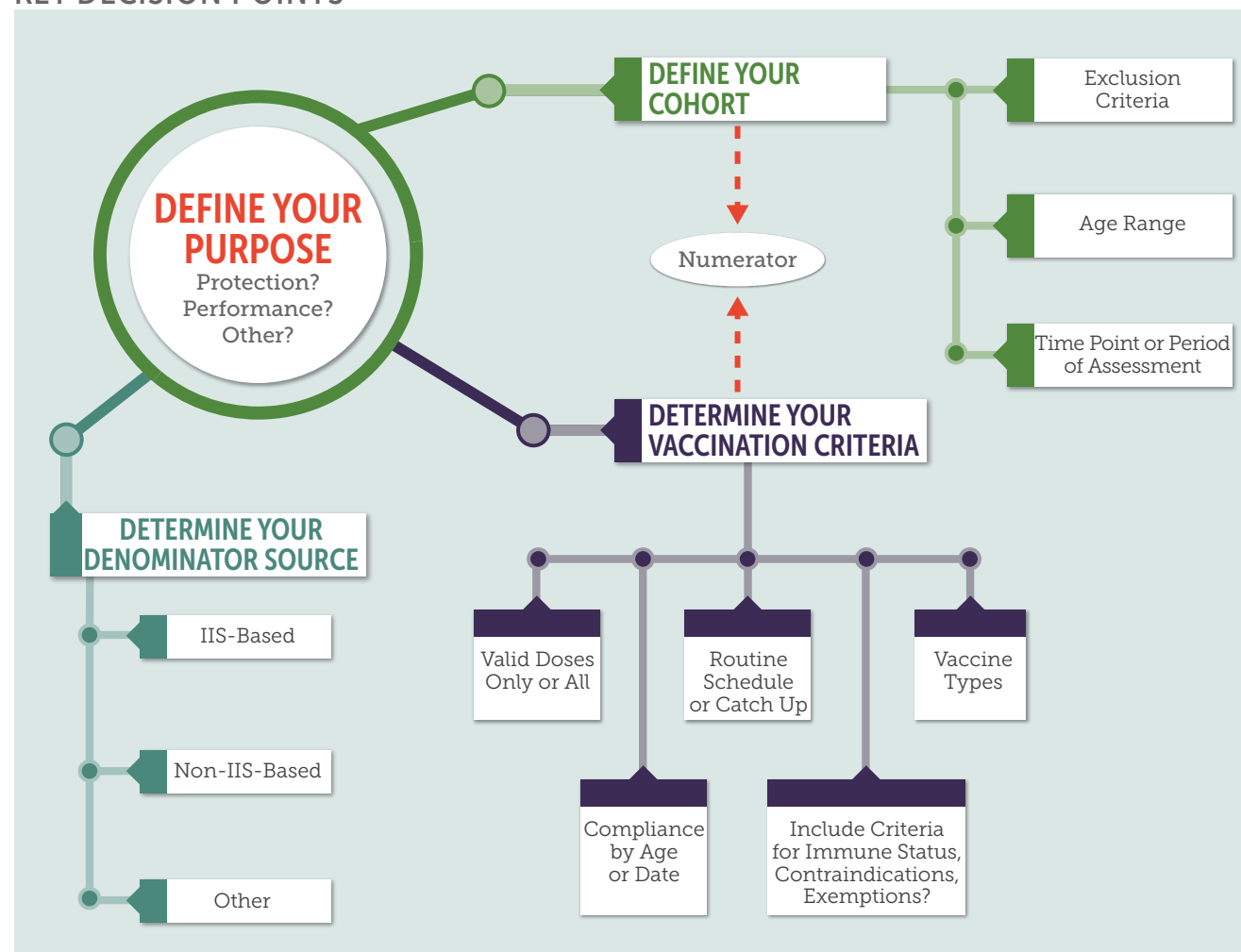
<sup>85</sup> Full MIROW best practice guides and some MIROW mini-guides translated into Spanish and French can be found at <http://www.immregistries.org/resources/aira-mirow>.

<sup>86</sup> <https://www.cdc.gov/vaccines/programs/iis/interop-proj/downloads/de-duplication.pdf>

<sup>87</sup> [http://repository.immregistries.org/files/resources/58a601d626d7a/aira\\_data\\_validation\\_guide.pdf](http://repository.immregistries.org/files/resources/58a601d626d7a/aira_data_validation_guide.pdf)

# APPENDIX E. KEY DECISION POINTS IN DESIGNING A VACCINATION COVERAGE ASSESSMENT<sup>88</sup>

## KEY DECISION POINTS



<sup>88</sup> This diagram can be found in AIRA's Analytic Guide for Assessing Vaccination Coverage Using an IIS: [http://repository.immregis-tries.org/files/resources/5835adc2ae282/analytic\\_guide\\_for\\_assessing\\_vaccination\\_coverage\\_using\\_an\\_iis.pdf](http://repository.immregis-tries.org/files/resources/5835adc2ae282/analytic_guide_for_assessing_vaccination_coverage_using_an_iis.pdf).

