PRACTICAL EXAMPLES OF IIS POPULATION-BASED COVERAGE ASSESSMENTS

An Addendum to the Analytic Guide for Assessing Vaccination Coverage Using an IIS

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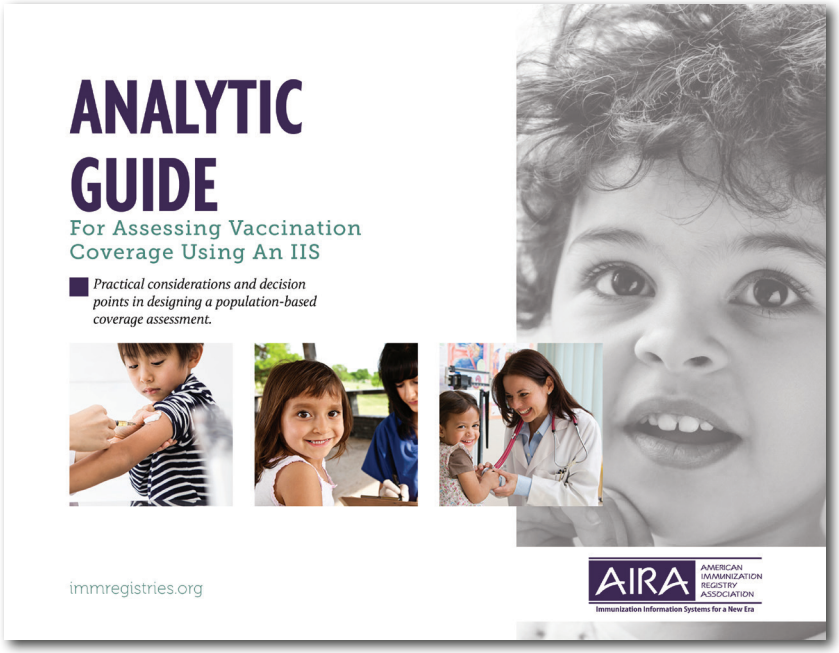
AIRA
AMERICAN IMMUNIZATION REGISTRY ASSOCIATION

Executive Summary

The *Analytic Guide for Assessing Vaccination Coverage Using an IIS* was published in November of 2015. The purpose of this guide is to assist IIS staff and other interested parties in using IIS data to do population-based coverage assessments. The guide describes practical considerations and key decision points in designing a population-based assessment using an IIS.



This Addendum builds on the important work of the *Analytic Guide for Assessing Vaccination Coverage Using an IIS* and describes additional real-life examples of coverage assessments using IIS data. These examples provide detailed explanations of the key decision points each IIS considered in designing their coverage assessments and the rationales for many of the decisions they made. The examples of coverage assessments described in this Addendum come from IIS in New York City, Colorado, Oregon, Minnesota and Washington state.

The target audience for this Addendum is primarily IIS and immunization program staff at the state and local levels. Immunization Program Managers may find the examples useful, and they may help generate ideas for use within their own jurisdiction. Additionally, anyone interested in designing population-based coverage assessments using IIS data may also find this Addendum helpful.

Each coverage assessment example in this Addendum is unique and describes a different approach to using IIS data for coverage assessments. New York City and Colorado were interested in rates of protection from vaccine-preventable diseases among children 19 through 35 months and adolescents 13 through 17 years. The coverage assessment example from Oregon looks at Tdap, Meningococcal, MMR, influenza and HPV vaccination practices for adolescents 13 through 17 years old. Oregon uses a weighting method based on IIS data and adjusts the data similarly to how statisticians adjust survey data so Oregon can account for potential bias and data limitations in the IIS. Finally, Minnesota and Washington state's coverage assessments target unique populations.

We hope as a result of this Addendum, IIS and immunization programs are inspired to use their IIS data to conduct population-based coverage assessments.

Process of Developing this Addendum

The American Immunization Registry Association (AIRA)'s Assessment Steering Committee (ASC) provided oversight for the development of this Addendum. AIRA staff solicited examples of coverage assessments from the IIS community, conducted interviews with IIS program staff who performed coverage assessments and then summarized the findings. The summaries were then distributed to the contributing IIS staff for validation. Final drafts of this Addendum were reviewed by the ASC, AIRA Board of Directors and AIRA members.

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Introduction

Purpose

The *Analytic Guide for Assessing Vaccination Coverage Using an IIS* (hereinafter referred to as the "Analytic Guide") describes practical considerations and key decision points for designing and performing population-based coverage assessments using immunization information system (IIS) data. The purpose of this Addendum to the Analytic Guide is to describe additional examples of population-based coverage practices from select IIS. The examples are intended to provide practical and replicable information that programs can utilize in planning and implementing similar assessments using their IIS data.

Review of Analytic Guide Concepts and Key Decision Points

The following is a review of major concepts and key decision points from the Analytic Guide. This framework of **key decision points** will be used to describe the IIS population-based coverage assessments included in this Addendum.

Key Decision Points

Define Your Purpose: The purpose of a coverage assessment drives many of the decisions made in defining the assessment criteria. Understanding the purpose and the assessment criteria is also essential in providing an accurate description of the assessment findings. There are two common purposes of immunization coverage assessments:

- Assess protection. Protection-based assessments aim to measure the proportion of the population immune to vaccine preventable disease. This type of assessment helps to understand the population at risk for disease.
- Assess performance. Performance-based assessments aim to measure the proportion of the population that received vaccinations. This type of assessment helps to understand vaccine administration practices.

Define Your Cohort and **Determine Your Vaccination Criteria** to *define the* **Numerator:** Deriving the assessment numerator requires clear delineation of the population cohort of interest and the immunization events to be assessed.

Define Your Cohort: Defining a cohort you wish to study involves identifying population inclusion and *exclusion criteria* and choosing the cohort age range. In order to determine who is in your cohort, you first need to decide who is out. Sample population exclusion criteria include: client address outside of a defined area, unknown client address, deceased clients, etc.

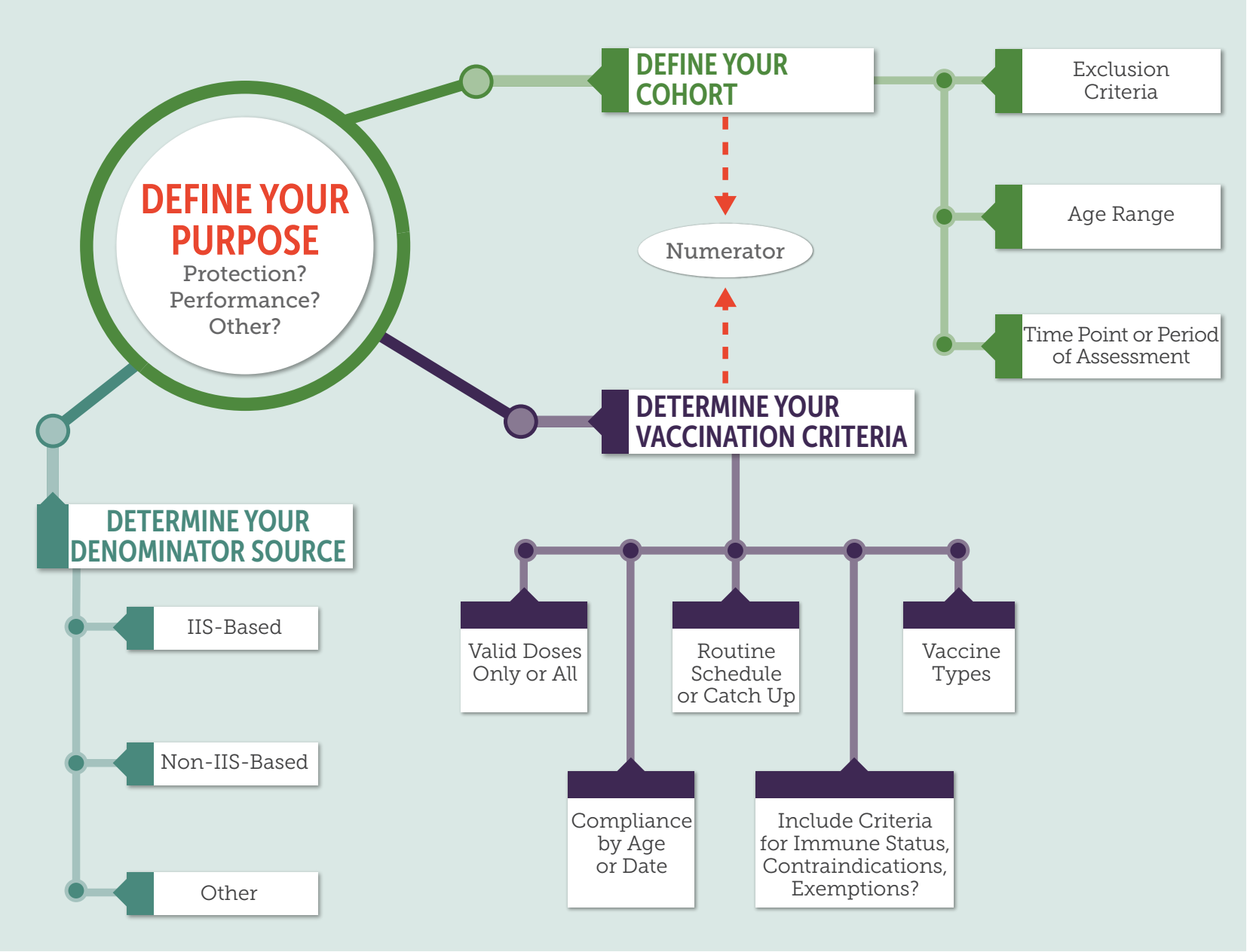
The cohort age range may include all clients of a particular age at a certain point in time (Method 1: Point in Time Assessment), all clients of a particular age throughout a given time period (Method 2: Period of Time Assessment – Not Allowing Aging In or Out), or all clients of a particular age at some point in a given time period (Method 3: Period of Time Assessment – Allowing Aging In and Out).

Determine Your Vaccination Criteria: The vaccination criteria should correlate with the population cohort based on Advisory Committee on Immunization Practices (ACIP) recommendations. Additional vaccination criteria to consider include: determining antigens and/or vaccination series to assess; inclusion or exclusion of invalid doses; vaccination compliance by a certain age or date (timeliness of vaccine administration); application of the routine and/or catch-up schedule; and inclusion or exclusion of client immunity, history of disease, contraindications, and/or exemptions.

Determine Your Denominator Source: The assessment denominator may be IIS data (IIS Methods 1-3) or another non-IIS population-based data set, such as census data (Non-IIS Method 1), school census data (Non-IIS Method 2) or vital statistics birth data (Non-IIS Method 3).

Below is a flowchart from the Analytic Guide that depicts these key decision points in designing a coverage assessment.

Key Decision Points



Population-Based Coverage Assessment Examples

The Analytic Guide Appendix F includes three examples of population-based coverage assessments using IIS data:

	Coverage Assessment	Cohort Assessment Age Range	Denominator Source
1	Trends in hepatitis A vaccination among US children 12-23 months of age, Immunization Information System (IIS) sentinel site data, 2006-2009	Method 1: Point in Time	IIS-Based, Method 1: Individual Has Record in IIS With or Without Immunizations
2	2014 Immunization Information Systems Annual Report (IISAR) Logic Guidance for Questions 40-41 – 4:3:1:3:3:1:4 Series Coverage (for children aged 19 through 35 months)	Method 1: Point in Time	Non-IIS, Method 1: Census and Census-derived Data
3	Seasonal influenza vaccine use among US children – Immunization Information System (IIS), August 2011 – May 2012	Method 2: Period of Time – Not Allowing Aging In or Out	IIS-Based, Method 1: Individual Has Record in IIS With or Without Immunizations

In-Depth Examples of IIS Coverage Assessments

This Addendum includes five additional examples of population-based coverage assessments from select IIS programs. The following table lists the examples in the order they are presented in this Addendum. Examples are organized in order from largest to smallest scale populations of interest, beginning with broad assessments of all young children and/or adolescents in a state/jurisdiction and finishing with more specific assessments of certain populations (e.g. Somali children, pregnant women).

