Recent Developments with the National Immunization Survey-Child (NIS-Child)

AIRA 2018 National Meeting

Session 7C

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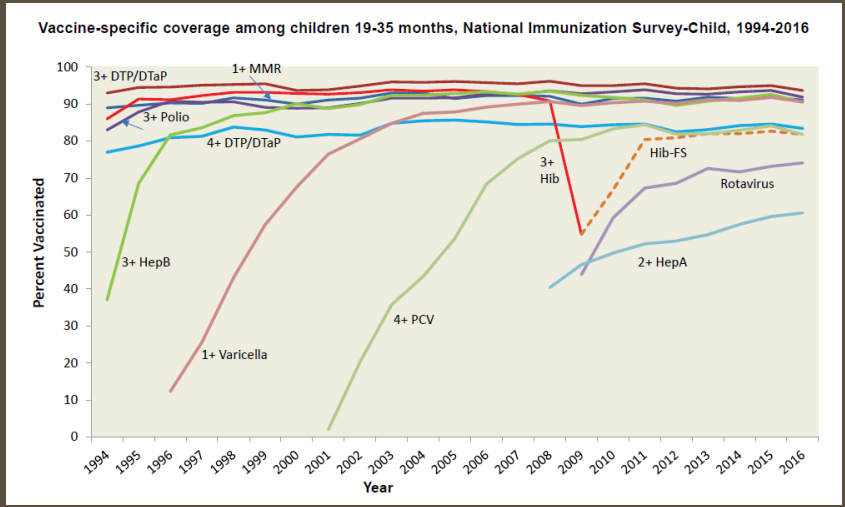
Topics covered

- Measuring vaccination coverage from NIS-Child by birth cohort
- Update on IIS-NIS integration

State and National Vaccination Coverage Levels Among Children Aged 19-35 Months -- United States, April-December 1994

The National Immunization Survey (NIS) is a single survey providing state and national estimates of vaccination coverage levels among children aged 19-35 months. CDC implemented the NIS in April 1994 as one element of the five-part Childhood Immunization Initiative (CII) (1), a national strategy to achieve and maintain high vaccination levels among children during the first 2 years of life. NIS collects quarterly data from the 50 states, the District of Columbia, and 27 urban areas considered to have populations at high risk for undervaccination. This report of initial NIS findings provides the results of both national and state vaccination coverage levels for April-December 1994.



Current Paradigm

Morbidity and Mortality Weekly Report

Vaccination Coverage Among Children Aged 19–35 Months — United States, 2016

Holly A. Hill, MD, PhD[1]; Laurie D. Elam-Evans, PhD[1]; David Yankey, MS, MPH[1]; James A. Singleton, PhD[1]; Yoonjae Kang, MPH[1]

Vaccination is the most effective intervention to reduce morbidity and mortality from vaccine-preventable dis-

inability to pay. Greater awareness and facilitating use of VFC might be helpful in reducing these disparities. Efforts should

Key Features of the NIS-Child

- Target population
  - Children ages 19-35 months anytime during each quarter of data collection
- Design
  - Random sample of cell telephone numbers
  - Stratified by 56 state/local awardee areas, selected local areas and territories
- Data Collection in two phases
  - Telephone interview of parent/guardian
  - Mail survey of child's vaccination providers
- Estimates produced annually ***by survey year***
  - Weighted to account for sampling design and minimize bias

Why Consider Switching to Birth Cohort Analysis? Summary of Report on the 2016 NIS-Child Data

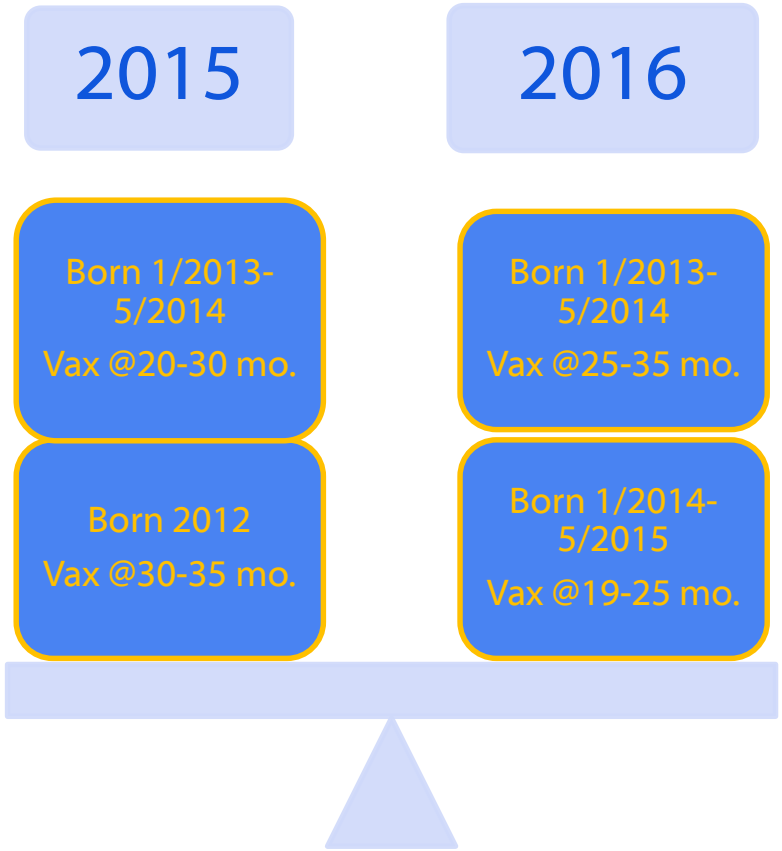
- Annual NIS estimates by survey year are difficult to interpret
  - Includes wide birth range (January 2013 – May 2015 for 2016 data)
  - Children are assessed for vaccination at differing ages (19-35 months)
- Interpreting a change in vaccination coverage from one survey year to the next is even more difficult
- Possible change in accuracy of estimates from 2015 to 2016 was identified using “bridging cohort” analysis
  - Created an appearance of decreased vaccination coverage
- Measuring year-to-year trends in vaccination coverage by birth cohort may be more informative for the NIS-Child community of users than the traditional measure by survey year

Source: https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-vax-trends-2012-2016.html

Comparing NIS-Child Vaccination Coverage Estimates – a Difference in Complex Moving Averages

Comparing same birth cohorts
62%

Comparing non-overlapping birth cohorts
38%



New Paradigm

Typical Sample Size per State by Survey Year and Annual Birth Cohort, NIS-Child 2013-2017

		Annual Birth Cohort							
		2010	2011	2012	2013	2014	2015	2016	Total
Survey Year	2013	94	134	22	0	0	0	0	250
	2014	0	94	134	22	0	0	0	250
	2015	0	0	94	134	22	0	0	250
	2016	0	0	0	94	134	22	0	250
	2017	0	0	0	0	94	134	22	250
	Total	94	228	250	250	250	156	22	

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	2017	0	0	0	0	94	134	22	250
	Total	94	228	250	250	250	156	22	

500

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Proposed Annual NIS-Child Estimation by Birth Cohort Defining the Denominator

Example Using Data Through 2017

	Estimate by Survey Year	Estimate by Birth Cohort
Birth Cohorts Included	2014 2015 2016 (Jan.-May)	2014 2015
Data Years Included	2017	2017 2016 2015