## APPENDIX F. QUICK REFERENCE GUIDE FOR IMPROVING READABILITY

**Source:** PRISM Readability Toolkit. Ridpath JR, Greene SM, Wiese CJ; 3rd ed. Seattle: Group Health Center for Health Studies; Version 4, updated June 2009.

### Guiding principles of plain language include:

- Use language your audience can easily understand.
- Write in a conversational style, as if you were speaking.
- Organize and filter content with your readers' needs in mind.
- Use reader-friendly formatting so that your document looks easy to read.

The following specific strategies will help you adhere to these principles:

### Check the reading level.

- Choose a readability formula, but be aware that they all have limitations—getting a “good score” is not a guarantee that your document is easy to read.

### Choose common, everyday words.

- Replace multi-syllable (or short but complex) words with simpler vocabulary. Avoid research and medical jargon whenever possible. If you must use a complicated term, define it in plain language and provide an example, an analogy, or a visual aid.
- Refer to the list of [Alternative Wording Suggestions](#) and other online resources, as necessary (see page 38).

### Use active voice.

- The subject of your sentence should act, instead of being acted upon. “We will ask you questions about your health” is active, while “You will be asked questions about your health” is passive.

### Write in the first person.

- Use pronouns, such as “I,” “we,” and “you.” This encourages the use of active voice and will be clearer and more engaging to the reader.

### Keep sentences short and to the point.

- Break up sentences joined with conjunctions or semicolons. It's okay to begin a complete sentence with “And” or “But.”
- Try to vary sentence length. Sentences should average 15 or fewer words.

### Limit paragraphs to one main idea.

- Start with a clear and concise topic sentence. Remove or relocate details that do not relate to the central topic. A paragraph of one or two sentences is okay.

### Use clear and descriptive headings.

- Meaningful headings that describe the content of different sections will give your readers “road signs” and help them navigate your document more easily.
- Use large font, bold, or other emphasis to ensure the headings stand out.

### Consider the needs of your audience.

- Include only the information that your audience really needs to know.
- Use large font and/or age-appropriate or culturally sensitive language to meet the needs of special populations like the elderly, children, minorities, or people with chronic health conditions, etc.

### **Organize and format your document so that key information is clear and easy to find.**

- Lead with the most important information, and sequence the information in a logical fashion that the audience can easily follow.
- Use bold, larger font, bullets, or graphics to emphasize critical information. Do not use justified margins or put entire sentences in all caps or italics.
- Put long lists of items into bulleted lists whenever practical. Use numerical lists whenever the items need to be understood or completed in order.

### **Use adequate white space and margins.**

- Break up dense copy by using ample white space between paragraphs and headings. Consider using all white space that may be leftover by adding space between paragraphs or increasing the font size of headers or text.
- Avoid decreasing margins to force text to fit on one page. Top and bottom margins should be at least 1", and side margins should be at least 1.25."

### **Read your document aloud.**

- This is one of the best ways to find errors and test for overall flow and clarity when you proofread. It can also help you troubleshoot—when you get stuck, try just speaking your thoughts.

### **Ask others to read and edit the document.**

- Someone unfamiliar to the project is more likely to notice text that is unclear.
- The person who will use the document most—such as the person who will administer informed consent—should always have a chance to review it.

### **Use fresh eyes when you edit or proofread.**

- Whenever possible, set the material aside for a day or two and proofread it again after taking a break. This step, along with reading your document out loud, is a good way to find errors that may have been overlooked before.

### **Double-check names and contact information.**

- Call all phone numbers and check all links and email addresses. Confirm that all names have been spelled correctly and that all titles are correct.

## APPENDIX G. TEMPLATE FOR ANALYSIS AND COMPARISON OF ASSESSMENTS

### 1. What was the purpose of the assessment?

### 2. Who was assessed?

- Demographic criteria used, e.g. age groups?
- Did assessment include the whole population (e.g., IIS-based)?
- Was assessment based on a representative sample? (e.g., NIS)?
- Was some other population subgrouping used?

### 3. How were data collected?

- From a randomized survey sample (e.g., NIS)?
- Through self-selection process (e.g., Internet panel surveys)?
- From entire group within a population database (e.g., IIS)?

### 4. How were rates generated?

- Statistical random sample methodology?
- Exclusion criteria used?
- Source of denominator (census, IIS, other)?
- Do the numerators and denominators appear to truly measure what is needed for the particular purpose?

### 5. How was vaccine coverage defined

- Which vaccine types were measured?
- How many doses were required to meet UTD status—routine or catch-up schedule allowed?
- What was the compliance by date or age, if used?
- Were only valid doses counted, or were all, valid and invalid?
- Did Immunity by disease and/or lab test count towards UTD status?
- Was it a “point in time” assessment, or did it cover a “period of time”?

### 6. How valid and precise are the results?

- Is the vaccination history based on self-reporting or on medical records?
- Is there a statistical margin of error (confidence interval)? If so, how wide is it?
- How much non-random error might there be in estimated vaccination proportions?
- Is the denominator representative of the target population? What biases might be introduced by the chosen denominator?
- Are results in agreement with other data sources or other time points of measurement?
- Does the method of data collection create inherent bias?

### 7. How recent are the results? Do they reflect clinical practice that occurred within a recent time period?

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