	Assessment Question	Purpose (and Vaccination Criteria)	Cohort: Assessment Age Range	Denominator Source
New York City	What are the quarterly vaccination coverage rates for the 4:3:1:3:3:1:4 vaccine series for children 19 through 35 months old in New York City? What are the vaccination coverage rates for 1 and 3 doses of HPV for adolescents 13 through 17 years old in New York City?	Protection from vaccine-preventable diseases among children 19 through 35 months and adolescents 13 through 17 years (Valid doses only; immunity included in numerator)	Method 1: Point in Time Assessment	Non-IIS Method 1: Census and Census-derived Data
Colorado 	What are the vaccination coverage rates for most immunizations by county in Colorado for children 19 through 35 months old and adolescents 13 through 17 years old?	Protection from vaccine-preventable diseases among children 19 through 35 months and adolescents 13 through 17 years (Valid doses only; history of disease included in numerator)	Method 3: Period of Time Assessment – Allowing Aging In and Out	IIS Method 2: Individual Has Record in IIS with Immunizations
Oregon	What is the Tdap, Meningoccocal, MMR (1 and 2 doses), influenza and HPV (1 and 3 doses) vaccination coverage among adolescents 13 through 17 years old in Oregon?	Vaccination practices for adolescents 13 through 17 years (Valid and invalid doses [invalid included with application of minimum age requirements and weighting applied]; immunity, contraindications and exemptions not included in analysis)	Method 1: Point in Time Assessment	IIS Method 3: Other Adjustments to IIS Data
Minnesota 	What is the vaccination coverage for all childhood vaccines for Somali children compared to non-Somali children by 24 months old born from 2004 through 2013 in Minnesota?	Vaccination practices and compliance with ACIP recommendations for Somali and non-Somali children (Valid doses only; immunity, contraindications and exemptions not included in analysis)	Method 1: Point in Time Assessment	IIS Method 1: Individual Has Record in IIS With or Without Immunizations
Washington	What percentage of women who deliver infants in Washington state receive Tdap and influenza vaccines during pregnancy and Tdap vaccine at 27 through 36 weeks gestation as recommended?	Vaccination practices and compliance with ACIP recommendations for pregnant women (Valid doses only; immunity, contraindications and exemptions not included in analysis)	Method 2: Period of Time Assessment – Not Allowing Aging In or Out	IIS Method 1: Individual Has Record in IIS With or Without Immunizations

In-Depth Descriptions of the Five Examples of IIS Coverage Assessments Included in This Addendum

A detailed description of each IIS coverage assessment example is included below.

New York City

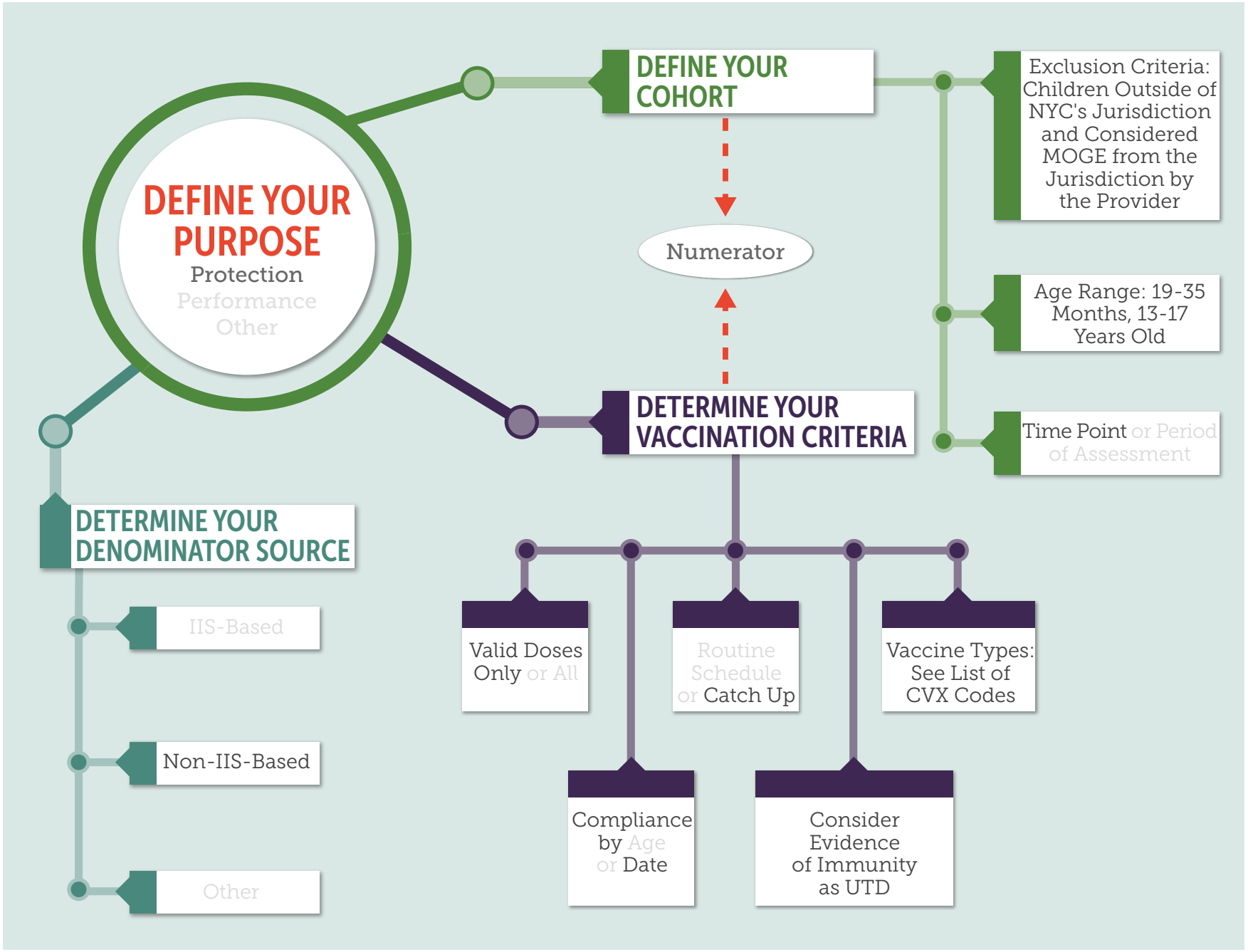
Assessment Question: What are the quarterly vaccination coverage rates for the 4:3:1:3:3:1:4 vaccine series for children 19 through 35 months old in New York City? What are the vaccination coverage rates for 1 and 3 doses of HPV for adolescents 13 through 17 years old in New York City?

Methods: This is a quarterly assessment of valid immunizations and evidence of immunity among populations of interest. Census population estimates are used for denominators.

Background: New York City has been conducting coverage assessments for over 10 years. They use vaccines and ages assessed by the National Immunization Surveys (NIS) for comparison and run quarterly coverage assessment reports directly from the IIS. This coverage assessment is conducted by IIS staff.

Use and Impact: The results of this coverage assessment help the IIS track progress in its jurisdiction for program analysis.

Key Decision Points: New York City



Define the Purpose: This coverage assessment assesses protection from vaccine-preventable disease among children 19 through 35 months old and adolescents 13 through 17 years old in New York City on a quarterly basis.

Define the Cohort (Numerator)

Exclusion (and Inclusion) Criteria: This assessment includes children and adolescents within the specified age cohorts with a last known address within New York City's jurisdiction. If a record's address is missing or incomplete, New York City assumes the individual still resides within the jurisdiction. Patients that have moved outside of New York City or are deceased as indicated by the provider are excluded in the assessment.

Cohort Age Range and Point in Time Assessment: Children 19 through 35 months old and adolescents 13 through 17 years old as of a particular point in time are assessed quarterly.

Decision Explained: New York City originally conducted coverage assessments for children 24 through 35 months old but changed the age range to align with the ages assessed by the National Immunization Survey (NIS). New York City wanted to assess whether vaccination coverage rates based on the IIS were within 10 percentage points of NIS rates.

Coverage assessments are run on a quarterly basis to evaluate the impact of IIS data quality improvement efforts as well as programmatic initiatives to raise vaccination coverage within New York City. A point in time assessment is used because it uses simpler and straightforward methodology and works better with census denominators given the census is a point in time population estimate.

Determine the Vaccination Criteria (Numerator)

Vaccinations of Interest: This coverage assessment assesses vaccination rates of the 4:3:1:3:3:1:4 vaccine series for children 19 through 35 months old. Adolescents 13 through 17 years old are assessed for one and three doses of HPV.

The 4:3:1:3:3:1:4 vaccine series includes ≥4 doses of DTaP, ≥3 doses of polio, ≥1 dose of MMR, ≥3 doses of Hib, ≥3 doses of HepB, ≥1 dose of Varicella and ≥4 doses of PCV

Decision Explained: New York City uses vaccines and ages assessed by the NIS for comparison.

Valid Doses/Invalid Doses: New York City includes valid doses only in the assessment. All valid CVX codes are included; CVX codes for Td (9, 113, 138, 139) and Tdap (115) are excluded for the childhood assessment.

Decision Explained: New York City uses valid doses only because they are assessing protection from vaccine preventable disease.

Routine and/or Catch-Up Immunization Schedule: This assessment uses the ACIP routine and catch-up schedules. Using the catch-up schedule, a child may be considered complete with one, two, three or four doses of Hib and PCV, depending on age at the start of series, spacing and product.

Inclusion of Comments: Evidence of immunity for MMR and varicella is considered up-to-date in the assessment. Contraindications or exemptions are not considered for this assessment.

Decision Explained: Because this coverage assessment's purpose is to assess protection from vaccine-preventable diseases, evidence of immunity for certain diseases is considered up-to-date when vaccination is not recommended.

Immunization Compliance by Age or Date: This assessment looks at immunization compliance by date instead of compliance by age.

Decision Explained: Assessing compliance by age is a quality measure to assess the timeliness of vaccination. For example, AFIX routinely assesses vaccination by 24 months old because AFIX seeks to assess performance and timeliness of vaccination. New York City, however, is primarily interested in coverage rates for patients not currently up-to-date and so assesses compliance by a specific date. This method is also consistent with NIS methodology.

Determine the Denominator Source

This coverage assessment uses 2010 census data within New York City's jurisdiction. Occasionally, census data is not broken down by the ages that are needed for the assessment. For example, if New York City is assessing 13 through 17 year olds but the census data indicates there are 300,000 16 through 18 year olds, New York City conducts simple calculations for aggregate estimates (300,000/3 years= 100,000 individuals/year). In this example, they would estimate 200,000 individuals 16 and 17 years old in the denominator.

Decision Explained: New York City conducts population-based assessments using census data because the IIS data is inflated due to duplicate records and patients who have moved outside of New York City's jurisdiction. The denominator is particularly inflated for adolescents, which would result in underestimated coverage.

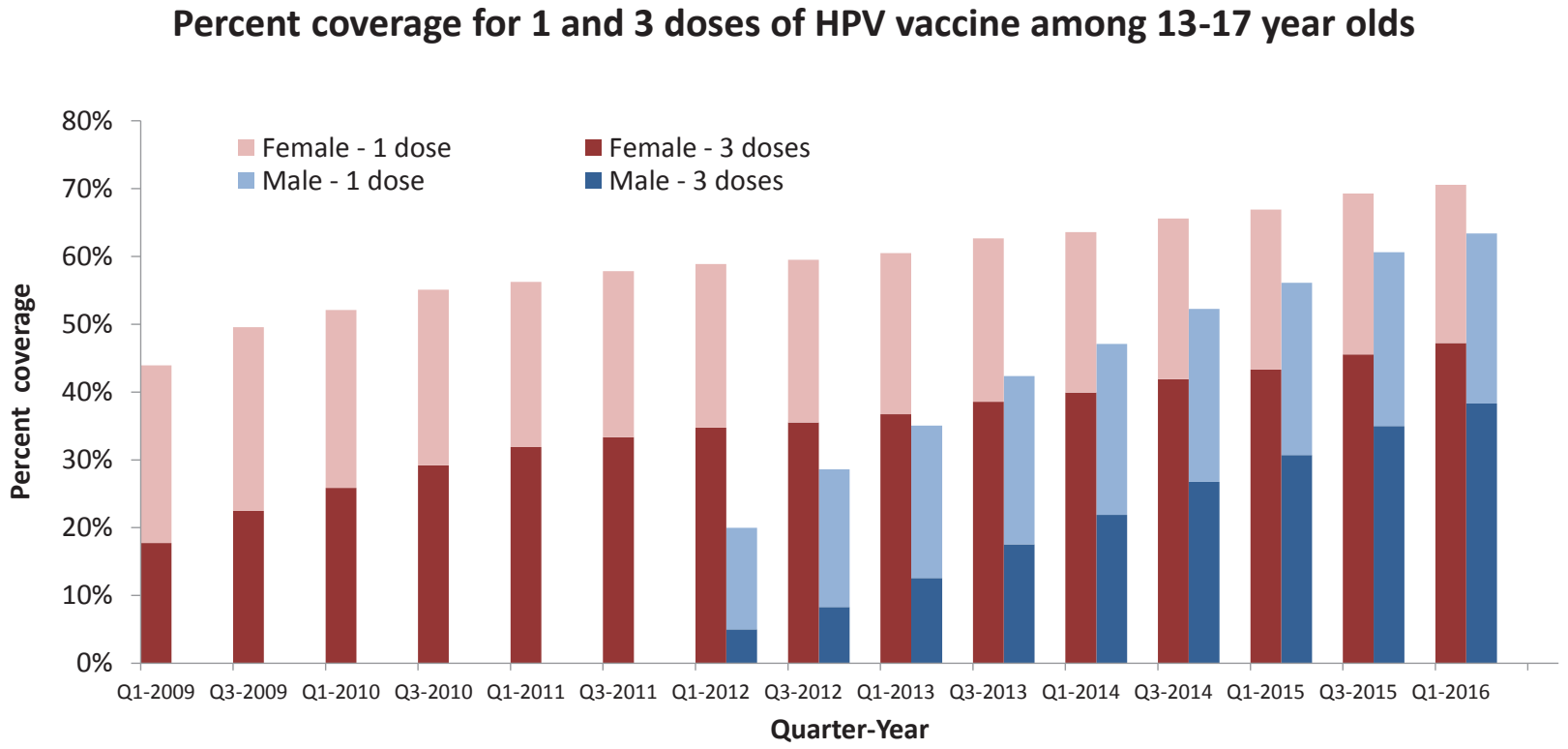
The national census is conducted every 10 years, but annual data adjustments are published based on various available datasets such as number of births, deaths, known migration etc. It's common to use intercensal estimates as they reflect more updated population estimates. The drawback of this methodology is that it is sometimes inaccurate, resulting in overestimation or underestimation of true coverage rates. This becomes evident when the following census is conducted, at which point the intercensal estimates are adjusted to take into account the most recent census numbers. New York City sometimes uses census estimates and sometimes uses intercensal estimates depending on the purpose of the assessment. For this particular assessment, 2010 census data was used.

