



Estimating U.S. national vaccination coverage using IIS data

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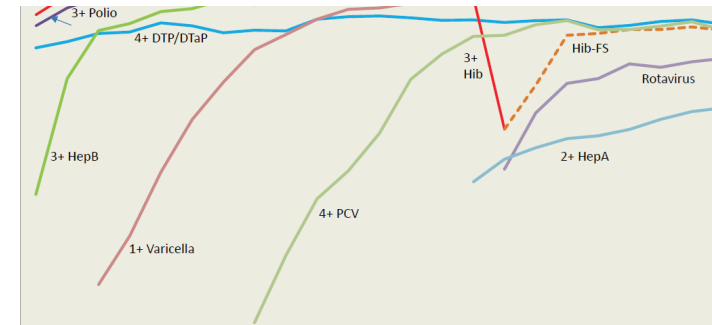
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August 13, 2019

Nationally Representative Surveys

- **Current methodology for U.S. vaccination coverage**
 - Examples: National Immunization Survey (NIS) family, Behavioral Risk Factor Surveillance System (BRFSS), National Health Interview Survey, etc.
 - Strengths
 - Consistent methodology across states
 - Nationally representative
 - Limitations
 - Response rates
 - Timeliness
 - Provider-verified or self-reported



IIS Data

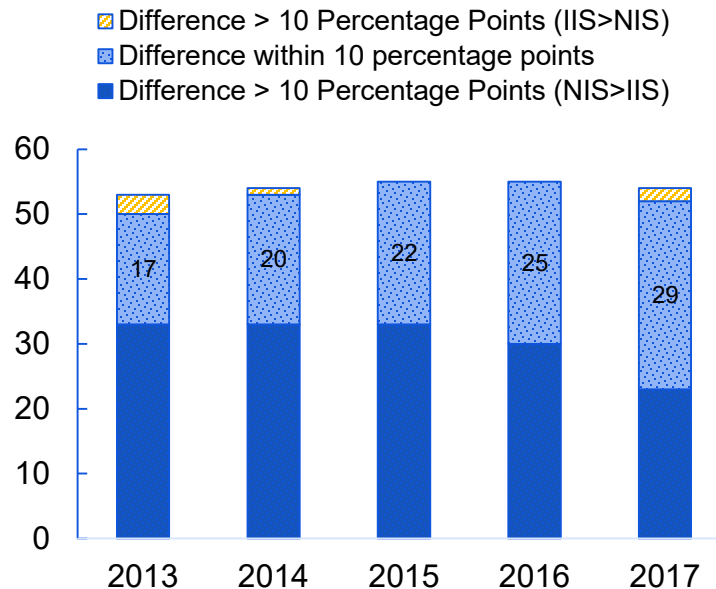
Strengths

- Provider-submitted
- Population-based
- Timely
- Containing data for all pediatric ages

Limitations

- Not all IISs are ready
 - Provider participation
 - Data quality
- May not be generalizable

Percentage point differences between NIS and IIS for combined 7-vaccine series completion — 2013–2017, IIS Annual Report



Factors Associated with Vaccination

- **Maternal characteristics**

- Age, race, ethnicity, education, marital status

- **Birth and household**

- Birth location, gestational age, birth order, family mobility, household size, non-English speaking household, foreign born

- **Other factors**

- Poverty/neighborhood income, insurance, urban/rural residence, provider type, school requirements



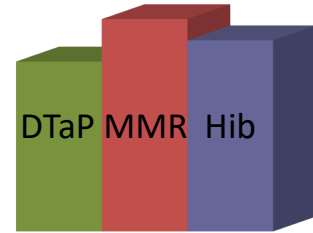
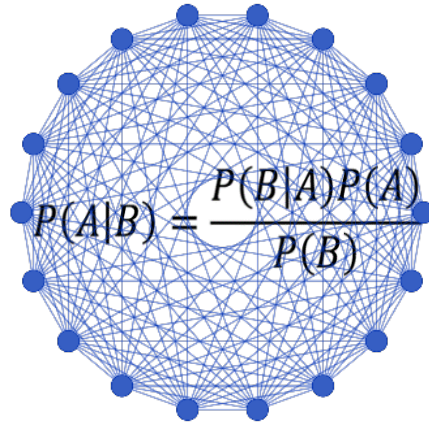
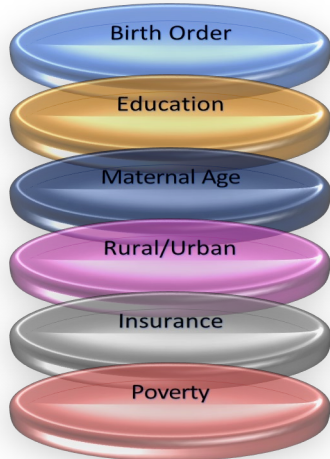
Methods

