Is it Feasible to Use Immunization Information Systems (IIS) as a Supplemental Sampling Frame for the National Immunization Survey (NIS)?

Laurie Elam-Evans, Centers for Disease Control and Prevention

Kathleen Santos, NORC at the University of Chicago

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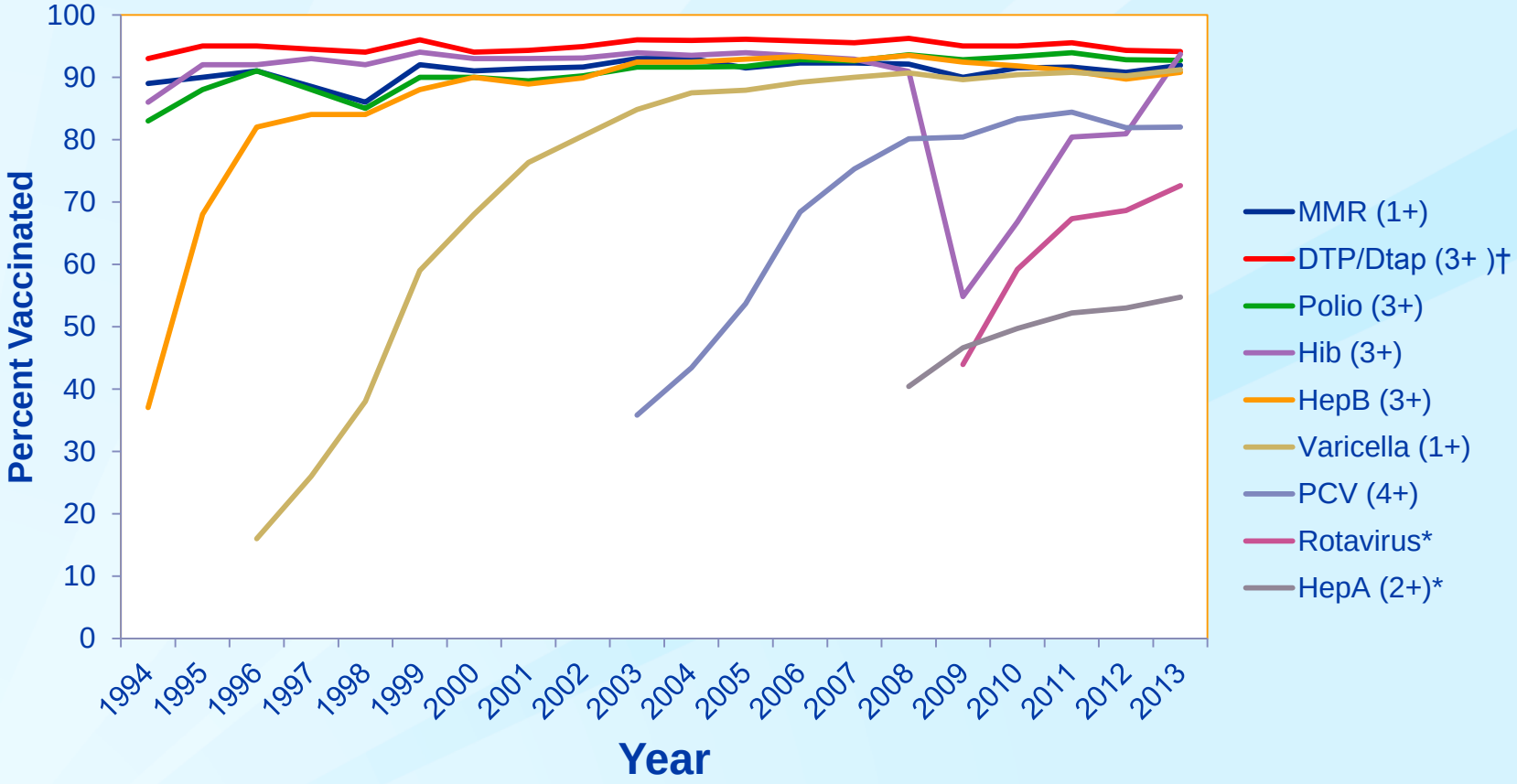
Outline

- **Background**
  - CDC Immunization Program
  - National Immunization Surveys
  - Immunization Information Systems
- **Challenges and Needs**
- **Sample Frame Project**
  - Methods
  - Results
  - Conclusions
- **Next Steps**

National Center for Immunization and Respiratory Diseases (NCIRD)

- **Mission**
  - The prevention of disease, disability, and death through immunization and by control of respiratory and related diseases.
    - Cost savings combined for children born 1994-2013 over their lifetimes
      - Vaccination of each U.S. birth cohort with the current childhood immunization schedule
        - Prevents approximately
          - 732,000 deaths
          - 322 million cases of disease
          - 21 million hospitalizations
        - Net savings of nearly
          - $295 billion in direct costs
          - $1.38 trillion in total societal costs.

Vaccine-specific coverage* among children 19-35 months, National Immunization Survey (NIS), United States, 1994-2013



* The *Healthy People* 2020 target for coverage is 90% for all vaccines with the exception of rotavirus (80%) and HepA (85%).
† DTP (3+) is not a Healthy People 2020 objective. DTaP (4+) is used to assess Healthy People 2020 objectives.
§ Reflects 3+ doses through 2008, and Full Series (3 or 4 doses depending on type of vaccine received) 2009 and later.