Methodology and Results

Method of Analysis: Coverage assessments are conducted using a web-based program written by New York City's vendor with guidance from IIS staff. This program, written in JAVA, was developed in the early 2000s. According to New York City, it was one of the best decisions the city has made because the program is routinely used by immunization staff for AFIX assessments and by IIS staff for population-based coverage assessments. The program is parameters-driven: staff can specify the age cohort they wish to assess, the vaccination criteria and compliance by age or date. Based on a variety of parameters, the program produces different reports.

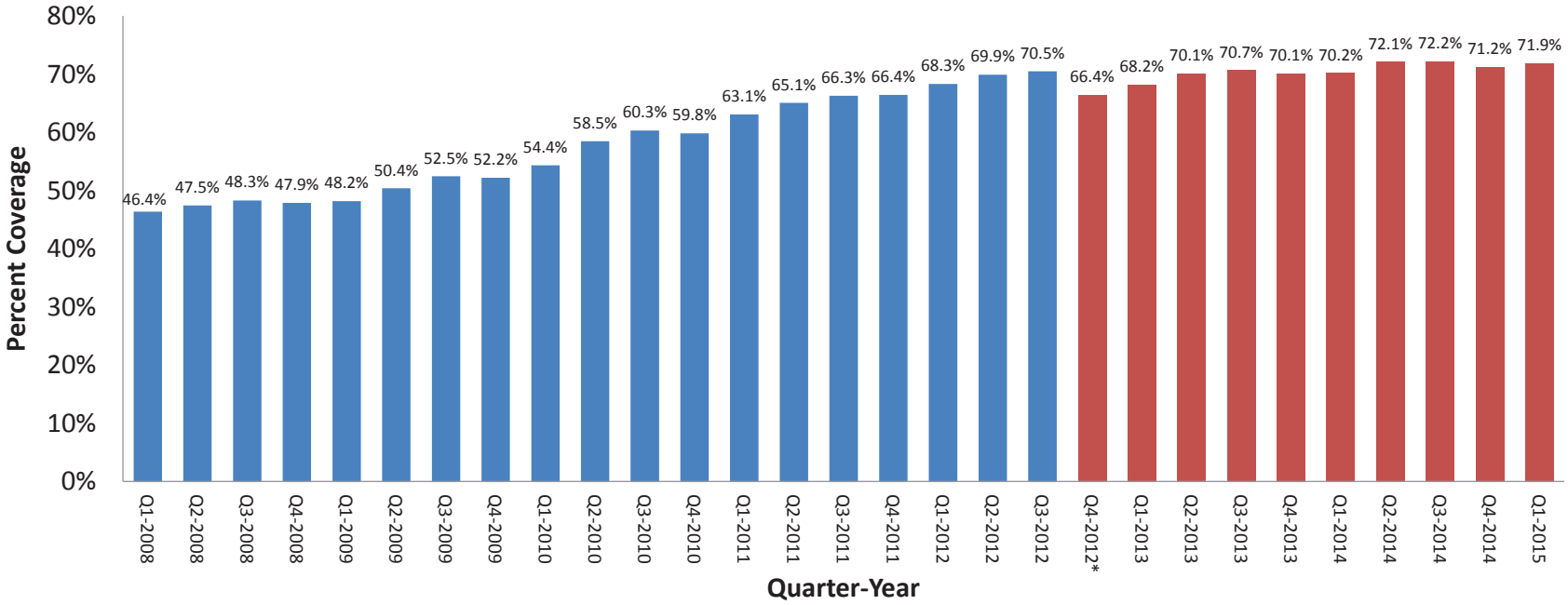
For population-based assessments, New York City runs a query first of the IIS to identify the identification numbers for the patients they wish to assess. These numbers are submitted to the program within a saved query that includes the eligibility criteria. The program runs an algorithm to determine up-to-date status for each patient on production data. Currently, the program evaluates each patient record sequentially and is slow, taking four to five days to complete large cohorts (e.g., 600,000 records for adolescents 13 through 17 years old). New York City has plans to change the program to run records in parallel, which will dramatically improve speed. Vaccination coverage rates are completed for the city as well as for individual zip codes.

Results: Results are shown in the graph below:



Data sources: NYC DOHMH Citywide Immunization Registry (numerators) and NYC DOHMH Epiquery and 2010 US Census (population estimates). EpiServices adjusted the number of adolescents upwards after analyzing Census 2010, which lowered coverage compared to previous quarters. Note that ACIP recommended routine use of quadrivalent HPV vaccine in males on October 25, 2011.

Percent of children ages 19-35 months with 4 DTaP, 3 Polio, 1 MMR, 3 Hib, 3 HepB, 1 Varicella, and 4 PCV13 (4:3:1:3:3:1:4) vaccines



** In Q4-2012, BOI began reporting 4:3:1:3:3:1:4 coverage. 4:3:1:3:3:1:4 coverage is shown as red bars; 4:3:1:3:3:1 coverage is in blue bars.*

Data sources: NYC DOHMH Citywide Immunization Registry (numerators) and NYC DOHMH Epiquery and 2010 US Census (population estimates). EpiServices adjusted the number of young children downwards after analyzing Census 2010, which increased coverage compared to previous quarters.

Implementation Considerations

This coverage assessment uses measures that can easily be compared to NIS results. Additionally, census-based denominators can give a more precise estimate for population numbers if there are concerns about oversaturation in the IIS data. The key is to use the same methodology to track progress and changes over time.

Tips for Other IIS: For IIS reluctant to run coverage assessments because they think their data is incomplete or inaccurate, start using the data regardless. Using the data can propel IIS programs to make it more complete; if the data isn't used, the IIS won't know how to improve data quality.

New York City also recommends selecting a coverage assessment to standardize and automate so there is a process in place for easily assessing coverage at least twice a year.

Interested in Learning More? Contact Vikki Papadouka, PhD, MPH, Director of Research and Evaluation, New York Citywide Immunization Registry, *vpapadou@health.nyc.gov*.

Colorado

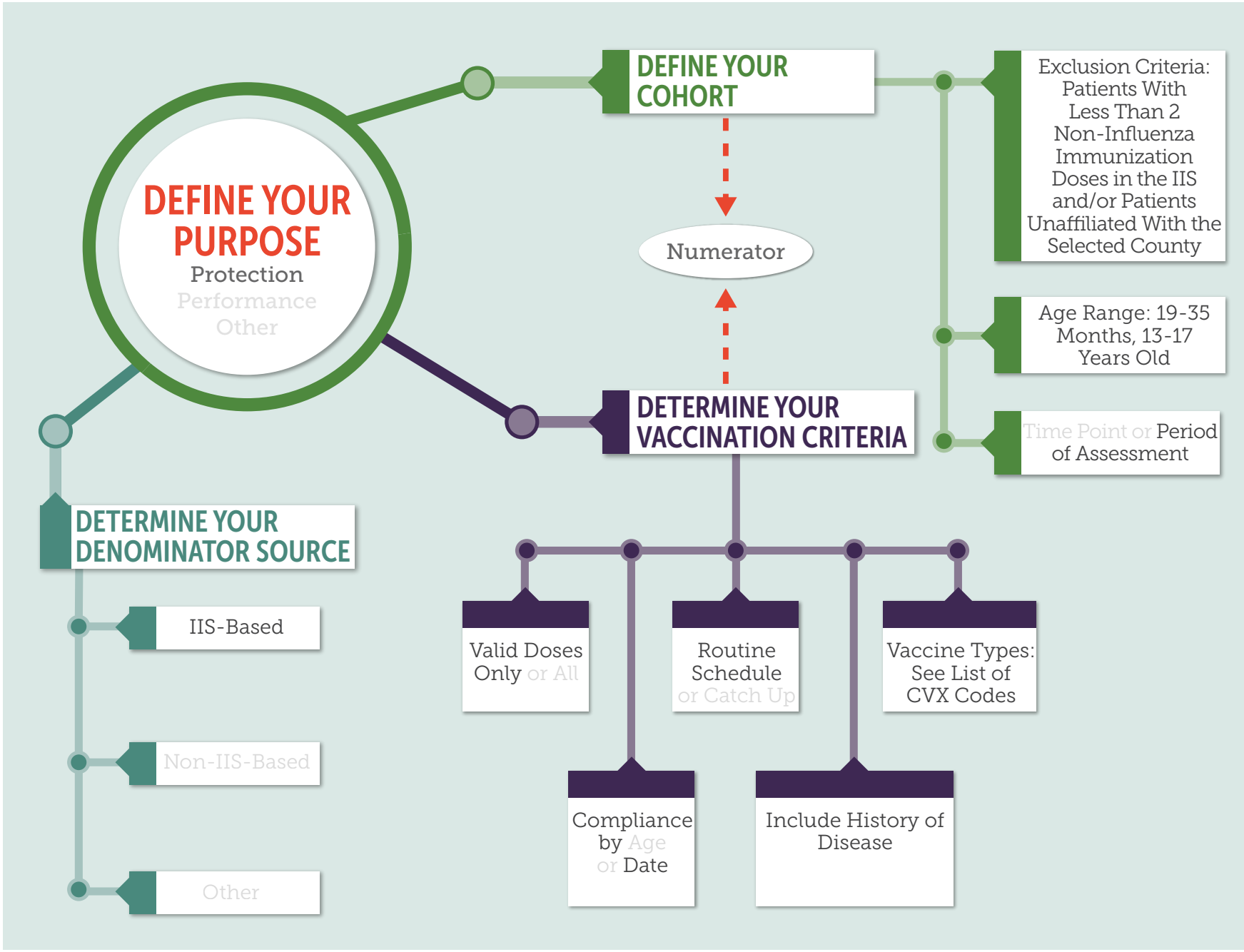
Assessment Question: What are the vaccination coverage rates for most immunizations by county in Colorado for children 19 through 35 months old and adolescents 13 through 17 years old?

Methods: This is a semiannual coverage assessment of valid doses among populations of interest. Individuals with two or more non-influenza immunizations in the IIS are used in both the numerator and denominator.

Background: Immunization program staff in Colorado initially began conducting coverage assessments in December 2014 to meet requests for vaccination coverage rates from stakeholders, including the public and local leadership. NIS coverage rates provide state-level data, but stakeholders (including legislators and local public health agencies) were interested in the data by county.

Use and Impact: These coverage assessment results are used by the immunization program, local public health agencies, immunization advocates, policy makers and other external partners. Results are sent to individual health agencies every six months in a report card format along with language regarding the limitations of the IIS data as well as Colorado's NIS results and Healthy People 2020 goals for comparison. The report cards are meant to encourage county health agencies to improve their county vaccination rates. Results in map form are also posted online (*Colorado Department of Public Health and Environment*, 2016).

Key Decision Points: Colorado



Define the Purpose: This coverage assessment assesses protection from vaccine-preventable disease of children 19 through 35 months old and adolescents 13 through 17 years old by county in Colorado on a semi-annual basis.