Proposed Annual NIS-Child Estimation by Birth Cohort Defining the Denominator

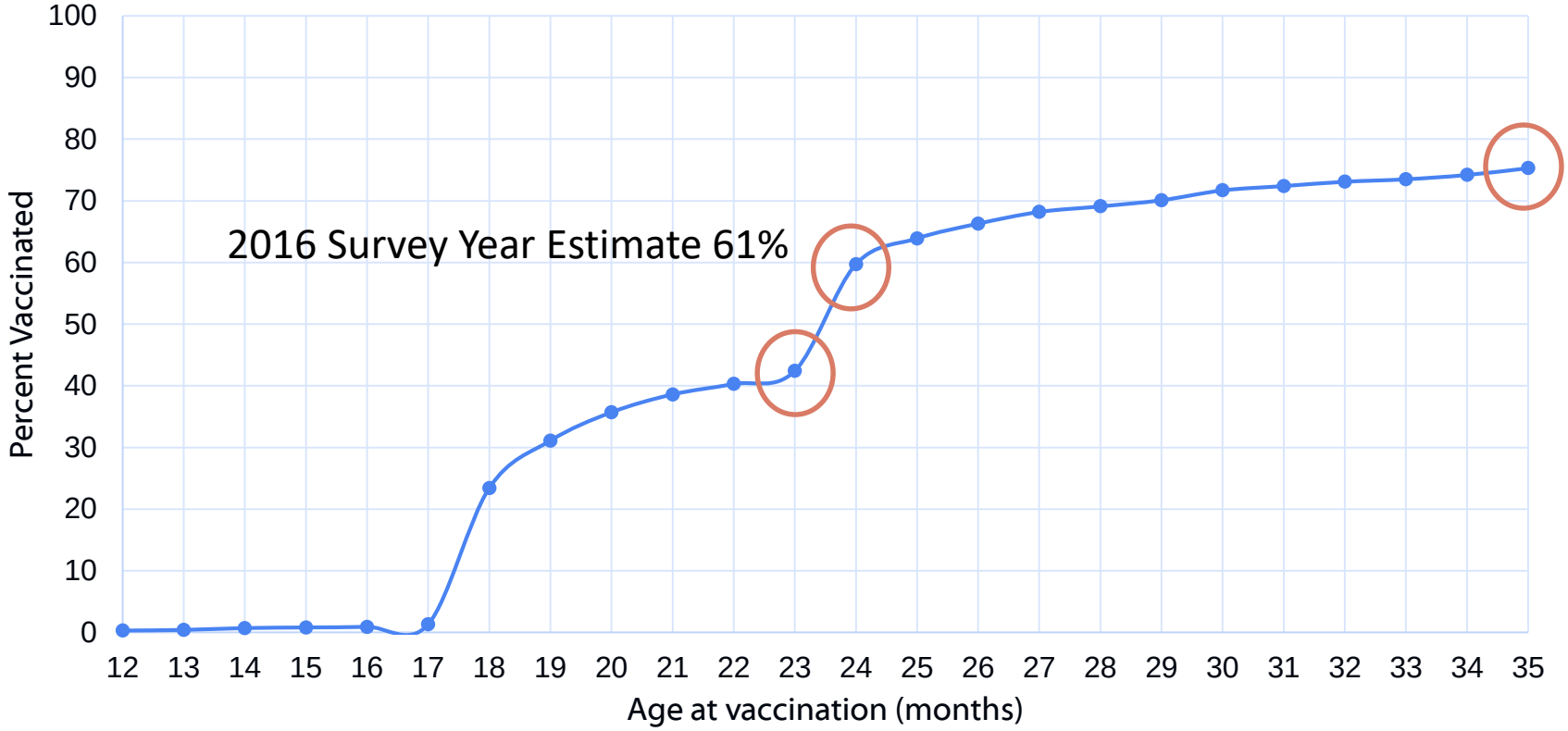
	Main Estimate		Reference Estimate	
Year Estimates Reported	**Birth Cohorts**	Data Years	**Birth Cohorts**	Data Years
2018	**2014-2015**	2015-2017	**2012-2013**	2013-2016
2019	**2015-2016**	2016-2018	**2013-2014**	2014-2017
2020	**2016-2017**	2017-2019	**2014-2015**	2015-2018

Proposed Annual Estimation by Birth Cohort Defining the Numerator

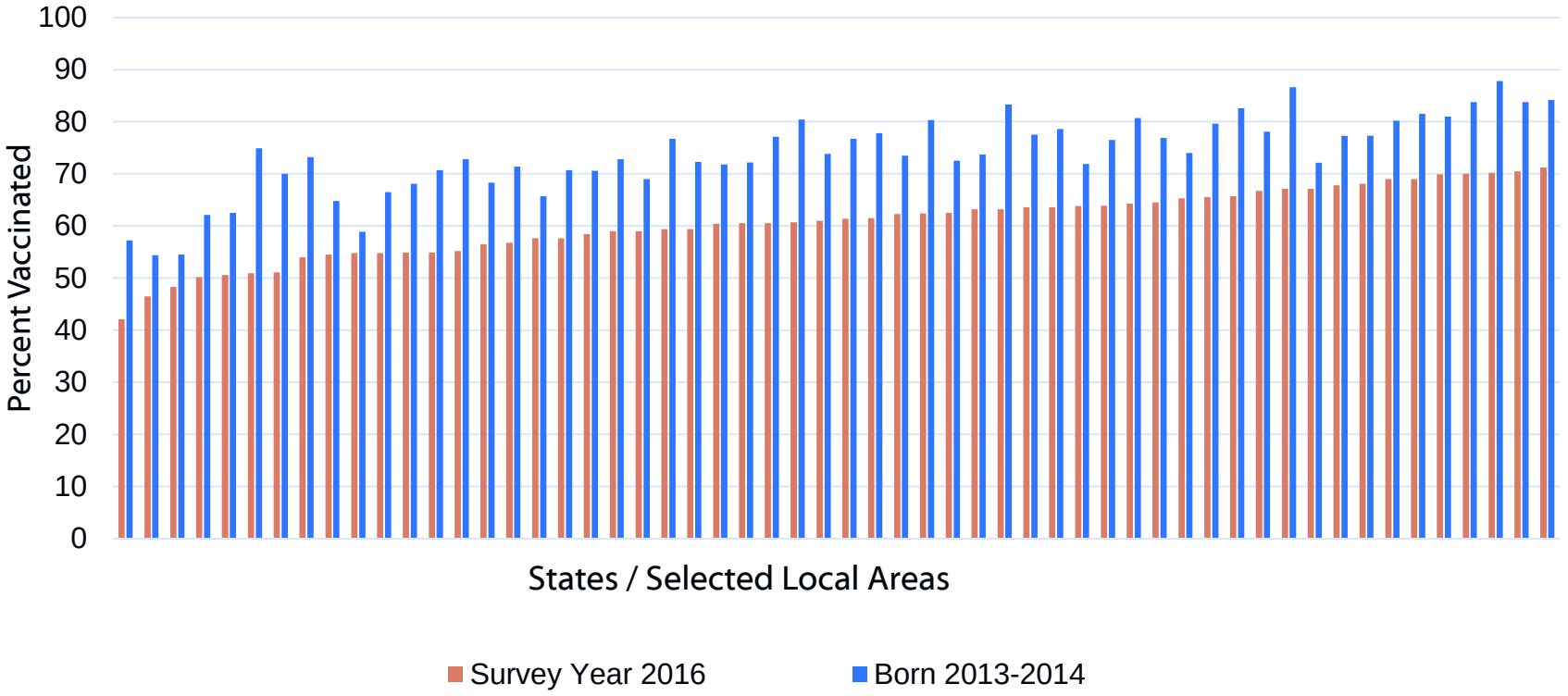
- Assess vaccination status by key milestone age to improve interpretation and make fair comparisons
- For main estimates assess vaccination status by age 24 months (before the 2nd birthday), with a few exceptions
  - Hepatitis B birth dose
  - Restrict rotavirus vaccination to doses received by age 8 months, 0 days
  - Expand 2nd dose hepatitis A vaccination coverage to age 35 months
- Use Kaplan-Meier method to account for censoring of vaccination status at ages 19-23 months for some children
  - Also provides vaccination uptake curve by age
  - Same method used for seasonal influenza vaccination coverage