National Immunization Survey (NIS)

- **A probability-based random-digit-dial (RDD) dual-frame landline telephone and cell telephone survey with a follow-up survey mailed to vaccination provider (PRC)**

- **Family of surveys**
  - NIS-Child - children 19-35 months (1994)
  - NIS-Teen – adolescents 13-17 years (2006)

- **Strength**
  - National, state, and selected local area estimates of vaccination coverage using a standard methodology

Immunization Information System (IIS)

- **State or local confidential, computerized, population-based, data systems that collect and consolidate vaccination doses administered by participating vaccination providers**
  - Functional IIS in 49 states, five large cities, the District of Columbia, and 8 territories
- **Started in the 1970s**
  - Common functional standards and core data elements were established in 2001 (and are evolving)
- **Strengths**
  - Clinical care - Provide a consolidated vaccination record and can forecast when recommended vaccinations are due
  - Population level - Provide aggregate information on vaccination coverage within a state or local area
  - Contains functionalities that assist the immunization program and its stakeholders
  - Many IIS have high levels of completeness for children and kindergarteners

Challenges

- **Pockets of under-vaccination**
  - Impoverished communities (socioeconomic barriers)
  - Vaccination acceptance concerns cluster (religious, cultural)
  - Low vaccination coverage increases the risk of disease transmission and outbreaks
- **Changing survey environment**
  - Decrease in landline telephones/increase use of cell telephones
  - Decrease in response rates
  - Increase in costs
- **Varied IIS environment**
  - May be variation in legislation, methods of populating the dataset, or administration of system
- **Perception**
  - Two systems funded to measure vaccination coverage
    - Varying objectives, perspectives, and stakeholder interests
- **Data sharing and confidentiality**
  - NIS: 308(d) – Assurance of Confidentiality
  - IIS: legislation, regulations, charters

Needs

- **Assess national and state level coverage (CDC)**
  - Valid and comparable estimates over time and across states
- **Enhance synergy**
  - Leverage the National Immunization Surveys and IIS
    - Minimize survey costs
    - Reduce survey respondent burden
    - Improve IIS completeness
    - Improve survey data validity
    - Manage funds entrusted to NCIRD to assess and evaluate the Immunization Program at the National, State, and selected local level
- **Manage national, state, and local data security issues**

NIS-IIS

- **Common element**
  - Provider reported vaccination
    - NIS – Immunization History Questionnaire (IHQ)
    - IIS
      - Mandatory reporting via state legislation, and
      - Voluntary reporting (in some cases required to administer government funded vaccines)
- **Data sets**
  - NIS and NIS-Teen
  - IIS from four U.S. states

NIS-IIS SAMPLE FRAME PROJECT

NIS-IIS Sample Frame Study: Objective and Research Question

- **Primary purpose:**
  - Evaluate the feasibility of and methods for including an IIS sample as part of a NIS multi-frame (RDD and IIS) sample.

- **Research question:**
  - What is the most appropriate methodology for using the available IIS list to supplement the NIS sample frame without incurring large bias and sample variance?

2013-2014 NIS-IIS Sample Frame

- **Objectives**
  - Assess potential to use IIS as an NIS sample frame
  - Determine the costs of using an IIS sample frame on both the IIS and NIS
  - Identify factors that could indicate when an IIS could be used to provide support as a possible sample frame for the NIS (“IIS readiness”)

NIS-IIS Sample Frame Study: Methods

- Four IISs with varying maturity were examined
- People Finder was used to update the street address and telephone number in the IIS to facilitate locating the households (HH) of sampled children.
- Independent samples of age-eligible children were drawn from the IISs.
- NIS-like data collection (HH phone interview and a survey mailed to vaccination provider) was conducted.
- Examined vaccination coverage rates and demographic characteristics :
  - Weighted pooled data
  - Traditional NIS

2013-2014 NIS-IIS Sample Frame Preliminary Results

- **Four IIS sample frames fielded**
  - There is variation in IIS in terms of the quality of the frame

2013-2014 NIS-IIS Sample Frame Disposition*

IIS	No contact information	Disconnected/ Modem/ Non-Residential	Potential Reachable Households	Sample Size
A	22%	19%	58%	16,069
B	58%	8%	34%	19,032
C	9%	15%	77%	11,922
D	10%	18%	72%	12,920

* Percentages are out of total sample selected from IIS.

NIS-IIS Sample Frame Study: Progress and Key Eligibility Rates

- NIS-like household telephone data collection is complete for all four state IIS samples.
- Provider data collection complete for two state IIS

NIS-IIS Household Eligibility Rates, Q1/2013-Q2/2013 Cohort

Frame	Age Eligibility Rate*
NIS**	
Landline	**1.9%**
Cell	**3.7%**
IIS A	53.7%
IIS B	73.4%
IIS C	75.6%
IIS D	72.5%

Age eligibility rate = No. HH with an age eligible child/ No. households screened for presence of age-eligibility slide