Define the Cohort (Numerator)

Exclusion (and Inclusion) Criteria: Colorado's assessment includes patients with a current address within the county being assessed. If the patient is missing the county in their address, they are assigned to the county where they received their most recent vaccination. If both fields are missing, the patient is excluded from the assessment.

NOTE: When Colorado began running coverage assessments, it found data electronically imported into the IIS is often missing the county. This has the potential to artificially lower coverage rates if up-to-date patients are excluded from the assessment because they are not associated with a county. To correct this, Colorado geocodes the addresses listed in the IIS and assigns patients a county based on geocoding. If the geocoding method does not work, then Colorado considers the county where the patient was most recently vaccinated. If both of these fields are null, only then is a patient excluded.

This assessment's numerator (and denominator) includes patients with at least two non-influenza vaccinations in the IIS.

Decision Explained: Colorado receives birth data from Vital Records, but it can be difficult to determine patients who have migrated in and out of the state. Using only records in the IIS with two or more non-influenza immunizations is a way to exclude some patients who have moved or who visit a provider that does not participate in the IIS.

Including only patients with at least two non-influenza vaccinations also automatically excludes patients who have only a birth dose of Hepatitis B on their IIS record. If this is the only immunization on an individual's record, it may be an indication they have migrated out of the state. Including these patients may underestimate coverage rates. Influenza vaccines are often received outside of the patient's medical home, so by including patients with at least two non-influenza vaccines in the IIS, the assessment captures records with a birth dose of Hepatitis B plus at least one other childhood or adolescent vaccine given on a subsequent medical home visit.

This criterion is applied to both the numerator and denominator. During a recent assessment, this criterion excluded approximately 16% of the records that met the initial age criteria in this assessment (a decrease from 95,798 to 80,473 patients).

Cohort Age Range and Period of Time Assessment: Colorado assesses children 19 through 35 months old and adolescents 13 through 17 years old over a six-month period of time. Assessments are conducted semiannually. Anyone within the age range at any point during the assessment period is included in the calculations to allow for patients to age in and out of the assessment period. The rates are calculated in March for the time period July 1 through December 31 of the previous year and in September for the time period January 1 through June 30 of the current year. The birth date ranges used for the January through June 2015 rates were 1/2/2012 through 11/30/2013 (19 through 35 month olds) and 1/2/1997 through 6/30/2002 (13 through 17 year olds).

Decision Explained: Colorado assesses these age groups so the rates can be compared to NIS. This coverage assessment is conducted in March for the previous six months ending December 31 to allow a few months for data to enter the IIS.

Determine the Vaccination Criteria (Numerator)

Vaccinations of Interest: Colorado assesses patients 19 through 35 months old for the 4:3:1:3:3:1:4 vaccination series as well as individual completion rates for DTaP, Polio, MMR, Hib, Hepatitis B, Varicella and PCV13. Colorado assesses 13 through 17 year olds based on vaccine completion rates for Tdap, HPV (females and males) and MCV4.

A list of CVX codes is provided below that includes unspecified formulations.[1]

Decision Explained: Colorado assesses vaccines used by the NIS. Stakeholders have not historically requested rates on other vaccine series such as Rotavirus or Hepatitis A. Other vaccines may be added to this assessment in the future if there are requests for this data.

Vaccine	CPT/CVX Codes
DTaP	CPT = 90701, 90718, 90700,90720, 90702, 90721, 90700, 90723, 90714, 90715, 90698, 90696 or CVX = 1, 9, 20, 22, 28, 50, 102, 106, 107, 110, 113, 115, 120, 130, 132, 138, 139, 146
Tdap	CPT = 90701, 90700, 90721, 90700, 90723, 90715, 90698, 90696 or CVX = 1, 20, 50, 102, 106, 107, 110, 115, 120, 130, 132
HepB	CPT = 90744, 90745, 90743, 90746, 90739, 90740, 90747, 90731, 90748, 90636, 90723 or CVX = 8, 42, 43, 44, 45, 51, 102, 104, 110, 132, 146
Hib	CPT = 90737, 90720, 90646, 90645, 90648, 90647, 90721, 90748, 90698, 90644 or CVX = 17, 22, 46, 47, 48, 49, 50, 51, 102, 120, 132, 146, 148
HPV	CPT = 90649, 90650, 90651 or CVX = 62, 118, 137, 165
Meningococcal	CPT = 90733, 90734, 90734, 90644 or CVX = 32, 103, 108, 114, 136, 147, 148
MMR	CPT = 90704, 90705, 90706, 90707, 90708, 90710 or CVX = 3, 4, 5, 6, 7, 38, 94
Pneumococcal	CPT = 90669, 90670, 90732 or CVX = 33, 100, 109, 133, 152
Polio	CPT = 90712, 90713, 90723, 90698, 90696 or CVX = 2, 10, 89, 110, 120, 130, 132, 146
Varicella	CPT = 90710, 90716 or CVX = 21, 94

[1] Note: For Tdap, Colorado uses an updated code created by its IIS vendor, which counts any Tdap or DTaP shot given at age 7 or older; for this reason, Tdap includes more than just CVX code 115.

Valid Doses/Invalid Doses: This coverage assessment evaluates up-to-date status based on valid doses only.

Decision Explained: Colorado counts only valid doses in the coverage assessment because it wants to measure protection as opposed to performance.

Routine and/or Catch-Up Immunization Schedule: The numerator for all rates includes only those considered up-to-date by the IIS forecasting/clinical decision support. The coverage assessment evaluates up-to-date status based on adherence to the routine ACIP schedule. The IIS forecaster does not include the catch-up schedule.

Decision Explained: Colorado is in the process of updating its IIS to include catch-up logic. For now, only the routine schedule is included in the IIS forecaster which is why the assessment evaluates status based only on the routine schedule.

Inclusion of Comments: If the patient has a history of the disease for varicella, they are considered up-to-date in the assessment for the varicella vaccine. Contraindications are excluded in the assessment.

Decision Explained: Patients with a documented history of varicella are included in the numerator because this assessment evaluates protection from vaccine-preventable disease.

Immunization Compliance by Age or Date: To be considered up-to-date, the patient must be in compliance by the last date of the assessment time period.

Decision Explained: Colorado is interested in finding out who is at risk for vaccine-preventable disease as of the assessment date rather than focusing on timeliness of vaccination in these populations.

Determine the Denominator Source

The denominator includes all individuals in the IIS matching the assessment eligibility requirements for immunizations. As described above, IIS records with less than two non-influenza vaccinations are excluded.

Decision Explained: Colorado uses an IIS-based denominator due to local demand and to promote the IIS as a central place for data.

Colorado's IIS has included birth records from Vital Records since 2004. The assessment includes only those IIS records with at least two non-influenza vaccinations to exclude individuals who have moved or visit a provider that does not participate in the IIS. Without this exclusion criterion in the numerator and denominator, Colorado believes the results would be artificially low.

Methodology and Results

Methods of Analysis: Colorado uses SQL Server Management Studio to query the data in a copy of the production database using a warehouse server. The copy of the production data refreshes daily, and the process for pulling rates for all counties can take three days. Using SQL Server Management Studio, data is pulled from the IIS, and rates are copied from the SQL server into Excel so a designated immunization program staff member can complete a mail merge with the data.

Assessments are conducted in Colorado every six months so they can provide updates on vaccination coverage rates twice per year. The process for conducting coverage assessments is time-consuming, so running coverage rates more frequently is time-prohibitive. Colorado also doubts it would see significant variation in the results with increased frequency.

Results: Colorado distributes county-level summary reports to each county health agency along with information on how to interpret the results. Online maps created using ArcGIS software are available for *children 19 through 35 months* and *adolescents 13 through 17 years old* (Colorado Department of Public Health and Environment, 2016).

Coverage levels by county are displayed in percentage ranges as opposed to point estimates. Colorado has a waiting list for providers and EHRs to interface with the IIS, and as a result, many providers do not send immunization data to the IIS. Because of this, coverage assessment results are likely underestimated.

Because of the amount of time required to query the data, statewide analyses have not been conducted in the IIS, but Colorado plans to do so in the future.

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

Colorado Immunization Information System (CIIS)
Summary Report of County-level Immunization Rates for: COUNTY
January 1 - June 30, 2015

Background

The Colorado Immunization Information System (CIIS) can be a valuable tool to estimate immunization uptake and track coverage levels over time. As it is not mandatory for healthcare providers to submit data to CIIS, immunization coverage levels are calculated based on the information present in CIIS. If there are a significant number of patients and/or immunizations missing in CIIS, immunization rates calculated may not accurately reflect the rates in your county. For this report, CIIS estimated the percentage of patients 19 - 35 months and 13 - 17 years that have fully met the defined vaccine series from January 1 through June 30, 2015. National Immunization Survey coverage estimates and Healthy People 2020 goals are provided below for comparison. *Information contained in this report was generated: September 10, 2015.*

Coverage Estimates and National Goals

National Immunization Survey (NIS): NIS-Child 19-35 months and NIS-Teen 13-17 years
The NIS is an annual telephone survey sponsored by the Centers for Disease Control and Prevention and is the most commonly referenced source for statewide immunization rates. Typically, immunization coverage rates generated from CIIS will be lower than those reported in the NIS due to the completeness of registry data and differing methodology (NIS counts valid and invalid doses while CIIS counts only valid doses).

2014 NIS - Child (19 - 35 months) Coverage Estimates for the 4:3:1:3:3:1:4 Series in Colorado:	**72.8%**
4+ Diphtheria, Tetanus, acellular Pertussis (DTaP):	85.4%
3+ Polio:	91.9%
1+ Measles, Mumps, Rubella (MMR):	87.4%
3 or 4+ *Haemophilus influenzae* b (Hib):	85.3%
3+ Hepatitis B:	89.5%
1+ Varicella:	87.9%
4+ Pneumococcal conjugate vaccine (PCV13):	84.8%

2014 and Revised 2013 NIS - Teen (13 - 17 years) Coverage Estimates in Colorado:
In 2014, the NIS-Teen survey methodology changed to include more teens in the survey. Previously, a teen could be excluded if they did not have adequate doses of childhood vaccines in their immunization record. Starting in 2014, teens were included in the survey if they had one or more providers reporting immunizations or if they were completely unvaccinated. The revised 2013 NIS-Teen rates using the new methodology and the 2014 are included below:

	Revised 2013	2014
1+ Tetanus, diphtheria, acellular pertussis (Tdap):	86.5%	90.2%
3+ Human papillomavirus (HPV) for females:	39.3%	42.1%
3+ Human papillomavirus (HPV) for males:	10.3%	21.9%
1+ Meningococcal conjugate vaccine (MCV4):	72.7%	76.8%

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Healthy People 2020 Goals
Healthy People 2020 provides science-based, 10-year national objectives for improving the health of all Americans. Healthy People 2020, led by the U.S. Department of Health and Human Services, is the result of a multi-year process that reflects input from a diverse group of individuals and organizations including public health and prevention experts, a wide range of federal, state and local government officials, a consortium of more than 2,000 organizations, and the public.

Increase the percentage of children aged 19 to 35 months who receive the recommended doses of DTaP, polio, MMR, Hib, hepatitis B, varicella, and PCV.

Series Target:	80%[1]
Individual Antigen Targets:	90%

Increase routine vaccination coverage levels for adolescents.

Individual Antigen Targets:	80%

County-level Coverage Estimates

Children 19 - 35 months of age

Included: All patients 19-35 months old, as of June 30, 2015, who lived in your county, received more than one non-influenza vaccination, and were considered active in CIIS.

4:3:1:3:3:1:4 Series Rate:

67.7%

Individual Antigen Rates

4+ Diphtheria, Tetanus, acellular Pertussis (DTaP):	76.8%
3+ Polio:	88.4%
1+ Measles, Mumps, Rubella (MMR):	88.0%
3 or 4+ *Haemophilus influenzae* b (Hib):	89.5%
3+ Hepatitis B:	87.2%
1+ Varicella:	87.4%
4+ Pneumococcal conjugate vaccine (PCV13):	75.2%

Adolescents 13-17 Years of age

Included: All patients 13-17 years old, as of June 30,2015, who lived in your county, received more than one non-influenza vaccination, and were considered active in CIIS.

Individual Antigen Rates

1+ Tetanus, diphtheria, acellular pertussis (Tdap):	69.9%
3+ Human papillomavirus (HPV) in females:	31.4%
3+ Human papillomavirus (HPV) for males:	14.1%
1+ Meningococcal conjugate vaccine (MCV4):	66.2%

[1] Leading Health Indicator - Subset of Healthy People 2020 objectives selected to indicate high priority health issues.