- **Weighting**
 - Extrapolate vaccination coverage by directly applying weights (e.g., proportions of mothers by race and education)

Methods

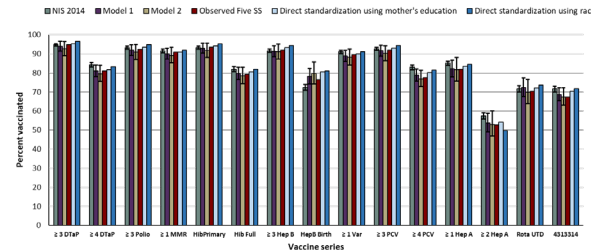
■ Statistical modeling

Vaccination Coverage			
County	DTaP	MMR	Hib
County 1
County 2
County x



What Have We Done?

- **Weighting and negative binominal regression**
 - Using IIS Sentinel Site data, NCHS, and AHRF data
- **Population:**
 - children aged 19–35 months in 2013–2015
 - Among children born in 2012 and 2013, before the 2nd birthday
- **Limited data**
- **Promising but non-consistent results**



How to Improve?

■ Data Source

- CoAg, CC4 (Coverage Assessment Project) awardee data (11 sites)
- CoAg, non-CC4 awardee data (voluntary, aggregate)
- Children:
 - Birth cohorts: 2014, 2015, 2016
 - Vaccination before 24 months of age
- Teen: NIS year 2016, 2017, 2018
- Flu: 2016-17, 2017-18, 2018-19

■ Covariates: both county and state levels

■ Modeling: hierarchical model (Bayesian)



National Estimates Project Plan



- Identify data source
- Construct datasets for modeling
- Table shell design
- Voluntary data request
 - Non-CC4 awardees
- Preliminary coding/testing
- DUA

- Weighting (direct standardization)
- Hierarchical model (Bayesian)
 - Normal model for rates
 - Normal transformation of the rates
 - Poisson Model
- Model fitting
- Covariate dimensionality reduction
- Model validation

Acknowledgements

- **Project Team**

- Karen Kirtland
- Trivellore “Raghu” Raghunathan
- Elizabeth Zell

- **Sentinel Sites**

- Rachel Potter, Cristi Bramer, Sydney Kuramoto, Miriam Muscoplat, Vikki Papadouka, Alexandra Ternier, Mary Woinarowicz, Andrew Osborn, Steve Robison, Aaron Dunn, Danielle Sill, Stephanie Schauer

Workshop Discussions

1. County-level vaccination coverage (7 minutes)

- Does your jurisdiction routinely analyze county-level vaccination coverage?
- Can you describe the technical challenges your jurisdiction faces regarding calculating numerators and denominators at the county level? What suggestions do you have in order to get accurate numerators and denominators at the county level?

2. Data saturation/completeness assessment (7 minutes)

- What has your jurisdiction done/what do you suggest to assess if the IIS captures the pediatric population (age 0-18 years)?
- What has your jurisdiction done/what do you suggest to assess if the IIS captures every shot administered to the pediatric population (age 0-18 years)?

3. Adjustment of data saturation/completeness (7 minutes)

Participation-based IIS denominator

- Children aged 0–8 years: count all persons in this age group with at least two doses of vaccination in IIS
- Children aged 9–12 years: count all persons with at least one dose of vaccination in IIS since age 4
- Adolescents (13–18 years): count all persons in this age group with at least one dose of vaccination in the IIS since age 9

Questions?

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Supplemental Slides

Methods

- **Weighting**

- Request aggregate data from more sites
- Race and mother's education

- **Hierarchical model (Bayesian)**

- Normal model for rates
- Normal transformation of the rates
- Poisson Model

Covariates

■ County level

- Immunization data
 - CoAg component project CC4 awardees
 - Voluntary data request to all awardees
- Maternal and birth data: NCHS
- SES data: AHRF, SVI (Census)

■ State level

- VFC eligibility, universal purchase, state mandates, exemptions

Input IIS Data (1)

■ Person-level data

- IIS denominators (for adjusting data completeness)
 - Total count of all persons in IIS (Child)
 - Total count of all persons having 1+ record in IIS since age 9 (adolescent)
 - OGIVE-based (adolescent)
- Cohorts
 - Child birth cohort: 2012-2016
 - Adolescent: NIS years 2013-2018
 - Flu: NIS years 2014-2018

Input IIS Data (2)

- **Vaccination metrics**

- All metrics published on MMWR from NIS-Child, NIS-Teen, and NIS-flu

Model considerations

- **Model fitting**
- **Covariate dimensionality reduction**
 - Principal component analysis
 - “Ridge” regression
- **Model validation**
 - Cross validation