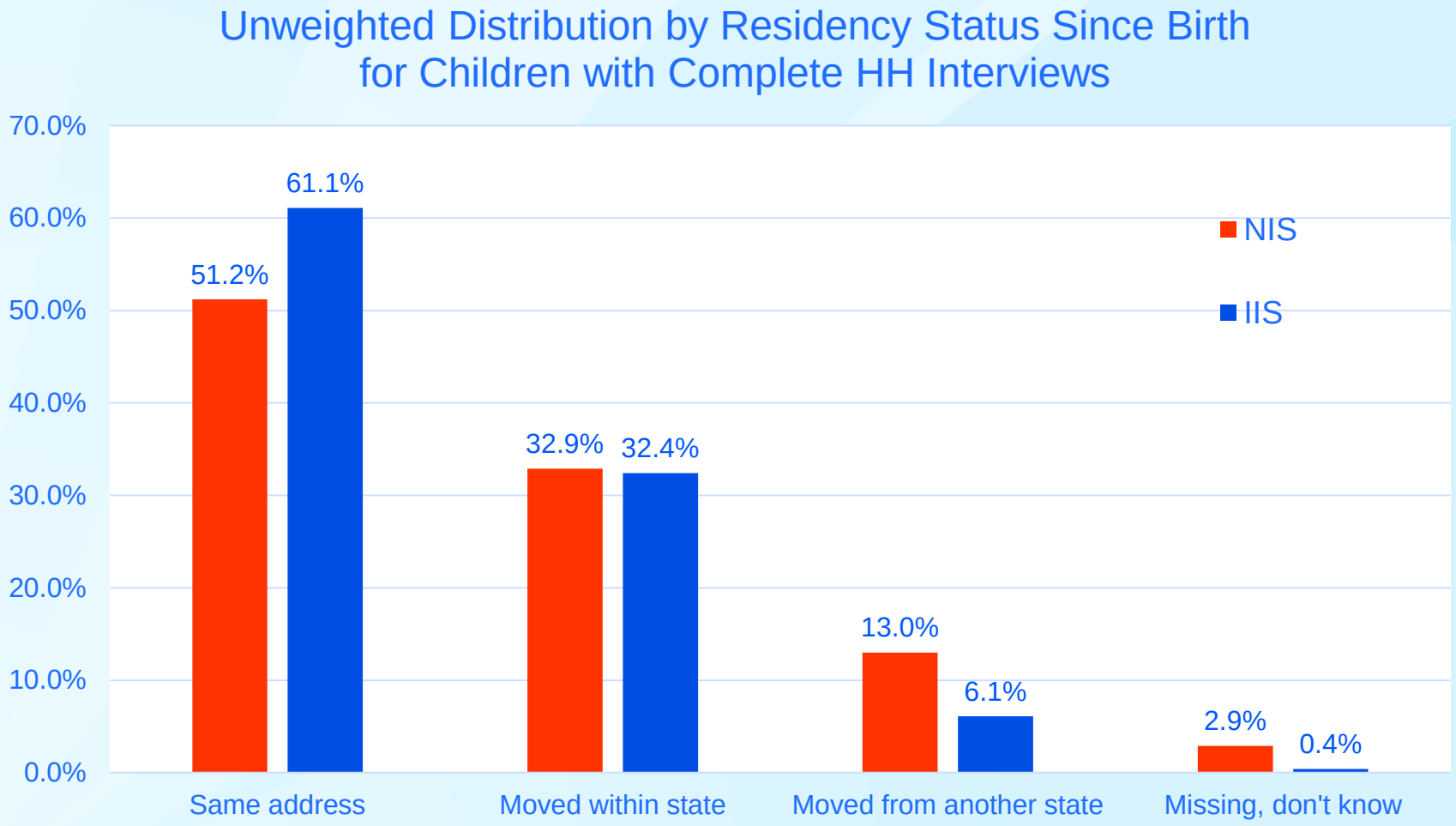
NIS Sample vs. IIS Sample (IIS A): Baseweighted Socio-Demographic Characteristics

Characteristic	IIS (n=1206)	NIS (n=207)	Pop	Pop - IIS	Pop - NIS
Mother's Education					
High school or less	36.6	36.6	55.3	**18.8**	**18.7**
Higher than high school	63.4	63.4	44.7	**-18.8**	**-18.7**
Mother's Age					
≤ 29 years	34.7	41.5	50.2	**15.5**	**8.7**
≥ 30 years	65.3	58.5	49.8	**-15.5**	**-8.7**
Mother's Race/Ethnicity					
Hispanic	35.8	31.2	38.1	2.3	**6.9**
Non-Hispanic black only	5.2	5.2	9.6	4.4	4.4
Non-Hispanic others	59.0	63.7	52.3	**-6.7**	**-11.4**