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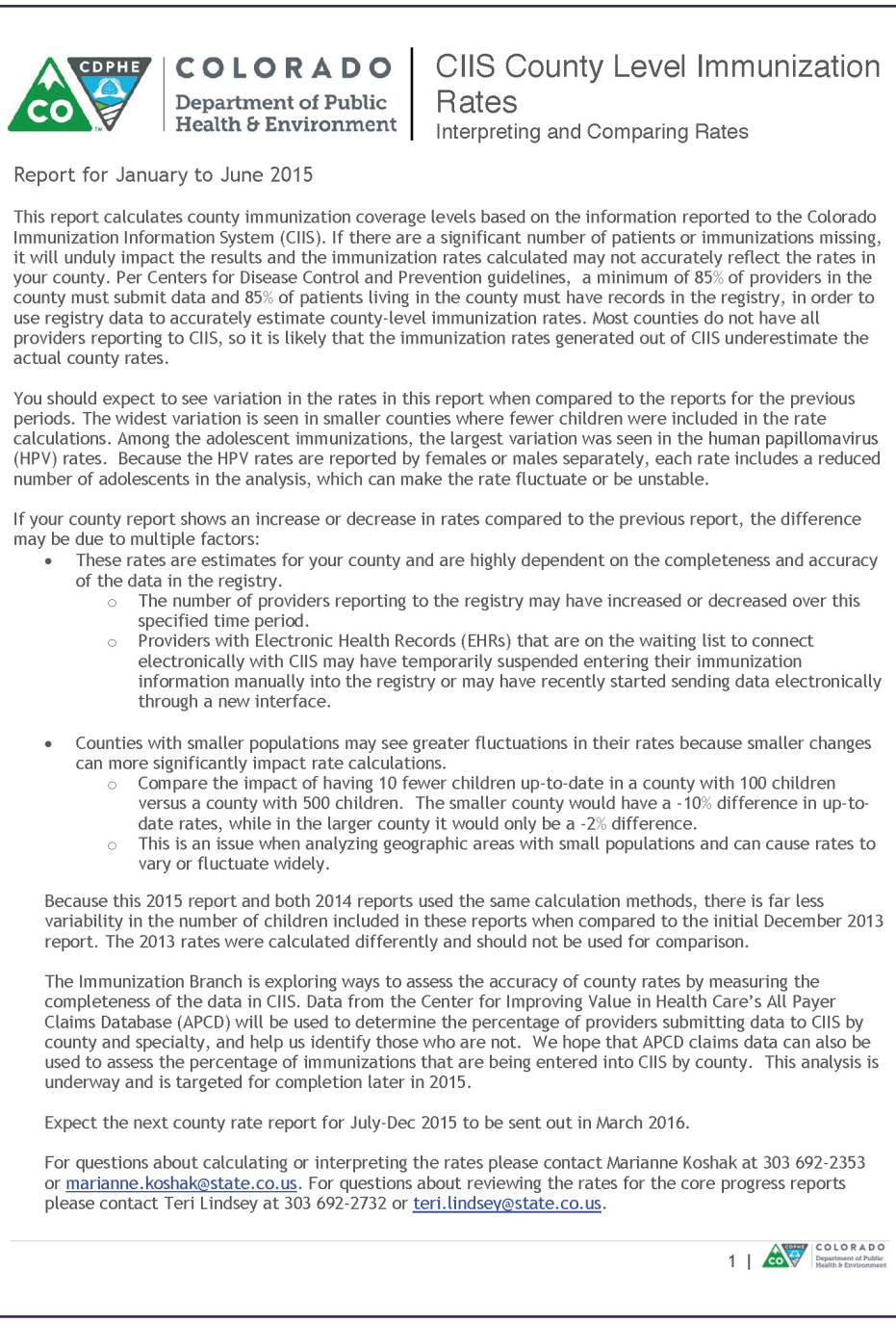

COLORADO
Department of Public Health & Environment

CIIS County Level Immunization Rates

Interpreting and Comparing Rates

Report for January to June 2015

This report calculates county immunization coverage levels based on the information reported to the Colorado Immunization Information System (CIIS). If there are a significant number of patients or immunizations missing, it will unduly impact the results and the immunization rates calculated may not accurately reflect the rates in your county. Per Centers for Disease Control and Prevention guidelines, a minimum of 85% of providers in the county must submit data and 85% of patients living in the county must have records in the registry, in order to use registry data to accurately estimate county-level immunization rates. 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.

You should expect to see variation in the rates in this report when compared to the reports for the previous periods. The widest variation is seen in smaller counties where fewer children were included in the rate calculations. Among the adolescent immunizations, the largest variation was seen in the human papillomavirus (HPV) rates. Because the HPV rates are reported by females or males separately, each rate includes a reduced number of adolescents in the analysis, which can make the rate fluctuate or be unstable.

If your county report shows an increase or decrease in rates compared to the previous report, the difference may be due to multiple factors:

- These rates are estimates for your county and are highly dependent on the completeness and accuracy of the data in the registry.
  - The number of providers reporting to the registry may have increased or decreased over this specified time period.
  - Providers with Electronic Health Records (EHRs) that are on the waiting list to connect electronically with CIIS may have temporarily suspended entering their immunization information manually into the registry or may have recently started sending data electronically through a new interface.
- Counties with smaller populations may see greater fluctuations in their rates because smaller changes can more significantly impact rate calculations.
  - Compare the impact of having 10 fewer children up-to-date in a county with 100 children versus a county with 500 children. The smaller county would have a -10% difference in up-to-date rates, while in the larger county it would only be a -2% difference.
  - This is an issue when analyzing geographic areas with small populations and can cause rates to vary or fluctuate widely.

Because this 2015 report and both 2014 reports used the same calculation methods, there is far less variability in the number of children included in these reports when compared to the initial December 2013 report. The 2013 rates were calculated differently and should not be used for comparison.

The Immunization Branch is exploring ways to assess the accuracy of county rates by measuring the completeness of the data in CIIS. Data from the Center for Improving Value in Health Care's All Payer Claims Database (APCD) will be used to determine the percentage of providers submitting data to CIIS by county and specialty, and help us identify those who are not. We hope that APCD claims data can also be used to assess the percentage of immunizations that are being entered into CIIS by county. This analysis is underway and is targeted for completion later in 2015.

Expect the next county rate report for July-Dec 2015 to be sent out in March 2016.

For questions about calculating or interpreting the rates please contact Marianne Koshak at 303 692-2353 or marianne.koshak@state.co.us. For questions about reviewing the rates for the core progress reports please contact Teri Lindsey at 303 692-2732 or teri.lindsey@state.co.us.

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Implementation Considerations

Since initiating county-level coverage assessments, Colorado has spent time revising the process both in terms of methodology and messaging to help interpret the data. This coverage assessment evaluates the same ages that are assessed by the NIS. Reviewers are often familiar with the format of the results, and this enables them to make comparisons with their NIS data. The language to communicate the coverage assessment results has evolved since its inception and includes limitations of the data and comparisons to Colorado's NIS rates. Colorado also assesses the validity of the results at the local level.

> In Colorado's experience, running coverage assessment rates can be less time-consuming than finding ways to accurately communicate the results, methodology and limitations to stakeholders.

Colorado strategically introduced coverage assessment results with immunization managers at local public health agencies using a sensitive, phased approach. The results were first shared privately with individual health agencies so they had an opportunity to become familiar with the results, respond and improve their rates. They were also given the opportunity to elect out of sharing their results publicly for the first year. Colorado chooses to share the results publicly in ranges (instead of point estimates) because they have lower confidence in the validity of the results. The assessment's limitations are also included with the results.

Coverage assessment vaccination rates produced by this method are likely underestimated. Given varying saturation levels, the estimates may be more accurate in one area compared to another. Counties with smaller populations may see greater fluctuations in their rates because smaller changes can more significantly impact rate calculations.

Tips for Other IIS: Before conducting coverage assessments, IIS should review their data quality on the specific data elements that may impact local level assessments, such as provider and patient saturation levels. Ideally, to conduct valid population estimates IIS should have at least 85% provider and patient saturation, which aligns with *CDC's requirement for IIS Sentinel Sites*. IIS should also ensure they have accurate forecasting algorithms to determine validity of past doses and whether patients are up to date.

Colorado assessed the limitations of its data and found gaps in the data, especially with data that had been imported electronically. Colorado modified the methodology, but these changes have made it difficult to compare rates year to year. It's also difficult to communicate methodology changes to stakeholders. To avoid significant changes in methodology, IIS should conduct a baseline data quality review before conducting coverage assessments.

Interested in Learning More? Contact Heather Roth, MA, program manager, Colorado Immunization Information System, *heather.roth@state.co.us*.

Oregon

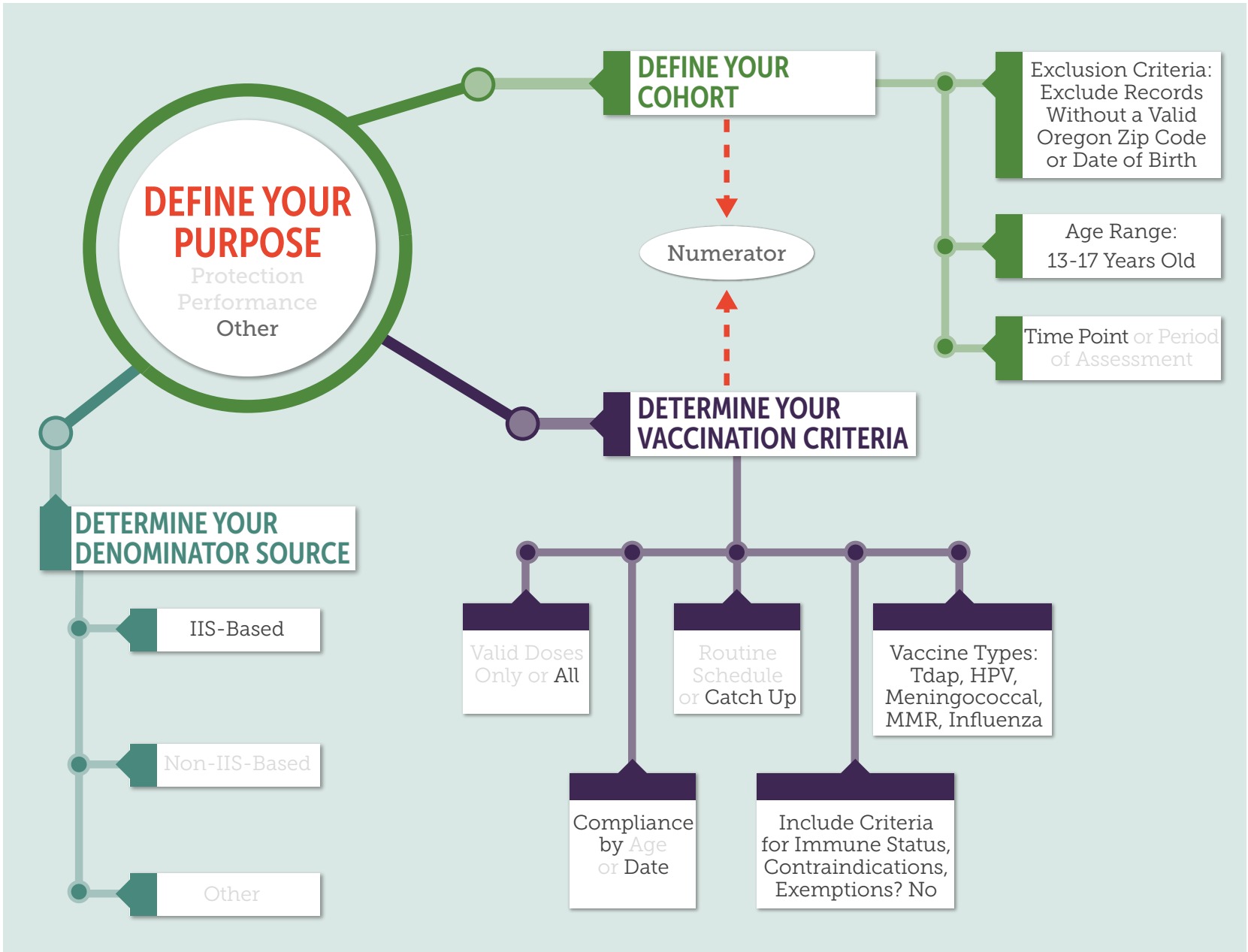
Assessment Question: What is the Tdap, Meningoccocal, MMR (one and two doses), influenza and HPV (one and three doses) vaccination coverage among adolescents 13 through 17 years old in Oregon?