Applying New Paradigm
Children Born 2010-2014
Using 2011-2016 NIS-Child Data

Estimated Coverage with ≥2 Doses of Hepatitis A Vaccine Among Children Born 2013-2014, NIS-Child 2014-2016, United States

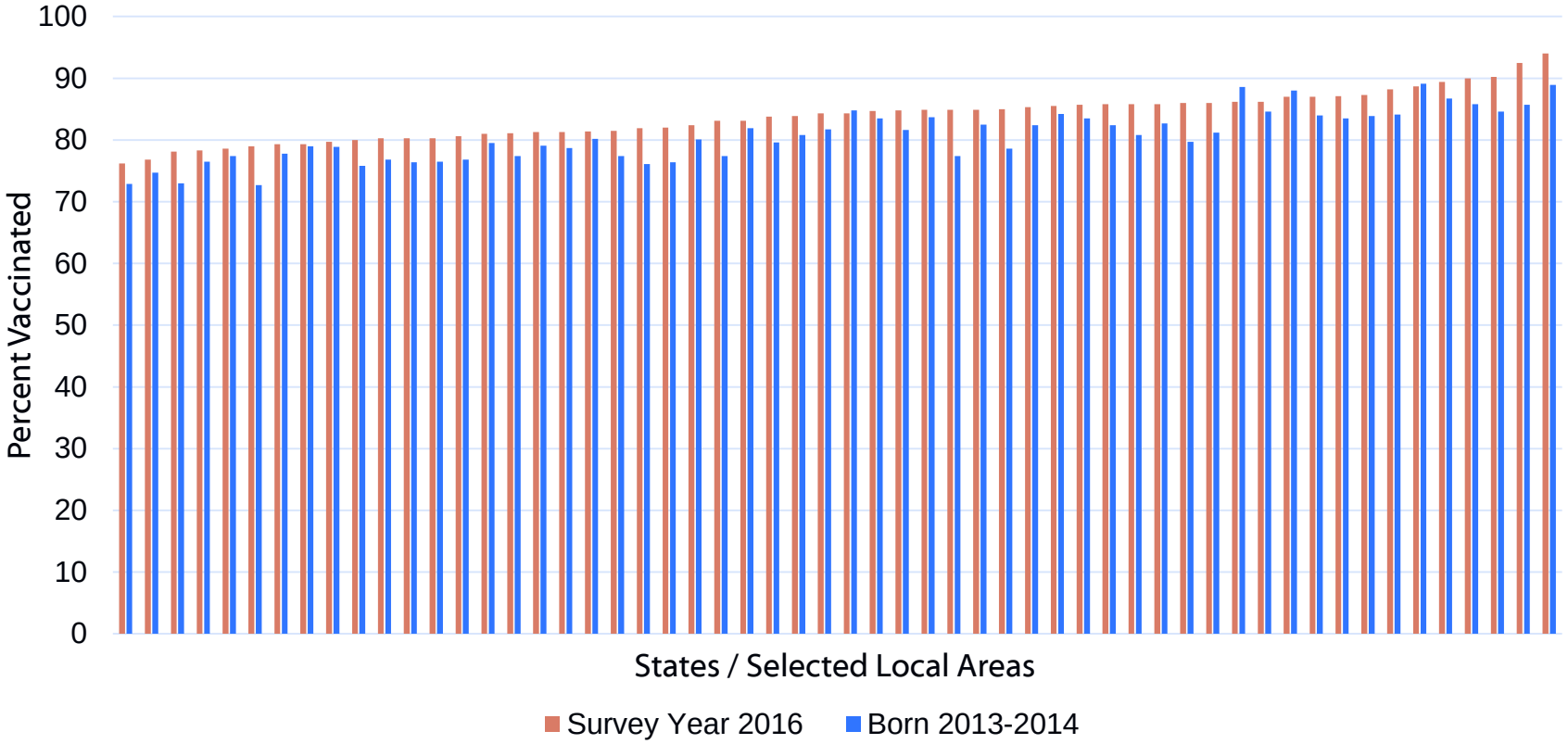


Estimated Coverage with ≥ 2 Doses of Hepatitis A Vaccine by 35 Months of Age Among Children born 2013-2014, NIS-Child 2014-2016

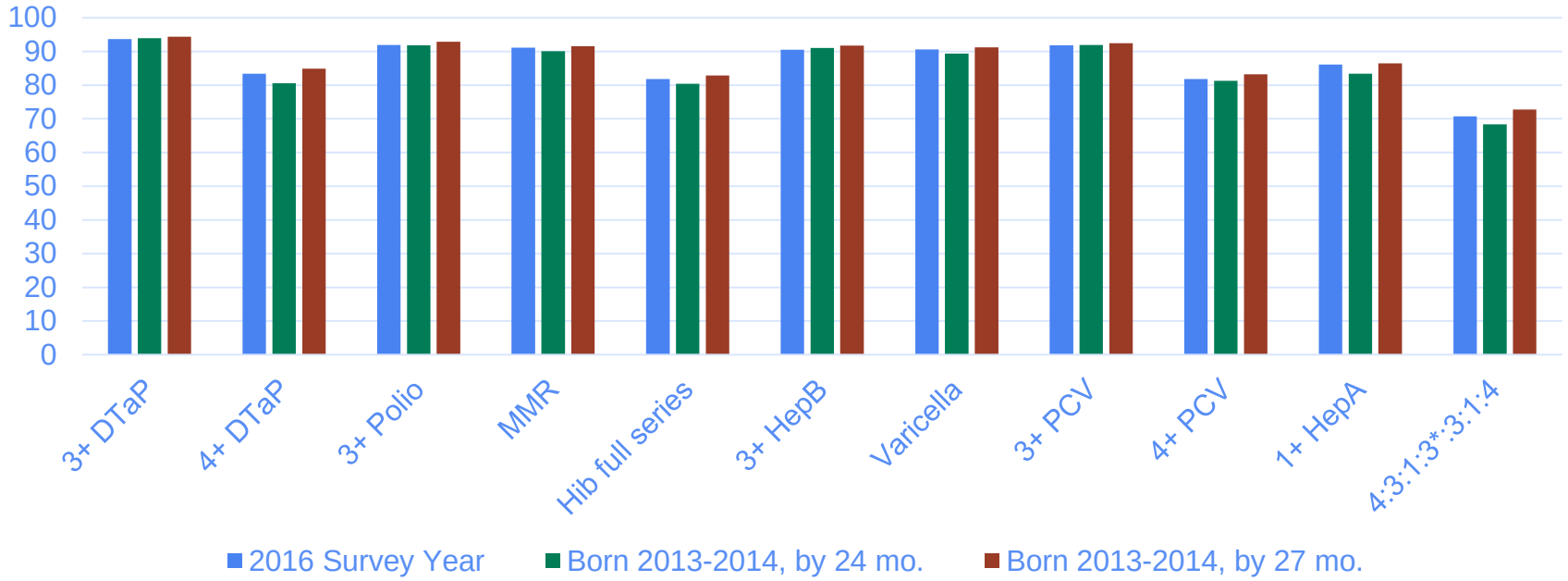


Estimated coverage with ≥ 1 MMR by 24 Months Among Children Born 2013-2014, NIS-Child 2014– 2016