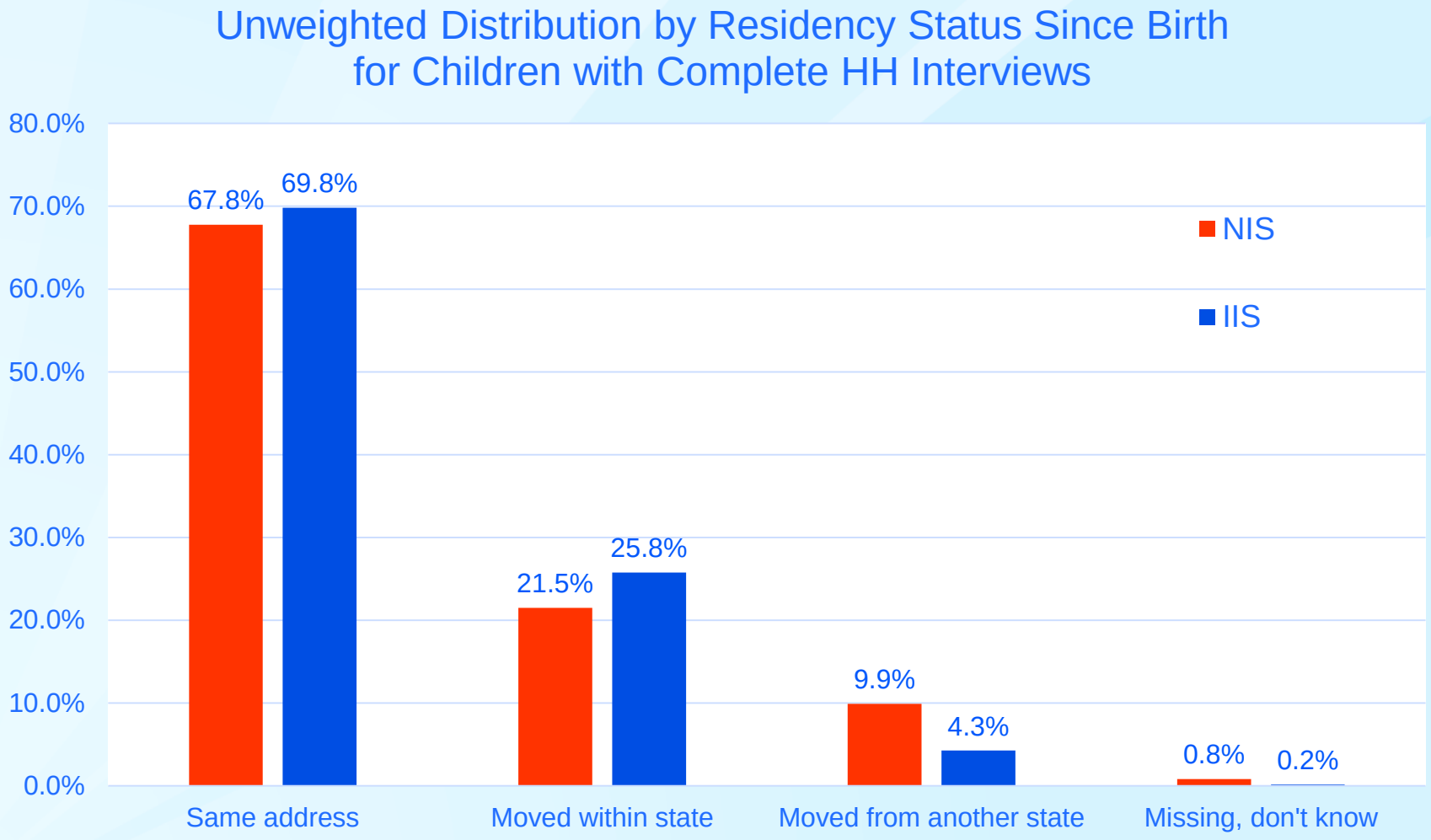
(Cont.) NIS Sample vs. IIS Sample (IIS A): Baseweighted Socio-Demographic Characteristics

Characteristic	IIS (n=1206)	NIS (n=207)	Pop	Pop - IIS	Pop - NIS
Household Income to Poverty Ratio					
Ratio < 1.33	36.4	32.5	33.1	-3.3	0.6
1.33 ≤ Ratio < 4	42.2	39.8	49.2	**7.0**	**9.4**
Ratio ≥ 4	21.4	27.7	17.7	-3.7	**-10.0**
Telephone Use Status					
Cell-phone only	50.6	53.3	46.0	-4.6	**-7.3**
Dual users	46.0	43.9	44.8	-1.2	0.9
Landline only	3.4	2.8	7.0	3.6	4.2