Methods: This is an assessment of valid and invalid doses (invalid included with minimum age requirements applied) among populations of interest. IIS populations are used as a denominator, and weighting is applied to help account for denominator inflation.

Background: Oregon began these coverage assessments due to demand from state, division and department leadership for data on two year olds in 2006. Adolescent coverage assessments using the methodology described in this Addendum began in 2013. This particular coverage assessment methodology was created to address data challenges within the IIS due to denominator inflation from unmerged records, record fragmentation and undocumented mobility. This weighting method has been successful in Oregon. In order to compare the results over time, Oregon does not plan to change the parameters or methodology used for this assessment.

Use and Impact: The results of this coverage assessment help the IIS determine pockets of need and track immunization trends over time. Oregon posts the results on its website (*Oregon Health Authority, 2015*) and sends the results to providers, counties, and decision makers within the Oregon Department of Health. Oregon also uses this assessment to assess compliance with school immunization requirements.

Key Decision Points: Oregon



Define the Purpose: This coverage assessment assesses vaccination practices for adolescents 13 through 17 years old in Oregon on an annual basis.

Define the Cohort (Numerator)

Exclusion (and Inclusion) Criteria: Records without a valid date of birth or without an Oregon zip code are excluded from the assessment. This assessment includes records with or without immunizations.

Decision Explained: The weighting method is useful to produce estimates that remove some biases from the data. As individual weights are based on the time since last immunization, including no or low immunization records does not significantly impact the rates.

Cohort Age Range and Point in Time Assessment: This assessment includes adolescents 13 through 17 years old as of a specific point in time. Oregon uses an assessment date of May 1.

Decision Explained: This age range was selected to match NIS results. Oregon also runs this coverage assessment for 11 and 12 year olds and is in the process of extending its methodology to study rates for children 7 through 10 years old.

A point in time assessment is conducted as of May 1 because Oregon uses the data to help understand compliance with school immunization requirements.

Determine the Vaccination Criteria (Numerator)

Vaccinations of Interest: Inactive, obsolete and active vaccine codes that match a vaccine group for Tdap, Meningococcal, MMR (one and two doses), influenza and HPV (one and three doses) are used.

Decision Explained: The initial set of vaccines included vaccines routinely administered to adolescents. MMR was later added to this assessment due to local concerns about school vaccination coverage and the risk of outbreaks.

Valid Doses/Invalid Doses: All valid and invalid doses (except for close administration dates which should be deduplicated in the IIS) are included in the assessment.

Decision Explained: Weighting is conducted based on current activity in the IIS even if the doses administered were invalid. Because Oregon adjusts record fragments and accounts for historical doses that may not have been entered into the IIS, all doses are included. Results with valid or invalid doses are expected to be similar for adolescents, but programs may wish to include only valid doses and should consider removing invalid doses for multi-dose series and for younger populations. Oregon's IIS also automatically merges records of doses administered within 14 days.

Routine and/or Catch-Up Immunization Schedule: This assessment used the routine and catch-up immunization schedules.

Inclusion of Comments: Lab proof of immunity, contraindications or exemptions are not included in the assessment.

Determine the Denominator Source

Oregon has developed a scientifically robust methodology to conduct population-based coverage assessments using an IIS-based denominator. Using an IIS-based population produces more accurate rates for this assessment, analogous to how surveys use only (weighted) respondents as denominators to calculate rates, rather than including everyone who didn't respond.

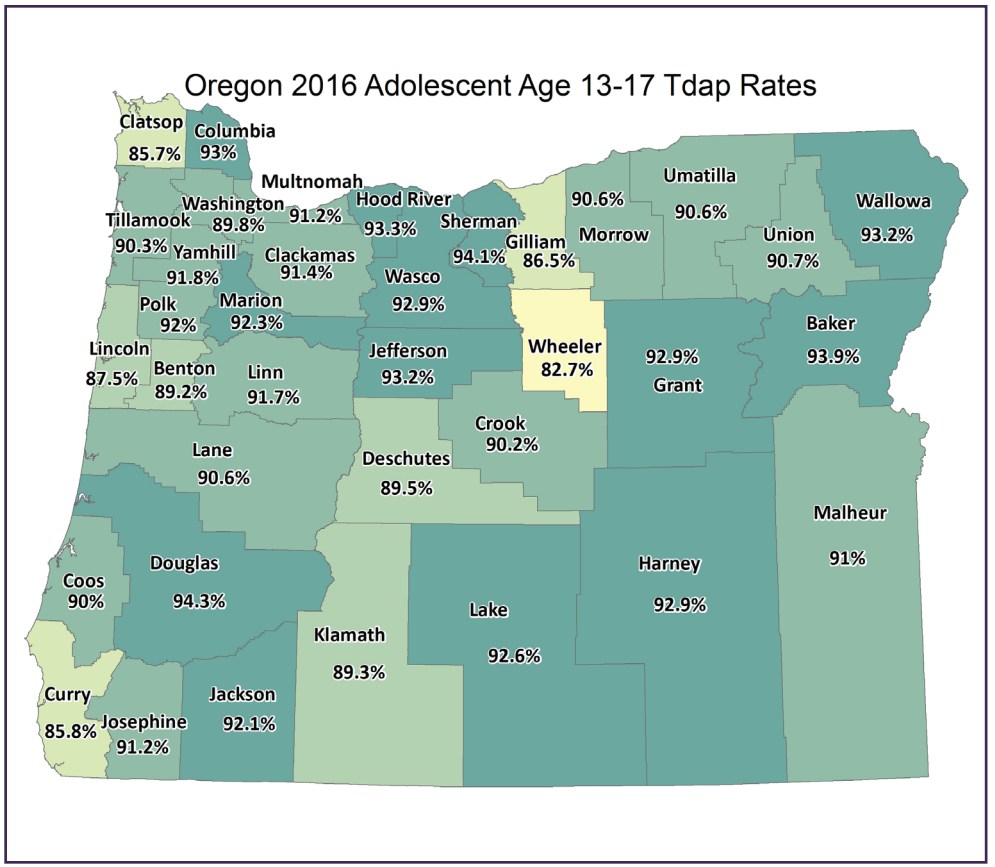
Methodology and Results

Method of Analysis: Oregon weights all records based on the time since the last observed immunization. As a result, adolescents without immunization records in the IIS or adolescents without recorded immunizations for long periods of time have lower weighted scores than adolescents with recently administered shots. A second stage of weighting is completed for immunizations that may have been administered to adolescents prior to the first immunization entered into the IIS. This second-stage weighting strategy is designed as a place-holder for assumed childhood doses so that the lack of records in the IIS does not lower the results of the coverage assessment as a result of this missing data.

> *Example:* If the adolescent's first immunization recorded in the IIS was at age eight, the record would be weighted to give the adolescent some credit for an infant dose of MMR, even if it was not reported, because the provider may not have reported historical doses.

Please refer to *Robison, 2015* for a detailed description of the weighting process. Once the records are weighted appropriately, simple percentage calculations are used to determine coverage rates. Oregon uses MS-Access to conduct this coverage assessment based on data extracted from the IIS, but SAS or SQL code could also be used. Records are assigned a county based on zip code to conduct county-level coverage assessment rates.

Results: Results are shown in table and map form online (Oregon Health Authority, 2016).



Implementation Considerations

This coverage assessment uses a statistically advanced weighted method to account for gaps in IIS data. The weighting method used in this coverage assessment accounts for local reporting biases so the coverage assessment results reflect true differences in vaccination rates rather than differences in reporting. This weighting approach works well with data limitations.

This method is best for immunizations given in the past two to four years using data that has been deduplicated. Oregon uses this method routinely for adolescents 13 through 17 years old and has found that the weighting method produces a reasonable correction for denominator inflation down to age three years old. However, further validation is needed.

Tips for Other IIS: Vaccination rates are often measured using surveys, and survey data is routinely weighted to account for biases and non-reporting. Similarly, IIS data can be weighted at the record level to account for biases and population representation. Rather than IIS being viewed as underpopulated data sources, they should be viewed as extremely overpopulated survey data instead.

Programs need to also consider patients who have moved or gone elsewhere (MOGE) as an important concept in using IIS data for population-based coverage assessments. One way to assess MOGE is to review records that have not been updated over a certain period of time. Based on this information, programs should consider how likely it is that those individuals still reside in the area of interest.

Interested in Learning More? Contact Steve Robison, epidemiologist, Oregon Immunization Program, *steve.g.robison@state.or.us*.

Minnesota

Assessment Question: What is the vaccination coverage for all childhood vaccines for Somali children compared to non-Somali children by 24 months old born from 2004 through 2013 in Minnesota?

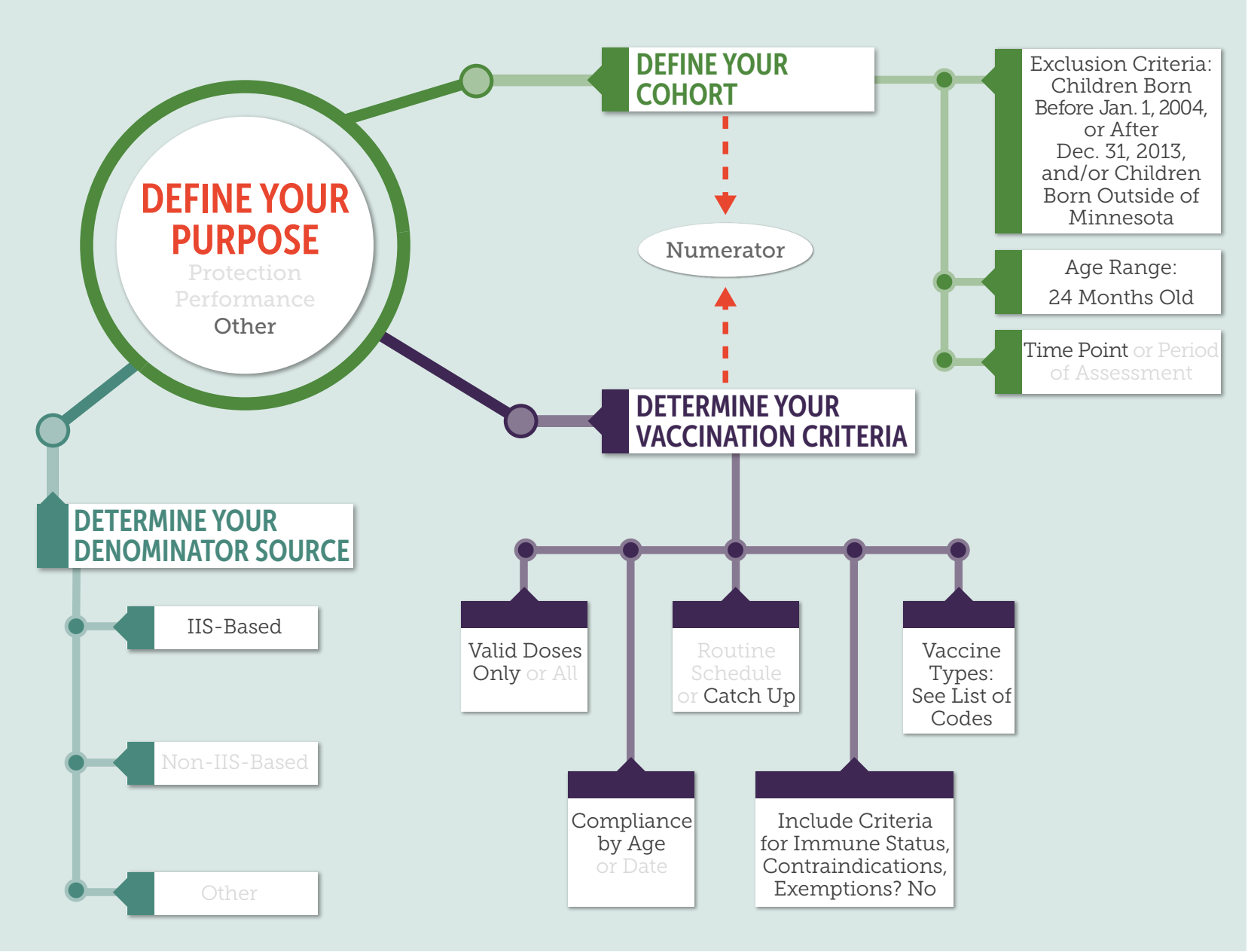
Methods: This assessment evaluated valid vaccinations among populations of interest. The population of interest was obtained using data from vital records and a vital records-IIS matching process. IIS records were used as the denominator.

Background: Interest in this coverage assessment began when Minnesota started hearing anecdotal rumors in 2009 of vaccine hesitancy in the Somali population due to autism concerns. A measles outbreak in 2011 prompted Minnesota to look at the available data to help understand the situation.