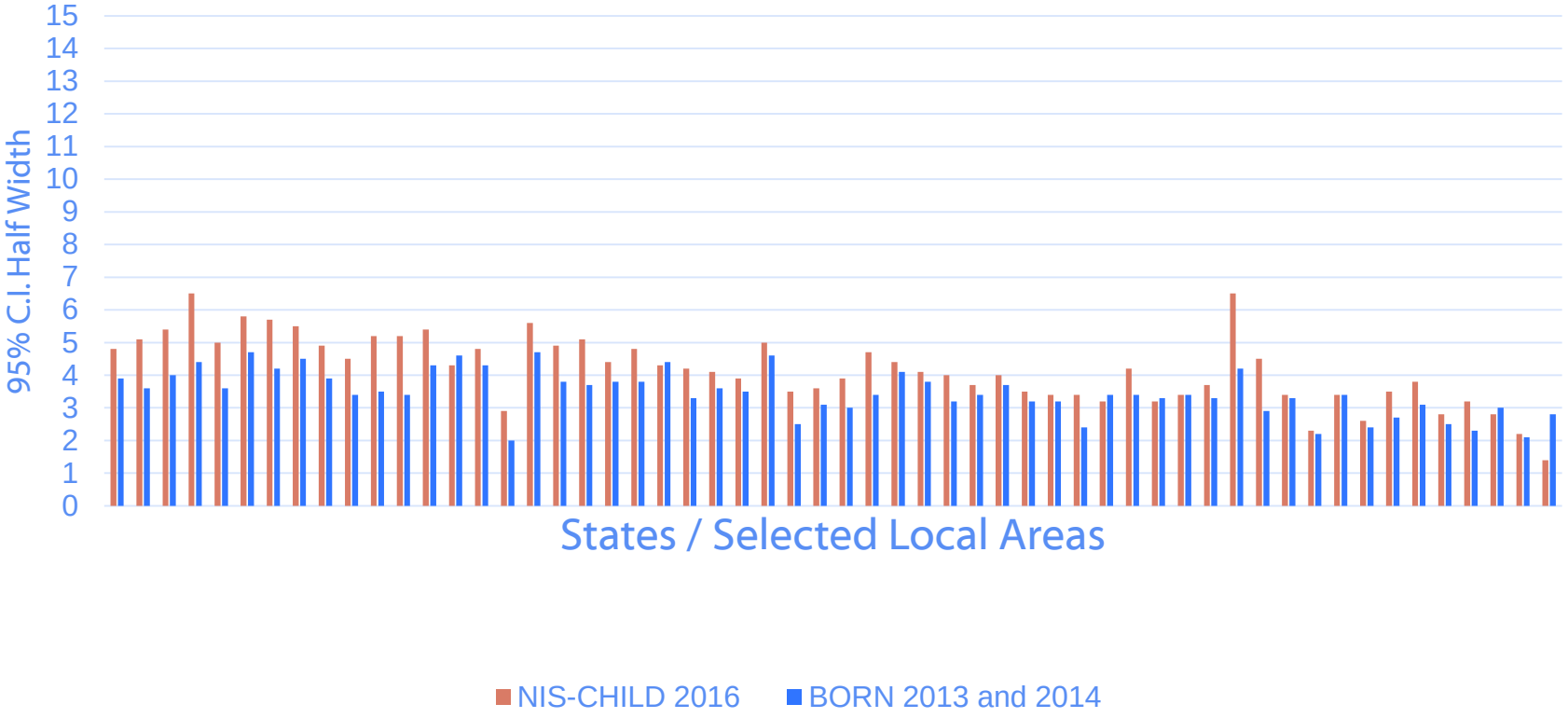
Estimated ≥ 4 DTaP Vaccination Coverage by 24 months Among Children Born 2013-2014, NIS-Child 2014–2016



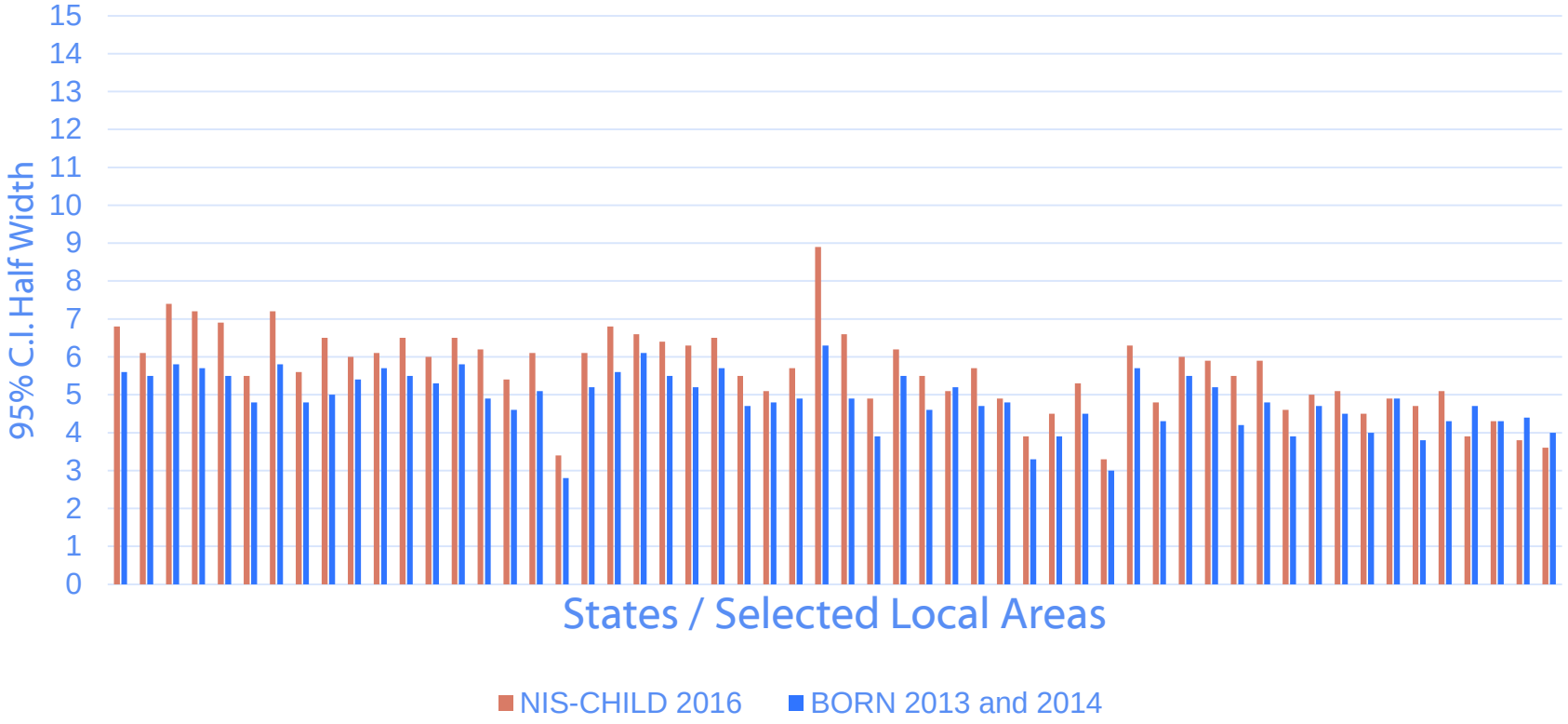
Vaccination Coverage by 2016 Survey Year, and by 24 and 27 Months Among Children Born 2013-2014, NIS-Child 2014-2016