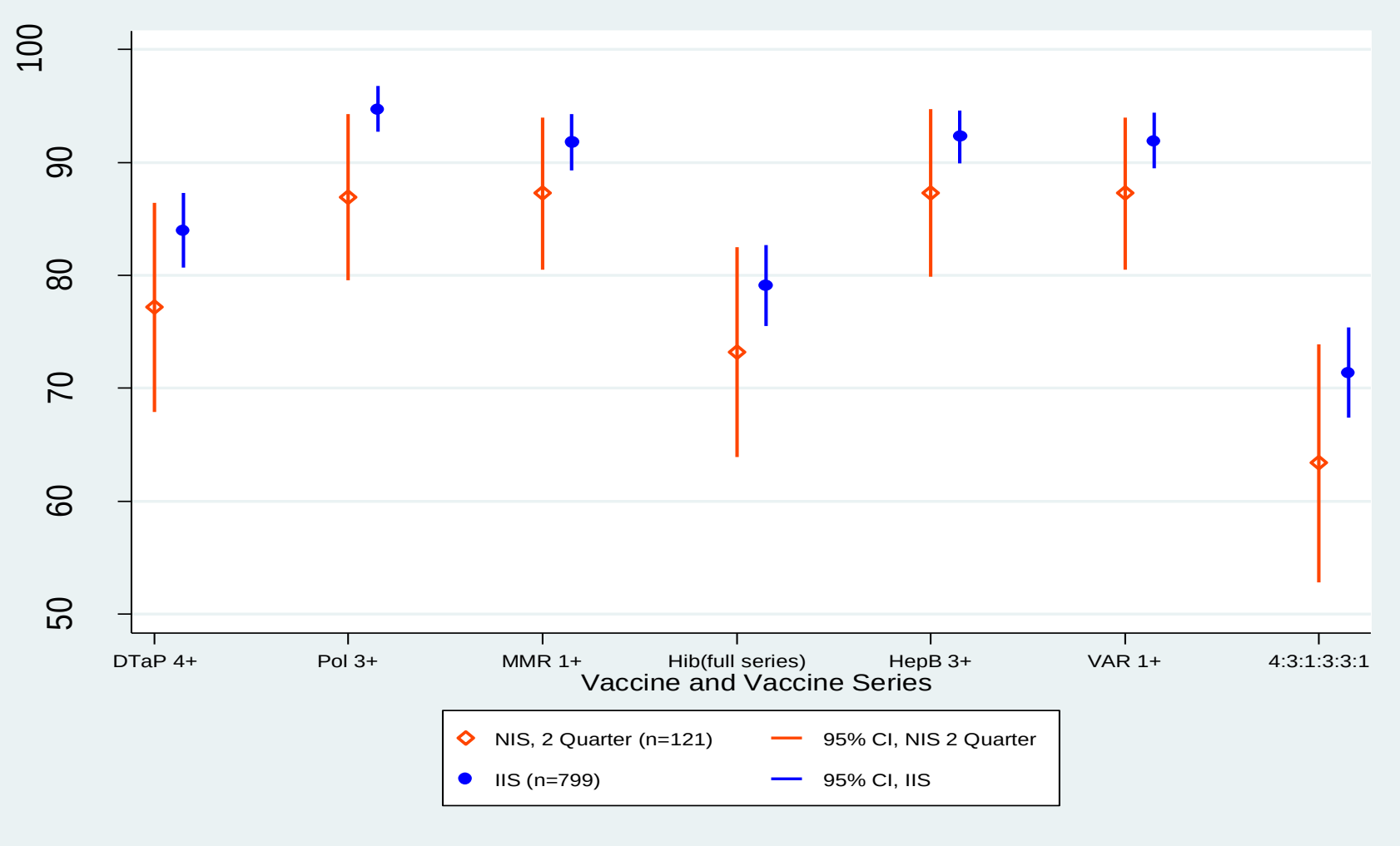
NIS Sample vs. IIS Sample (IIS A): Differences in Distribution of Residency Status



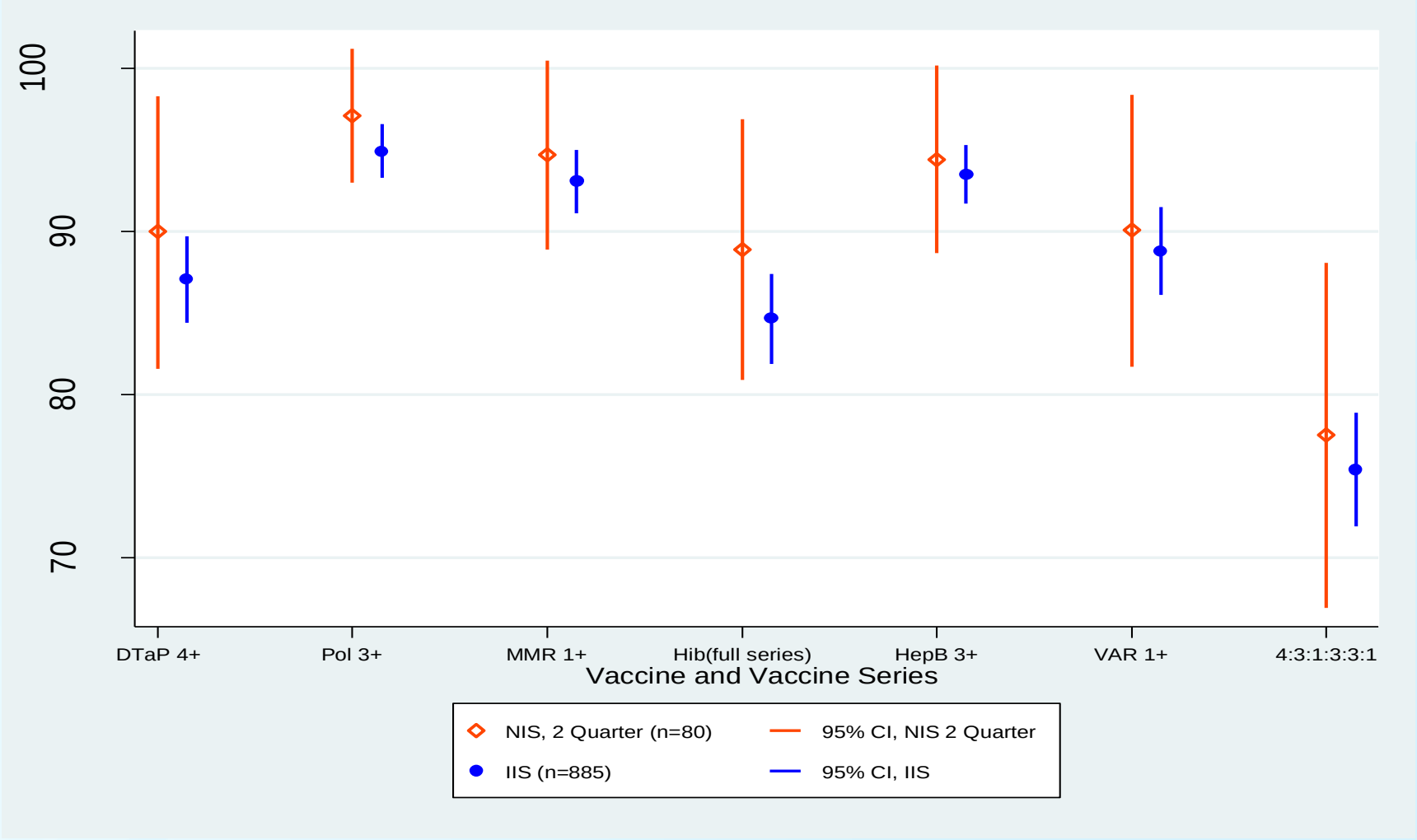
NIS Sample vs. IIS Sample (IIS B): Differences in Distribution of Residency Status