Minnesota has been using its IIS for population-based coverage assessments since the late 2000s. However, this particular coverage assessment was the first time Minnesota used IIS data to assess coverage among the Somali population. The coverage assessment initially looked at whether children were up to date by 24 months and was eventually expanded to assess vaccination coverage by 72 months. An epidemiologist in Minnesota conducted this assessment.

Use and Impact: This coverage assessment confirmed anecdotal reports of lower vaccination rates among Somali children by 24 months old and informed targeted outreach to the Somali community to eliminate health disparities. As a result, epidemiologists within Minnesota's immunization program work closely with a Somali outreach team to help ensure Somali children are appropriately vaccinated. Local public health organizations also conduct county-specific outreach in 11 counties throughout Minnesota with increased Somali populations. With this data, health care providers are driven to address this issue at the local public health level.

Key Decision Points: Minnesota



Define the Purpose: This coverage assessment compares vaccination practices and compliance with ACIP recommendations for Somali children and non-Somali children born in Minnesota at 24 months old.

Determine the Cohort (Numerator)

Exclusion (and Inclusion) Criteria: Minnesota used vital statistics data to identify Somali children. Children were identified as Somali if the mother or father's country of birth was Somalia on the birth certificate or if the child's race/ethnicity was indicated as Somali. These birth certificate records were matched to records in the IIS using the birth certificate number. All other records were considered non-Somali.

Children born outside of Minnesota, no longer currently residing in Minnesota or deceased were excluded from the assessment. Children born before January 1, 2004, or after December 31, 2013, were also excluded.

Decision Explained: In order to be matched to a birth certificate and identified as Somali or non-Somali, children are included in the assessment only if they were born in Minnesota with a birth certificate.

If a child's address was missing or considered invalid, they were still included in the assessment. Anecdotally, Minnesota's Somali outreach team believes while many Somali families may move for employment opportunities, it is often only the working adult(s) who move. Issues of younger children who have moved or gone elsewhere are less prominent, so children with invalid or missing addresses are included if the child was born in Minnesota.

Cohort Age Range and Point in Time Assessment: Minnesota included all children born from January 1, 2004, through December 31, 2013, within Minnesota in the assessment.

Determine the Vaccination Criteria (Numerator)

Vaccinations of Interest: Minnesota individually assessed coverage of each vaccine (DTaP, HepB, Hib, MMR, PCV, Polio and Varicella) and the rates of three DTaP and three PCV by age 24 months using the active vaccine codes indicated below.

Decision Explained: Minnesota heard anecdotal reports of vaccine hesitancy in the Somali community for MMR and other doses administered at 12 months. For this reason, Minnesota was particularly interested in childhood doses received at 12 months.

Vaccine	CPT/CVX Codes
DTaP	CPT = 90696, 90698, 90700, 90700, 90701, 90702, 90720, 90721, 90723 or CVX = 01, 20, 22, 28, 50, 102, 106, 107, 110, 120, 130, 132
HepB	CPT = 90636, 90723, 90731, 90731, 90740, 90743, 90744, 90745, 90746, 90747, 90748 or CVX = 08, 42, 43, 43, 44, 45, 51, 102, 104, 110
Hib	CPT = 90644, 90645, 90646, 90647, 90648, 90698, 90720, 90721, 90737, 90737, 90748 or CVX = 17, 22, 46, 47, 48, 49, 50, 51, 102, 120, 148
MMR	CPT = 90707, 90708, 90709, 90710 or CVX = 03, 04, 38, 94
PCV	CPT = 90669, 90670 or CVX = 100, 109, 133, 152
Polio	CPT = 90696, 90698, 90712, 90713, 90723 or CVX = 02, 10, 89, 110, 120, 130, 132
Varicella	CPT = 90710, 90716 or CVX = 21, 94

Valid Doses/Invalid Doses: Only valid doses were included in the assessment.

Decision Explained: Only valid doses were considered because this coverage assessment's purpose was to assess vaccination coverage and compliance (protection).

Routine and/or Catch-Up Immunization Schedule: This assessment used the ACIP routine and catch-up schedules.

Decision Explained: The ACIP catch-up schedule was used because Minnesota's IIS forecaster/CDSi includes logic for the catch-up schedule. Up-to-date status in Minnesota's IIS is determined from the number of doses needed based on when certain vaccines were administered.

Inclusion of Comments: Lab proof of immunity, contraindications and exemptions were not considered in the assessment.

Decision Explained: Minnesota's IIS is in the process of implementing updates that will allow the IIS to better analyze comments related to immune status by disease history. In the future, Minnesota may consider immunity by history of disease in the assessment, although Minnesota staff is unsure this will impact the results.

Immunization Compliance by Age or Date: Minnesota assessed children's up-to-date status by 24 months old. Eventually, this assessment was expanded to assess up-to-date status among Somali and non-Somali children by 72 months old.

Decision Explained: Assessing compliance by 24 months old provides a few months for young children to become up-to-date after immunizations are due for most children at 15 through 18 months old. Minnesota was interested in seeing if any differences in vaccination coverage among Somali and non-Somali children at 24 months old were eliminated by the time they entered school; 72 months was a proxy for school entrance.

Determine the Denominator Source

The denominator used IIS data and included IIS records with or without recorded immunizations.

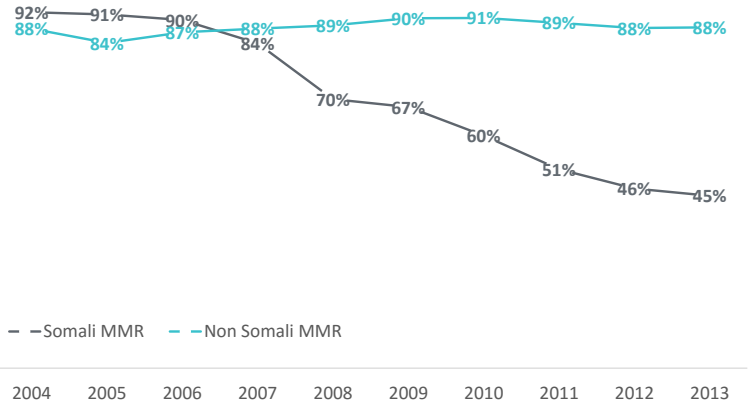
Decision Explained: Minnesota's IIS is populated by vital records data and as a result, can be used to determine population-based coverage. This assessment included IIS records with or without recorded immunizations because issues of individuals who have moved or gone elsewhere are not as pronounced in younger children as they are in adolescents/adults.

Methodology and Results

Method of Analysis: The analysis was completed in SAS. Each year when the vital records data become available, Minnesota reaches out to Vital Records and obtains birth data from the previous year. The Vital Records office uses a saved SQL query to pull this information for the IIS staff. This query pulls birth certificate numbers for clients that match any of the following criteria: Somali race, Somali ethnicity, mother with a birth country of Somalia, and father with a birth country of Somalia. IIS staff import this data into SAS Enterprise Guide to match birth certificate numbers against IIS data. In SAS, part of the cohort is identified as Somali based on birth certificate numbers, and the rest of the cohort is identified as non-Somali. The analysis of up-to-date status by 24 months is calculated statewide, by county and by region as requested.

Results: Somali children had lower rates of MMR and Varicella coverage by 24 months compared to non-Somali children in Minnesota. However, a follow-up analysis for children born in 2004 through 2008 found Somali children received two doses of Varicella and MMR at the same rate as non-Somali children by 72 months old. Results are displayed visually on the next page (*Setty, 2016*).

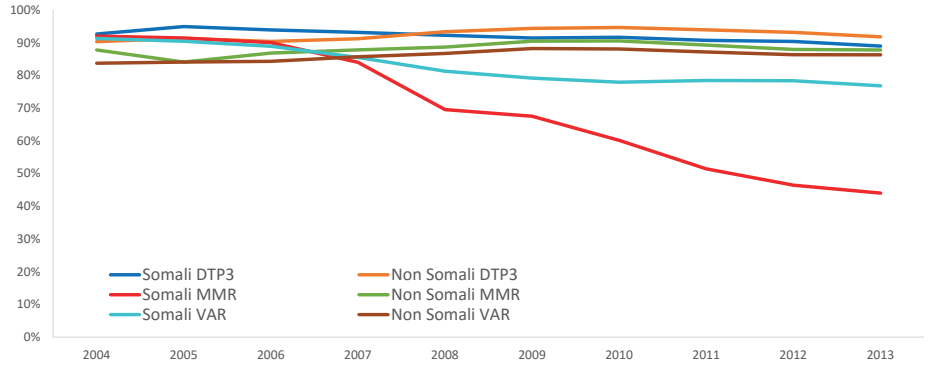
Comparison of +1 MMR Rates by 24 Months for Children of Somali and Non-Somali Descent, by Birth Year



MDH

MIIC

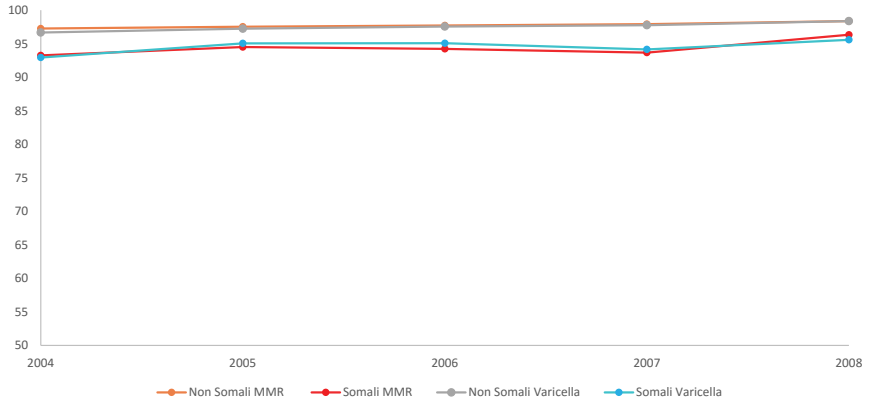
Comparison of Immunization Rates by 24 Months for Children of Somali and Non-Somali Descent, by Birth Year



MDH

MIIC

Comparison of Selected Immunization Rates by 72 Months in Children of Somali Descent versus Non-Somali, 2004-2008



MDH

MIIC

Given the significant interest in using the data to assess vaccination coverage among the Somali population and Minnesota's emphasis on health equity, Minnesota is interested in looking at coverage among other races and ethnicities in the near future.

Implementation Considerations

If IIS consume vital statistics data, including birth certificate numbers as is the case in Minnesota, the matching process to identify race/ethnicity should be fairly simple. This coverage assessment may be more difficult for IIS that do not consume vital statistics data and the birth certificate unique identifier (or a corresponding medical record number). While the assessment would still be possible, the matching process may take more work. Common names in the Somali community can sometimes be challenging, and the data is potentially sensitive. IIS should ensure they have managerial support for this type of coverage assessment before replicating the process. Minnesota has significant support because of department-wide initiatives to tackle public health inequities, and as a result, Minnesota is able to devote resources to these types of coverage assessments.

Race and ethnicity information is sometimes not stored in Minnesota's IIS. It would be important for IIS to explore how they support data at a granular level (for example, the completeness of race and ethnicity fields may be affected by data exchange). Vital statistics data is self-reported, and in some adoption cases, the parent information may be changed to reflect the adoptive parents rather than the birth parents. However, Minnesota does not believe this is a significant issue for this particular coverage assessment.

Tips for Other IIS: Overall, Minnesota has found there is a lot of interest in using IIS data. Coverage assessments like this are a powerful way to show use and value of the IIS. Minnesota has learned the importance of reviewing the data currently stored in the IIS. Through data exchange, Minnesota found race and ethnicity fields are often overwritten in the IIS so it referred to the original vital records data to secure this information.

Interested in Learning More? Contact Sudha Setty, MPH, epidemiologist, Minnesota Department of Health, *Sudha.Setty@state.mn.us*.