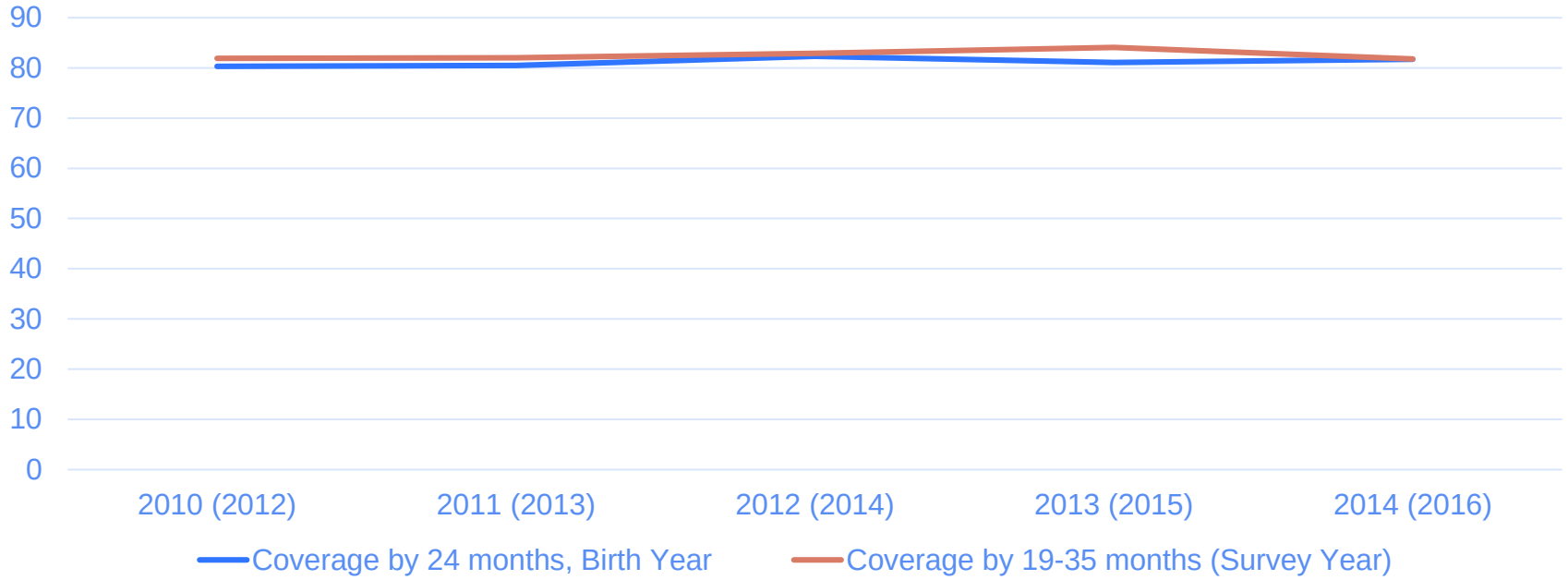
Estimated coverage with ≥ 1 MMR by 24 Months Among Children Born 2013-2014, National Immunization Survey – Child (NIS-Child), 2014– 2016



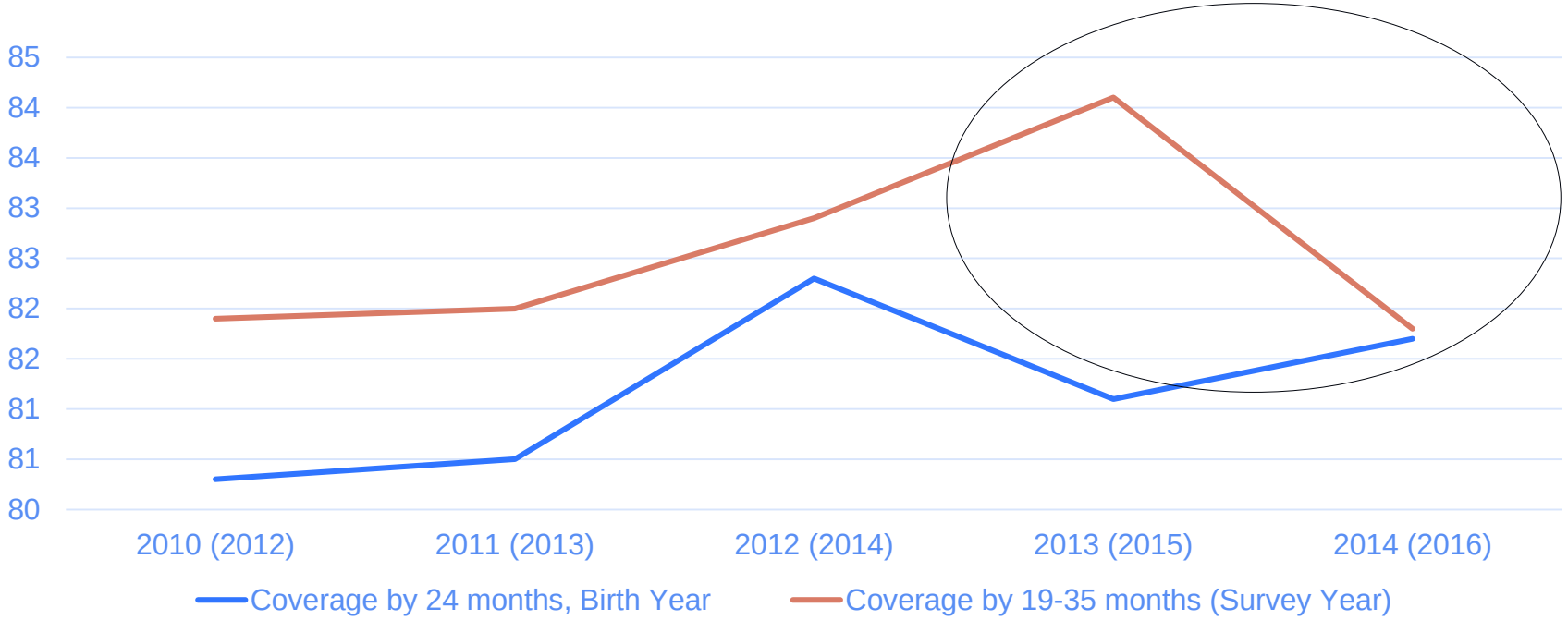
Estimated ≥ 4 DTaP Vaccination Coverage by 24 months Among Children Born 2013-2014, National Immunization Survey – Child (NIS-Child) 2014–2016



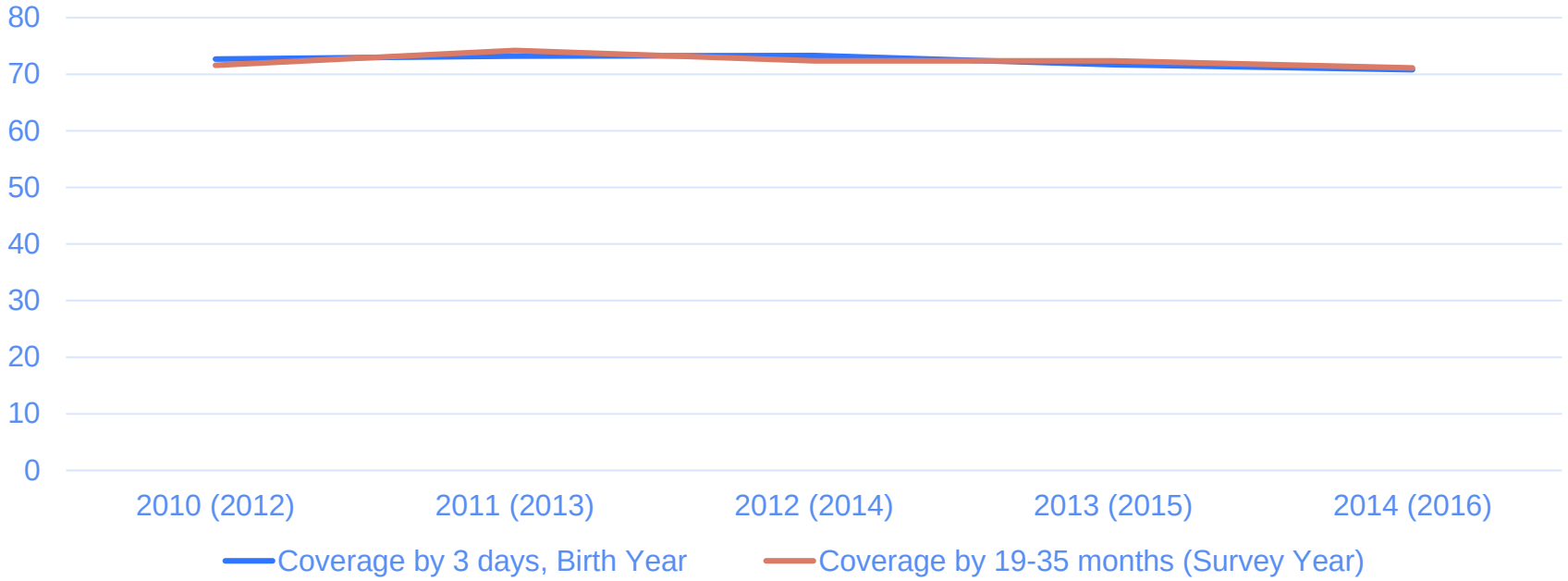
Estimated Coverage with 4+ PCV by Annual Birth Cohort and Survey Year, United States, NIS-Child