NIS Sample vs. IIS Sample (IIS A): Weighted Vaccination Coverage Rates



NIS Sample vs. IIS Sample (IIS B): Weighted Vaccination Coverage Rates



Methods: Weighting Adjustments for NIS and IIS Sample Integration

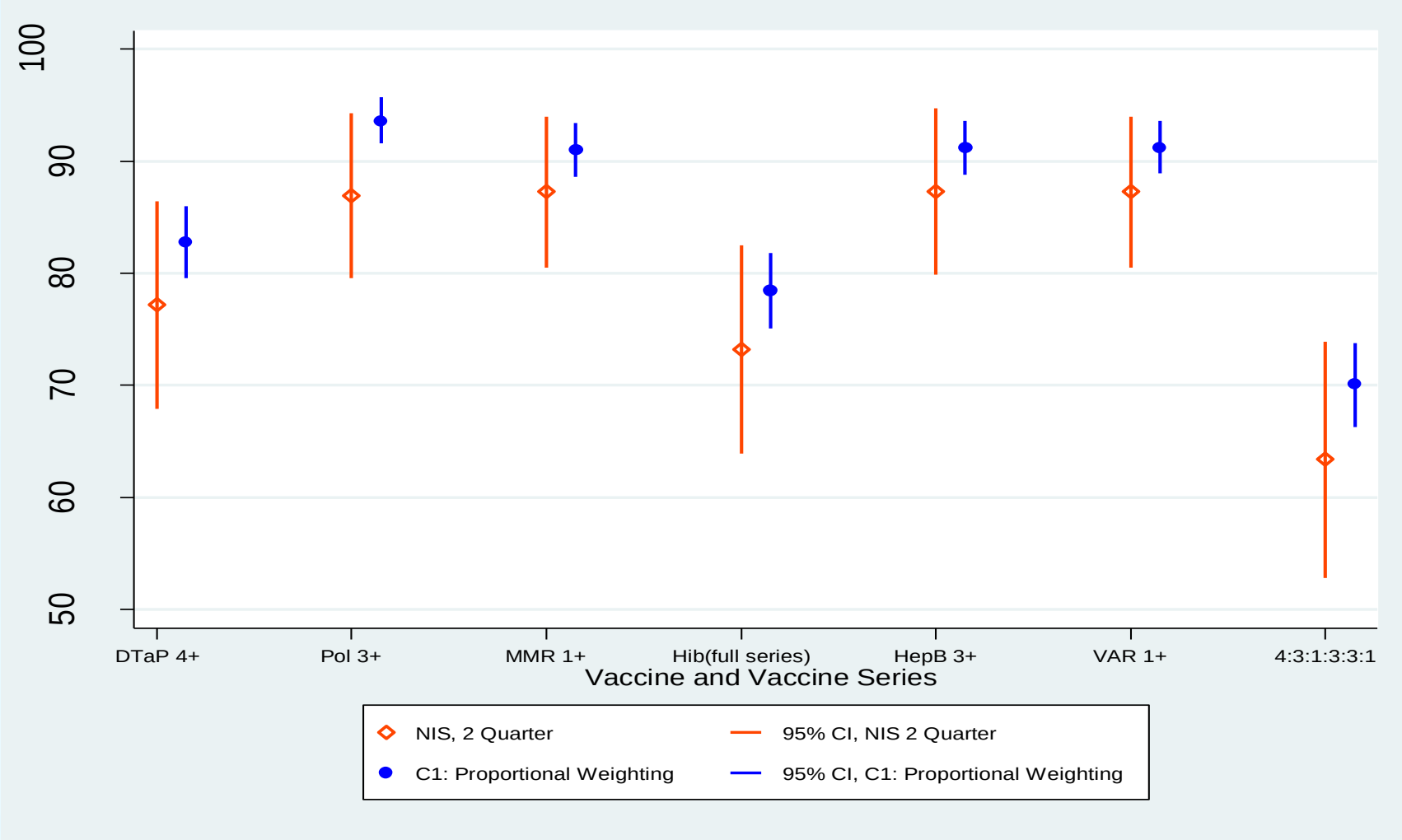
Combined data and adjusted for composite factors:

C1 : Proportional Weighting:

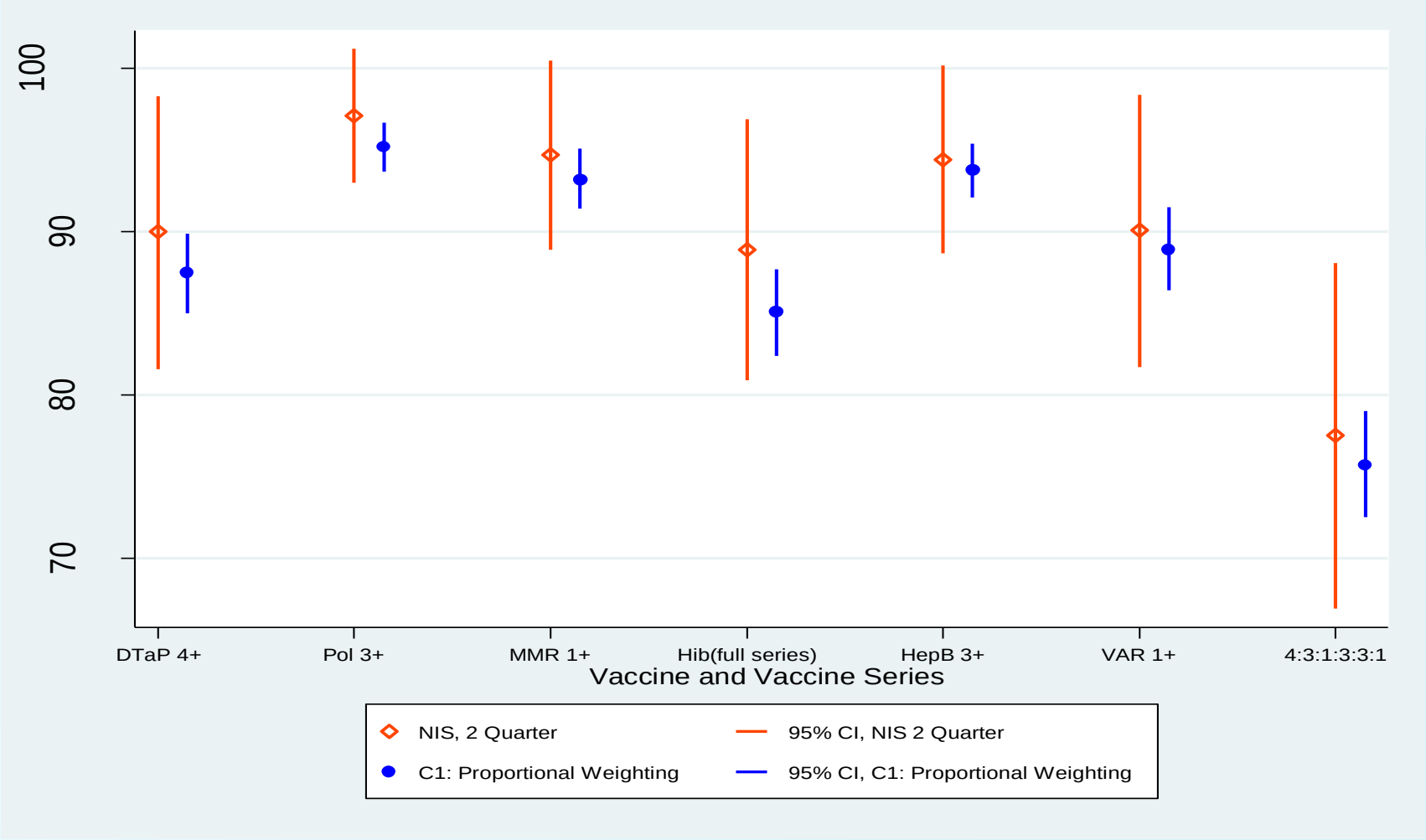
$$W' = W \times \frac{n}{N}, \quad \text{Ex: } \frac{n}{N} = \frac{800}{200+800} = .80$$

where n is the size of the IIS sample in pooled data, and N is the size of the pooled total

NIS Sample vs. Combined Sample (NIS-IIS A): Weighted Vaccination Coverage Rates



NIS Sample vs. Combined Sample (NIS-IIS B): Weighted Vaccination Coverage Rates



Results: Vaccination Coverage Estimates, Combined (NIS-IIS) vs. the NIS

- **7 vaccines or vaccine series**
- **15 socio-demographic subgroups**
  - **Gender:** Male, Female
  - **Child's race/ethnicity:** Hispanic, Non-Hispanic White, Non-Hispanic Others
  - **Mother's education:** High school or less, More than high school
  - **HH income to poverty ratio:** <1.33, 1.33~4, 4+
  - **MSA status:** MSA Central City, MSA Non-Central City, Non MSA
  - **Telephone use status:** Cell phone only, not cell phone only