Washington

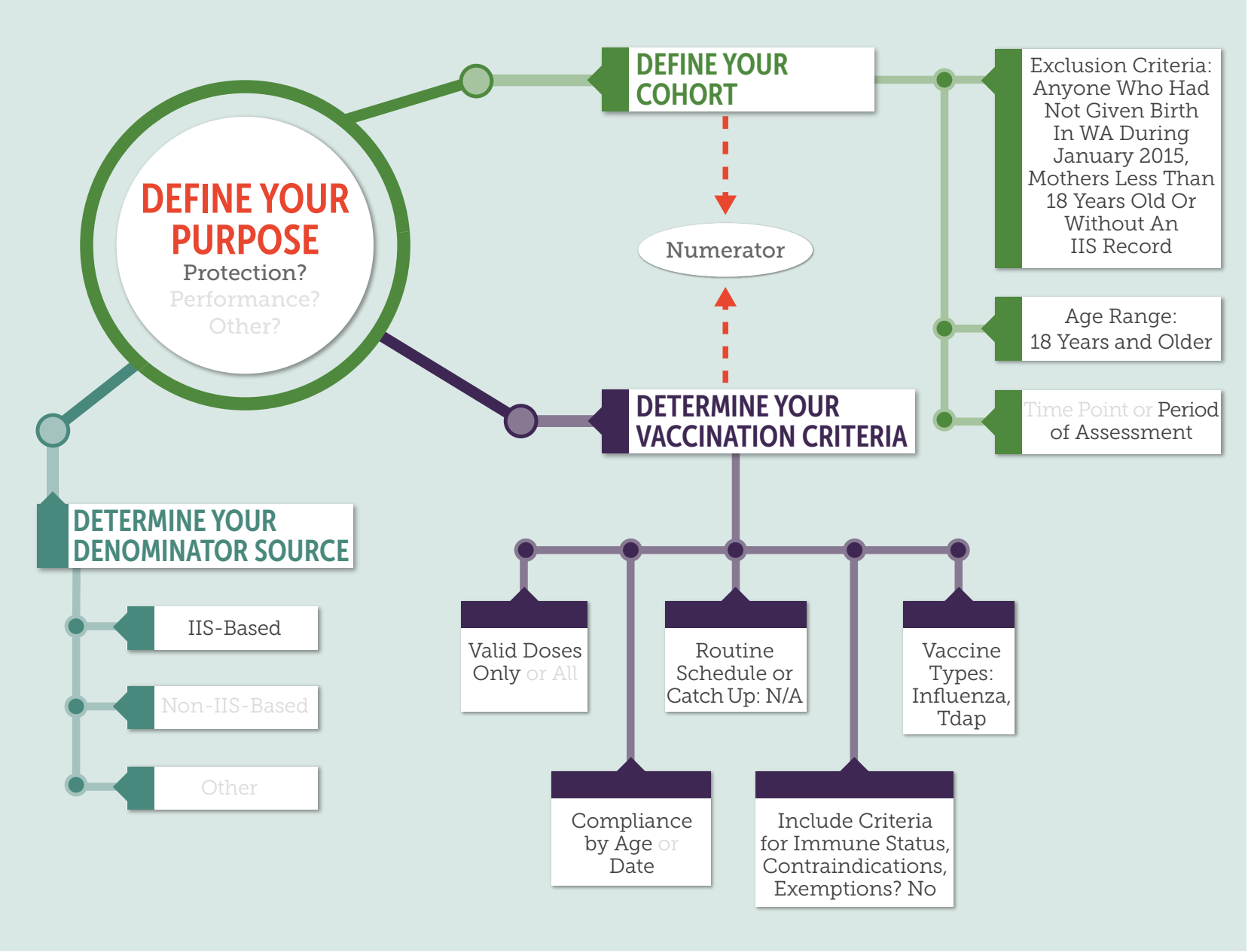
Assessment Question: What percentage of women who deliver infants in Washington state receive influenza vaccine during pregnancy and Tdap vaccine at 27 through 36 weeks gestation as recommended?

Methods: This assessment is based on valid vaccinations among populations of interest. The population of interest was obtained by matching mothers' information on birth certificates to IIS records. The denominator included all client records in the IIS matching the assessment eligibility requirements.

Background: An epidemiologist in Washington conducted this pilot coverage assessment due to curiosity surrounding Tdap and influenza coverage among pregnant women, especially following a pertussis outbreak in Washington. Existing sources of data on influenza coverage were insufficient: Behavioral Risk Factor Surveillance System (BRFSS) studies assess influenza coverage, but the population sample of pregnant women is often too small to draw conclusions and does not allow demographic stratification. Pregnancy Risk Assessment Monitoring System (PRAMS) data does not provide timely results.

Use and Impact: Washington conducted this coverage assessment as a pilot to determine if this type of assessment could meaningfully assess vaccination during pregnancy and provide timely results. The assessment was a success and will be expanded in the future to assess vaccination behavior during pregnancy over multiple years to monitor vaccination trends in Washington.

Key Decision Points: Washington



Define the Purpose: This coverage assessment assesses protection from some vaccine-preventable diseases during pregnancy for women who gave birth in Washington during the month of January 2015.

Define the Cohort (Numerator)

Exclusion (and Inclusion) Criteria: This assessment included women over 18 years old who gave birth in Washington from January 1, 2015, through January 31, 2015, with an IIS record. All birth certificates in Washington were matched to IIS records based on mothers' first, middle and last names, date of birth and zip code of residence.

Individuals who did not give birth during January 2015 in Washington were excluded. Women 17 years and younger and women without an IIS record were also excluded.

Decision Explained: Given staff limitations and because the matching process involves manually verifying matches, Washington conducted a pilot to see if data from one month could assess Tdap and influenza uptake during pregnancy. The assessment will be expanded in future years to include more data.

Cohort Age Range and Period of Time Assessment: The assessment assessed the vaccination behavior of women 18 years and older throughout pregnancy.

Decision Explained: Only mothers 18 years and older were analyzed to avoid any potential privacy concerns and interference with Tdap requirements for school.

Define the Vaccination Criteria (Numerator)

Vaccinations of Interest: Influenza and Tdap were assessed.

Decision Explained: Influenza and Tdap are the only vaccinations routinely recommended by ACIP for pregnant women at this time.

Valid Doses/Invalid Doses: This assessment included only valid doses.

Decision Explained: Only valid doses were considered because this assessment measures protection from influenza and Tdap in pregnant women.

Routine and/or Catch-Up Immunization Schedule: This criterion is not applicable for this assessment.

Inclusion of Comments: Contraindications were not assessed.

Decision Explained: Contraindications are not routinely captured in the IIS.

Immunization Compliance by Age or Date: Rates of Tdap and influenza uptake were assessed at any point during pregnancy. Washington also calculated the percentage of women that received Tdap at 27 through 36 weeks gestation as recommended. The birth certificate in Washington includes a variable for gestational age at delivery, which is used to calculate the period of time that each woman was pregnant and to calculate weeks of gestation for mothers who received Tdap.

SAS Code:

Wks_gest_vacc: *weeks of gestation at vaccination*

est_gest_period: *MD estimated gestational age at delivery*

CDOB: *child's date of birth/the date of delivery*

vacc_or_contra_date: *date of vaccination*

wks_gest_vacc = *est_gest_period - ((cdob - vacc_or_contra_date)/7)*

The period of pregnancy is calculated using the estimated gestational age at delivery and working backwards to get the start date of the pregnancy.

Determine the Denominator Source

The denominator included all individuals in the IIS matching the assessment eligibility requirements with or without immunizations.

Decision Explained: The denominator included only matched mothers. Washington did not consider excluding matched individuals in the IIS without recorded immunizations who have IIS records but no recorded immunizations..

Methodology and Results

Method of Analysis: Washington assessed 7,184 birth certificates with 6,990 unique mothers aged 18 years and older. Mothers listed on the birth certificates were matched to records in the IIS using SAS v. 9.4 programs by creating combinations of identifying information in both incoming data sets (e.g., DOB + first name, DOB + legal name, first name + legal name). Potential matches were placed in three categories: true matches which were accepted, potential matches that required manual review and non-matches that were discarded.

Initially, 4,171 mothers listed on the birth certificates matched an IIS record. After attributing for matches to multiple IIS records and birth certificates and deduplicating the data, 3,711 unique mothers were identified (53% match rate).

Washington initially wrote a SQL query from the IIS production data that included all immunizations administered on or before January 31, 2015. Washington also requested data from the Washington Center for Health Statistics to obtain a dataset of women who gave birth during January 2015. A SAS program was used to match the two datasets. Simple percentage calculations were used to determine vaccination rates.

Results: This assessment found higher rates of Tdap in pregnant women than previously found in other studies but lower influenza rates than expected. Specifically, 31.4% of pregnant women received a Tdap at 27 through 36 weeks gestation, as recommended, and 32.3% received an influenza shot during pregnancy. The results are displayed in the next column (*Eavey, 2016*).

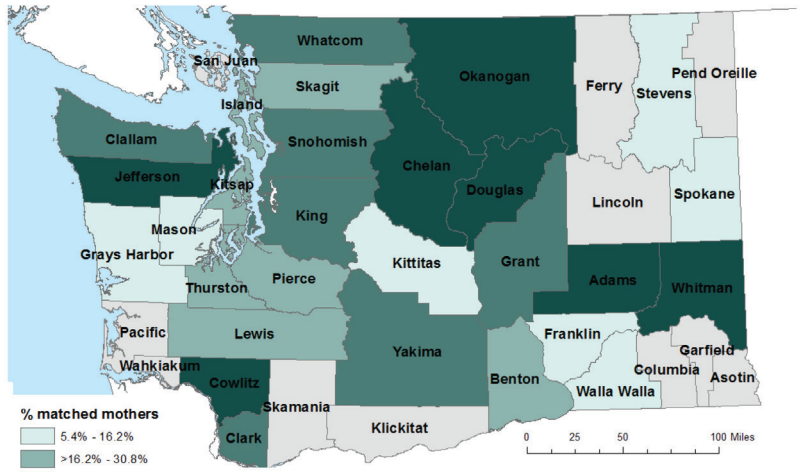
Results – Vaccinations

- 33,852 total vaccination records for 3,711 matched mothers

Vaccine	Total vaccination records (valid and before 2/1/2015)	# records per matched mother	% matched mothers vaccinated during pregnancy	% matched mothers vaccinated at 27-36 weeks
Tdap	3,285	0 – 4	39.1% (N= 1,451)	31.4% (N=1,164)
Influenza	4,158	0 – 14	32.3% (N=1,209)	N/A

Washington State Department of Health

Percentage of matched mothers with a Tdap vaccination between 27 and 36 weeks gestation, by county



Range: 0% - 63% of mothers vaccinated between 27 and 36 weeks gestation.
Similar pattern for flu (not shown).
Includes all counties with >4 matched mothers.

Implementation Considerations

Washington relies on vital statistics data to identify pregnant women and gestational age of vaccine administration. SAS programs to conduct this assessment have been developed, and the data is already reported to Washington's Department of Health through the Washington Center for Health Statistics and the IIS. This study uses already collected population-based data resulting in a generalizable dataset at little cost to the immunization program. However, the manual matching process to identify pregnant women is time-consuming given staff limitations.

Based on the methodology, it is possible the results may underestimate or overestimate true coverage. Underestimated coverage may be possible for the following reasons: reporting of adult immunizations in Washington's IIS is voluntary, reporting may vary by geographic region and/or clinic size, and the denominator includes all individuals in the IIS with or without immunizations. This method also has the potential to overestimate coverage since the calculation is based on the assumption that non-matched mothers are as likely as matched mothers to be vaccinated.

Tips for Other IIS: Be aware of the limitations in your data and in your IIS, including reporting and participation limitations.

Interested in Learning More? Contact Joanna Eavey, MSPH, epidemiologist, Washington State Department of Health, *joanna.eavey@doh.wa.gov*.

Conclusion

This Addendum provides examples of coverage assessments being conducted in the IIS community and explores the decisions made at each key decision point. Many of the IIS included in this Addendum have found that coverage assessments provide valuable information to their immunization programs and that assessment results can be used to influence programmatic activities, support program evaluations and identify gaps in IIS data quality.

Many of the IIS interviewed for this Addendum had similar advice for other IIS; primarily, conduct a baseline data quality review prior to conducting coverage assessments using IIS data. This data quality review should include data in the IIS that would impact coverage assessment results such as patient and provider saturation levels, clinical decision support/forecasting algorithm accuracy, and the quality of data in key fields such as zip code, race or ethnicity (based on the assessment). Thoroughly understanding the gaps in the IIS data can help IIS design their coverage assessment methodology to account for those gaps (as seen in Oregon and Minnesota). A data quality review may also help IIS better understand (and thus communicate) the limitations of their coverage assessment results (as seen in Colorado).

Also, while it can be time-consuming to plan for and conduct an initial analysis, once a methodology is defined and an analysis has been completed, IIS can reuse the process. Changes to the methodology can be introduced as needed to account for additional factors or updated immunization recommendations. Even with small changes to the methodology, analyses can be completed routinely to assess trends over time.

The IIS interviewed for this Addendum all have found local interest in using the IIS data, which has been a powerful way to show the value of the IIS. IIS can use coverage assessments as an effective tool to support the existing work of IIS and immunization programs. Overall, the IIS interviewed for this Addendum agreed: Use the data!

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