Estimated Coverage with 4+ PCV by Annual Birth Cohort and Survey Year, United States, NIS-Child



Estimated Coverage with Hepatitis B Birth Dose by Annual Birth Cohort and Survey Year, United States, NIS-Child



Limitations

- Estimates of vaccination coverage using NIS-Child data from 2011-2016 used existing survey weights
  - Weighted distributions of children by month of birth were fairly uniform as expected when based on three years of NIS data
  - For the 2014 birth cohort using the 2015 and 2016 data, the weighted number of children by month of birth decreased from 440k in January to 160k in December
- Estimates of vaccination coverage and confidence intervals may differ if survey weights specifically designed for birth cohort analysis were used

Discussion

Why Change Now

- Improve value of NIS-Child to immunization programs
- NIS-Child estimates by survey year have done their job over the past 23 years, but we are in a new era:
  - Increased use of IIS for vaccination coverage assessment
  - Relatively stable national vaccination coverage rates over time
  - Decreasing response rates and increased susceptibility to artificial changes in estimates by survey year
  - Better understanding of limitations of estimates by survey year
    - Complex rolling average of 2.5 annual birth cohorts with older children assessed at older ages than younger children

Risk of Relying on Estimates by Survey Year

- Difference in vaccination coverage from one survey year to the next is mainly measuring vaccinations received after age 19 months among children born during the same 17 months
- Could lead to false conclusions about trends in immunization program performance
  - Apparent decreases in coverage not supported by more direct assessment by birth cohort (e.g., 2016 NIS-Child)
  - Could also have apparent increases in coverage, or no change in vaccination coverage by survey year, that are not evident by birth cohort analysis

Advantages of Birth Cohort Approach

- More directly assess immunization program performance
- Estimates and trends easier to interpret
- Standard age at assessment (e.g., by 24 months)
  - Flexibility to look at different milestone ages with maximal use of data
    - e.g., ≥2 hepatitis A vaccinations by age 35 months
- Larger sample size and improved precision

Advantages of Birth Cohort Approach

- Coherence with other measures
  - HEDIS, FQHC reporting to HRSA, core CMS Medicaid child set, AFIX/IQIP
- Averages over any possible year-to-year changes in survey accuracy
- Ability to combine increasing number of annual birth cohorts for different purposes*
  - Overall national estimates (1), overall awardee estimates (2), awardee estimates stratified by sociodemographic variables or regions (3-5)

* https://www.census.gov/programs-surveys/acs/guidance/estimates.html

Advantages of Birth Cohort Approach

- Easier to replicate with IIS data for “apples to apples” comparisons
- Key features of NIS estimates by survey year can be approximated with IIS data using the average of point-in-time estimates taken each day of the year
  - Coverage among children 19-35 months on day x
- Estimates by birth cohort
  - Denominator = children born in year x
  - Numerator = children vaccinated by age 24 months

Disadvantages of Birth Cohort Approach

- Communicating and adjusting to a paradigm shift
- Transition reporting by survey year to birth cohort
  - MMWR, ChildVaxView, HP2030, federal health reports, PAHO/WHO, …
- Main estimates from one year overlap by one annual birth cohort with estimates from the next year
  - Additional trend assessment by annual birth cohort (e.g., over past five annual birth cohorts)
- Need new survey weights designed for birth cohort analysis
- Increased analytic complexity (Kaplan-Meier method)

Feedback from Immunization Programs

- Presented proposal at NIC May 2018
- Presented AIM webinar July 13, 2018
- AIM member feedback August 3, 2018
- Most AIM members support:
  - Switch to NIS-Child estimates by birth year
  - <24 months of age milestone for main coverage estimates
  - Report HEDIS influenza vaccination measure
    - 2 doses by 24 months, vaccinations reported by providers
- AIM member suggestions
  - CDC propose additional age milestones for coverage estimates
  - CDC provide further support and information during roll-out

Implementation Plan (1)

- MMWR October 12, 2018 similar to last year
  - Two main tables with estimates by survey year
  - Results section and graph with national trends by monthly birth cohort
  - Supplemental tables for updated bridging cohort analysis and trends
  - Awardee estimates for 2017 posted online in ChildVaxView
  - Foreshadow plans for next year
- Healthy People 2030 objectives report most recent complete annual birth cohort – baseline children born 2014 using 2015-2017 data
- Obtain new survey weights specifically designed for annual birth cohort estimation from NIS contractor (~October 2018)

Implementation Plan (2)

- Estimate vaccination coverage by annual birth cohorts from 1994-2015 nationally and by awardee
- Publish peer-reviewed paper on birth cohort approach before next fall
- Decide what to include in MMWR next year
- Further awardee and partner engagement
  - NVAC presentation September 13, 2018
  - Share birth cohort estimates based on NIS-Child data through 2017 with awardees before June 2019, with draft CDC talking points

Implementation Plan (3)

- Redesign interactive awardee estimates in ChildVaxView
  - Decide on supplemental age milestones by vaccine to report online
- Consider changes to NIS sample design to optimize estimation by annual birth cohort (e.g. for 2019 sample)
  - Include children born in 2016 but age >35 months throughout quarter
    - 22% increase in sample size with little additional cost
- When an IIS can provide the sole sample frame, could sample one annual birth cohort per year
  - e.g., in 2020 sample the 2018 birth cohort (all turn 2 years in 2020)

Acknowledgements

- Assessment Branch, ISD
  - Holly A. Hill
  - Benjamin Fredua (Leidos)
  - Laurie Elam-Evans
  - David Yankey
  - Zhen Zhao
- NORC at the University of Chicago
  - Ben Skalland
  - Kirk Wolter

Update on IIS-NIS Integration

Overall Goal

- Accelerate existing efforts to integrate IIS and NIS functions to produce accurate and comparable estimates of vaccination coverage at national and awardee levels, and monitor disparities by sociodemographic characteristics at the national level

  - Facilitate awardee use of IIS data for state and local level vaccination coverage assessment

What is the path to full IIS-NIS integration?

Phase 1

- IIS augments the NIS cell phone sampling frame; from augmented sample:
- 1) collect uniform set of sociodemographic information, and 2) identify child's vaccination providers
- NIS vaccination data from the NIS provider record check process (PRC)

Phase 2

- IIS as the only sample frame (drop the random digit dialing cell phone sampling frame):
- 1) collect uniform set of sociodemographic information, and 2) identify child's vaccination providers
- NIS vaccination data from the PRC

Phase 3

- IIS as the only sample frame:
- 1) collect uniform set of sociodemographic information, and 2) identify child's vaccination providers
- NIS vaccination data from the PRC and IIS

Phase 4

IIS as the only sample frame:
1) collect uniform set of sociodemographic information, and 2) drop collection of child's vaccination providers
NIS vaccination data only from the IIS (drop the PRC)

Current Status

- Fourteen state and local immunization programs participating in first wave using phone numbers in IIS to enhance the 2019 NIS random cell phone sample
  - Phone number locating offered
  - Matching of NIS sample to IIS offered
- Participation in IIS-NIS integration a proposed requirement in the fiscal year 2019 VFC/317 cooperative agreement
  - Initial focus on improving prevalence of telephone numbers in IIS and developing data sharing agreements

Planning for Possible Future Without NIS

- Increase the number of IIS that can provide valid vaccination coverage estimates to contribute to national estimates
- How assess validity of IIS data for vaccination coverage assessment?
  - CDC paying for matches of 2017 NIS-Child and NIS-Teen data to IIS, for areas with IIS estimates within 10 percentage points of NIS estimates
  - Best ways to assess IIS data quality for vaccination coverage assessment besides matching to NIS?
    - Retrospective kindergarten or current middle school assessments
    - Chart reviews based on sample from IIS conducted by awardee
      - With or without reach out to parents to identify all providers
- Further develop models for extrapolating IIS estimates from high-quality IIS to national level

State IIS data – aggregated at state or county level

EHR/Claims data sources

State x

State y

State z

CDC

1) Adjust for bias for reporting states
2) Account for missing data from non-reporting states

National Estimates

Adjusted State Estimates (for reporting states)

Thank You
Questions?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Additional Slides

Figure 13. Estimated vaccination coverage with ≥4 doses of pneumococcal conjugate vaccine by 19 months of age,* by month and year of birth† -- National Immunization Survey-Child, United States 2012-2016

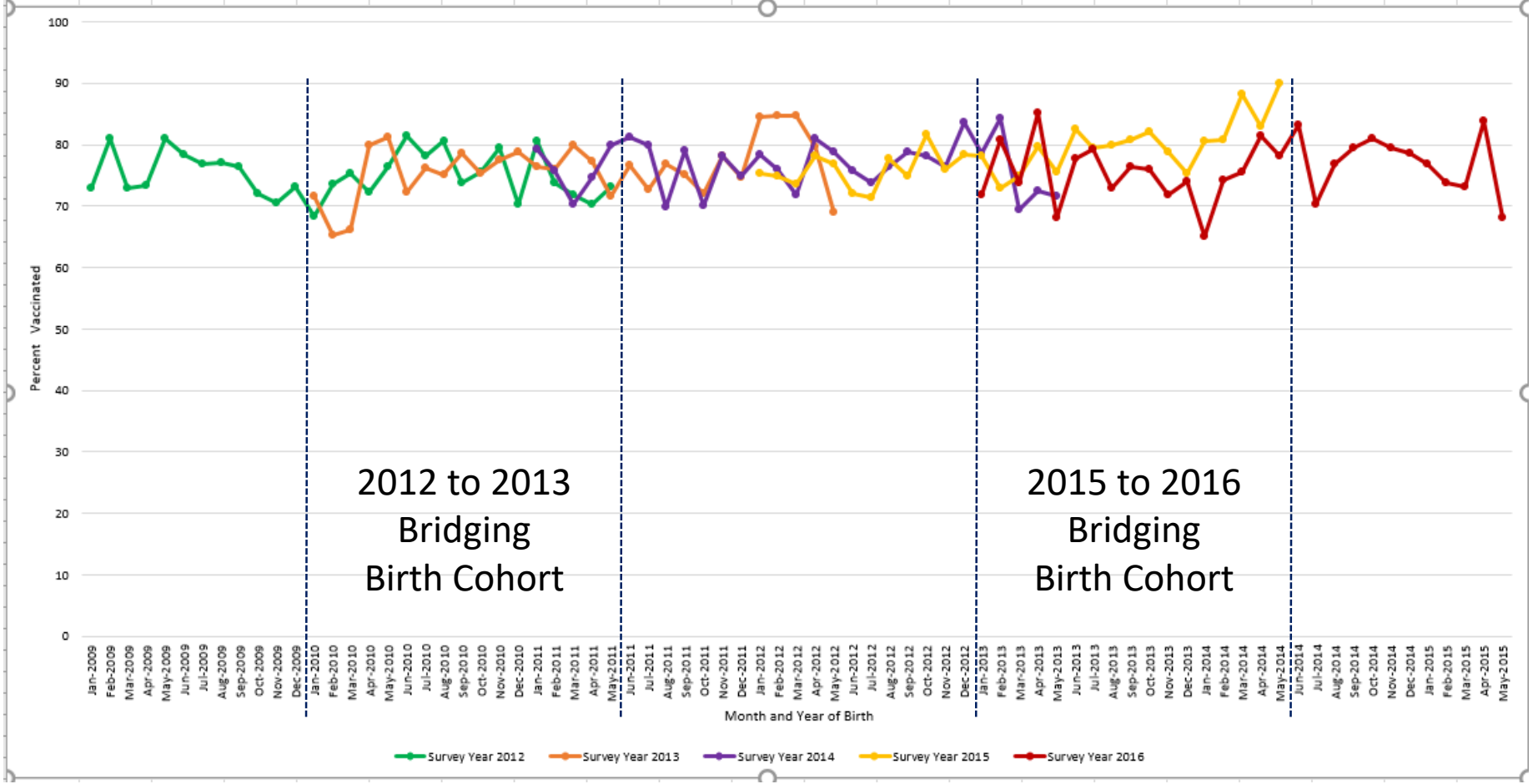
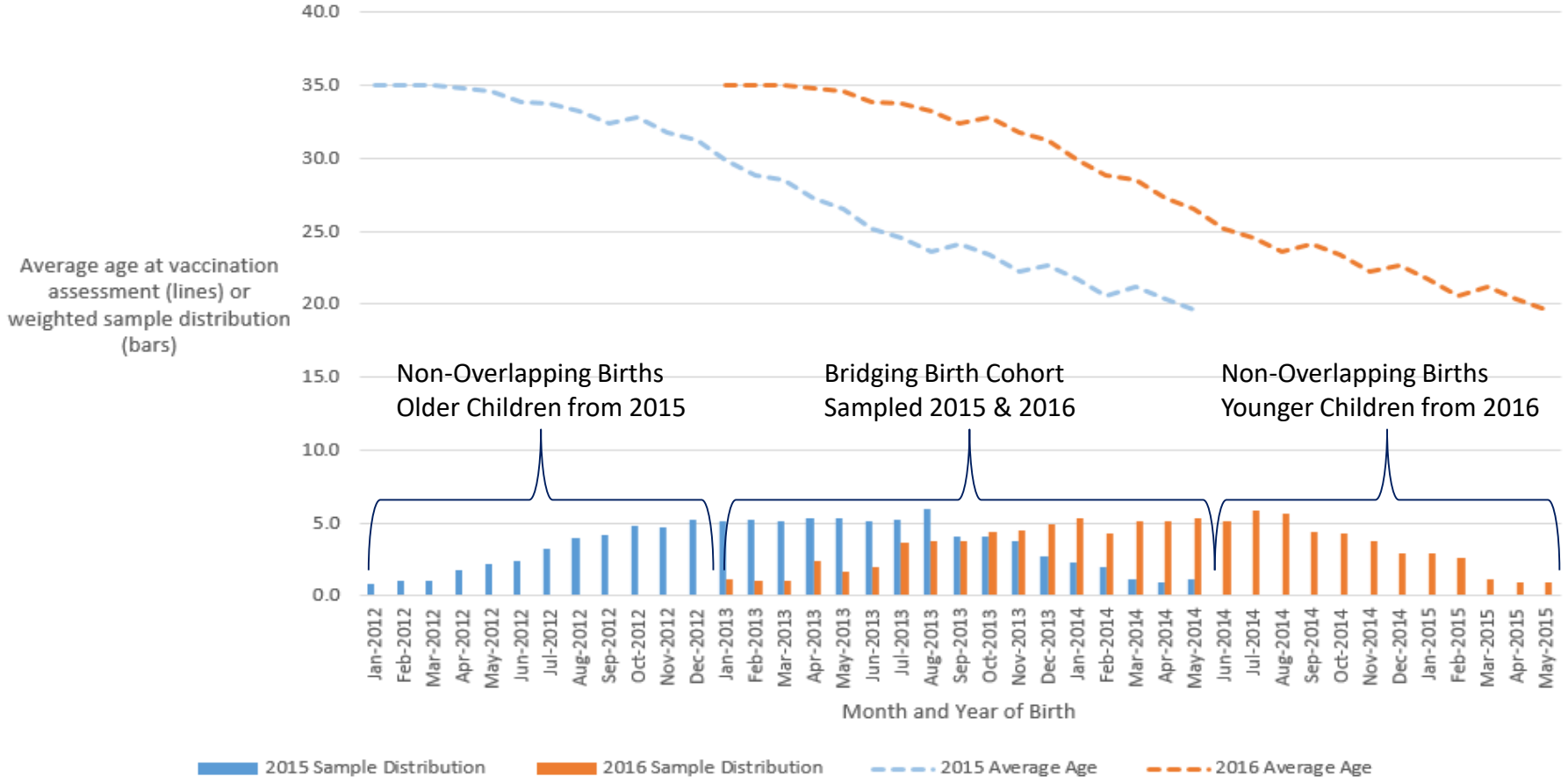
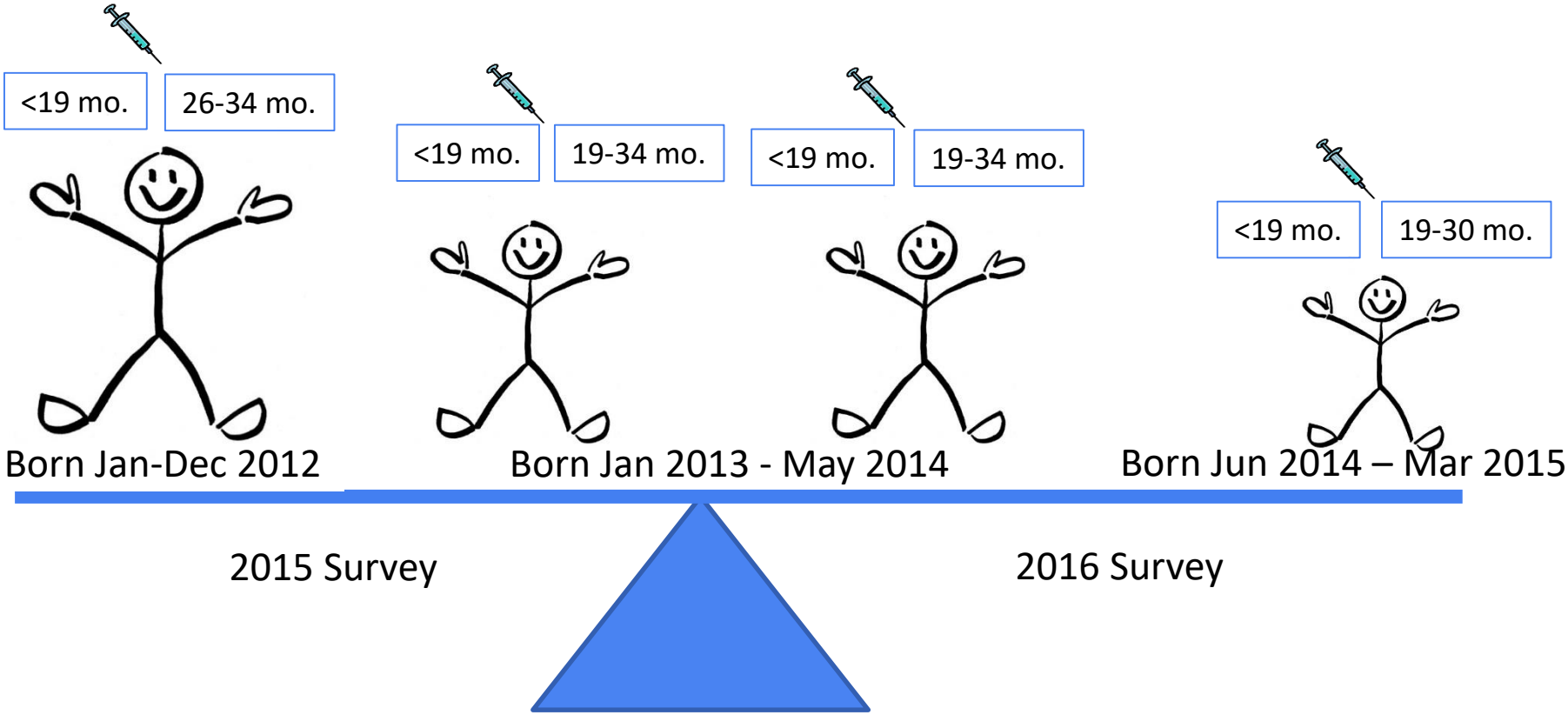


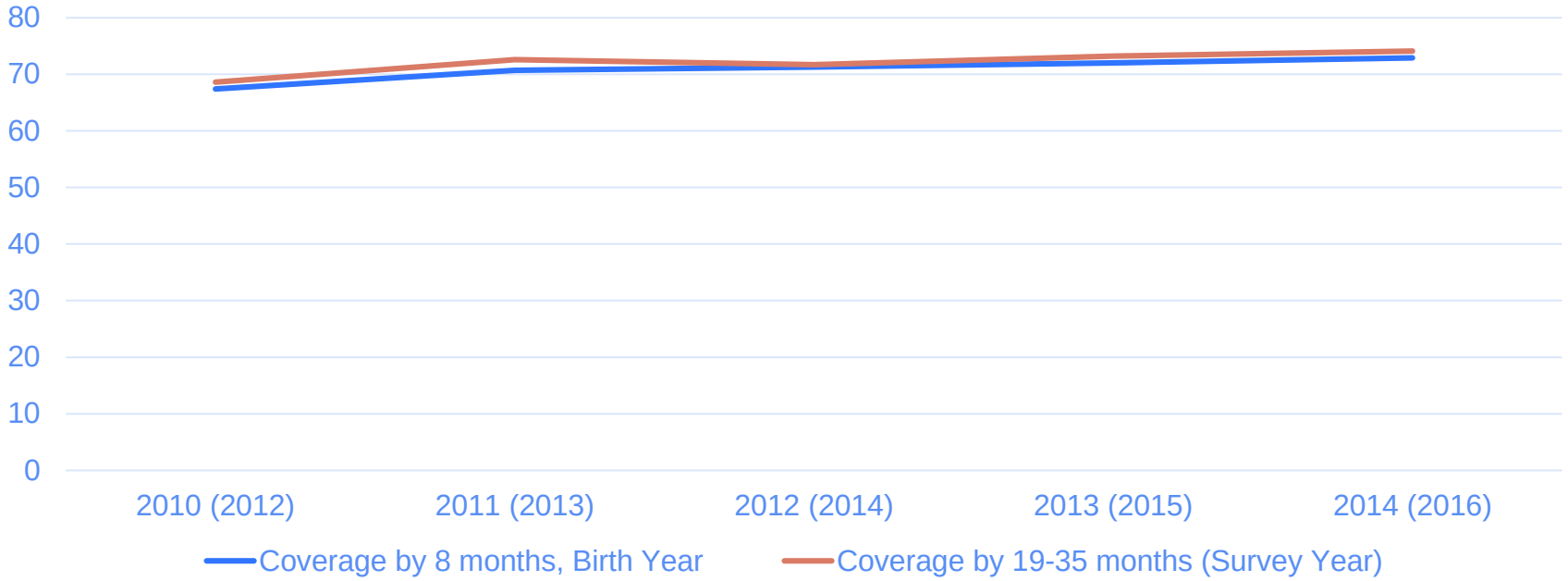
Figure 2. Distribution of weighted sample and average age at vaccination assessment by month and year of birth, National Immunization Survey (NIS)-Child, 2015 and 2016



The difference between a NIS-Child 2016 and 2015 vaccination coverage estimate can be split into four parts based on birth dates and age when vaccinated



Estimated Coverage with Rotavirus Vaccine by Annual Birth Cohort and Survey Year, United States, NIS-Child



Expected 95% Confidence Interval (CI) Half-Width

Expected 95% Confidence Interval Half-Width for Assessing Recent Change in Vaccination Coverage