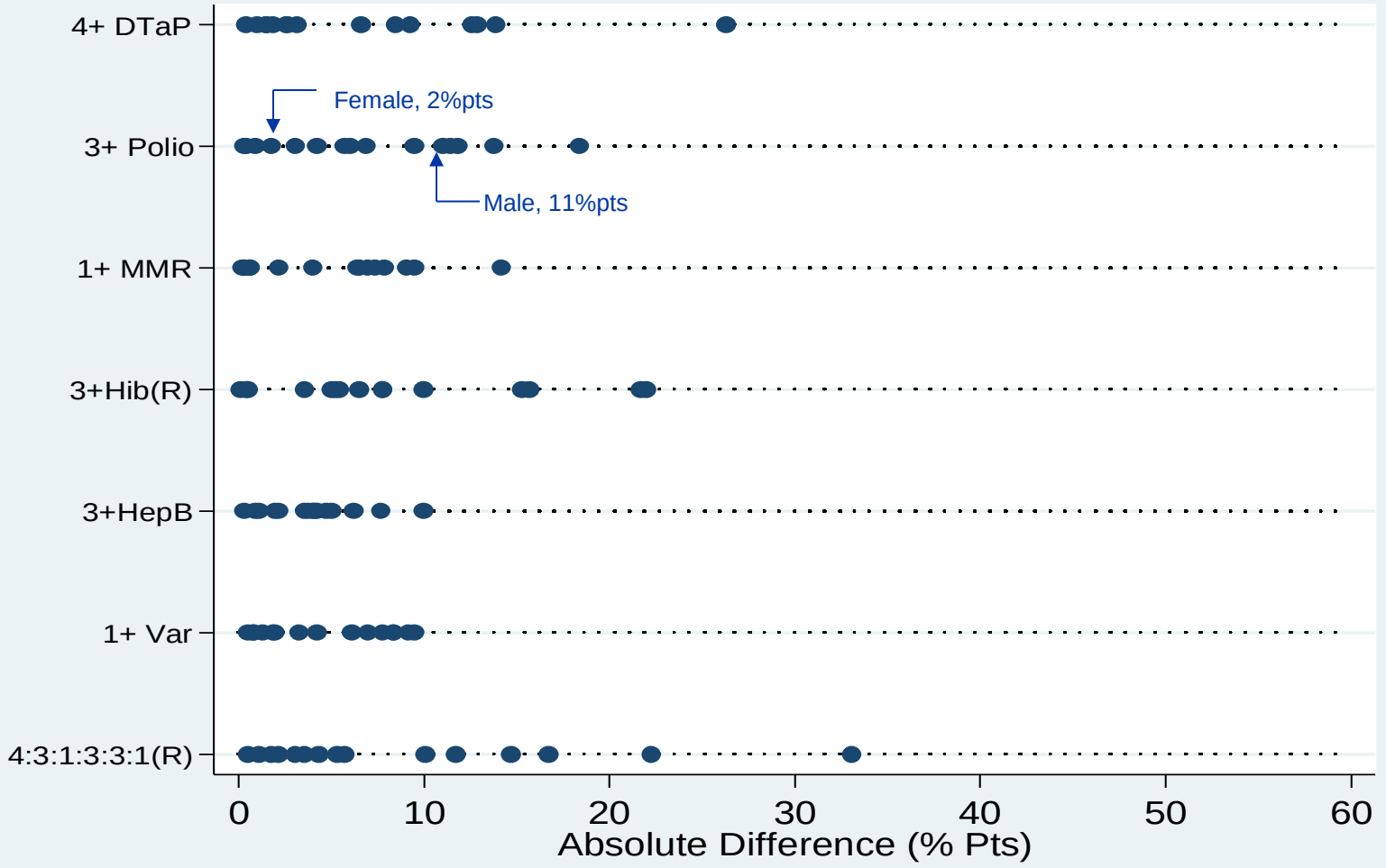
Results: Vaccination Coverage Estimates, Combined (NIS-IIS) vs. the NIS

- Estimated vaccination coverage rates for 7 vaccines or vaccine series across 15 socio-demographic subgroups using the Proportional Weighting (C1) approach and compared to the NIS estimates.
  - Absolute value of the difference in vaccination coverage (percentage points)
    - C1 Difference = |C1 Estimate – NIS Estimate|
- Example: 3+ Polio by Gender

Characteristic	NIS Estimate*	C1 Estimate	C1 Difference
Male	81%	92%	**11%**
Female	93%	95%	**2%**

* Q1 and Q2, 2013

Absolute Difference in Vaccination Coverage Rates within Socio Demographic Subgroups for Combined (NIS-IIS) vs. the NIS, IIS A



Results: Absolute Difference in 7 Vaccination Coverage Rates across 15 Socio Demographic Subgroups

Summary Measures	C1 Difference	
	IIS A	IIS B
Minimum	0.1	0.0
Median	5.0	4.2
Maximum	33.1	57.4

Conclusions

- **IIS offers opportunity for substantial cost reductions due to its exceptionally high eligibility rate.**
  - Time consuming and complex to deal with each state individually.
  - Telephone contact information not complete.
  - Coverage by state and ability to use state information varies widely.
- **Demographic comparisons between the NIS and IIS showed a fairly high level of comparability, but some differences still exist.**
  - Sampling and weighting approaches for a single IIS or multi-frame NIS-IIS design will need to account for demographic differences such as for mover status.
- **The combined NIS-IIS vaccination rates for IIS A and IIS B are within 7 percentage points of the NIS estimates for the vaccines and vaccine series.**
  - There were no statistically significant differences between the NIS and IIS estimates at the state level for IIS A or IIS B.

Next Steps

- **Develop optimum sample design and data collection methodology for combining NIS and IIS samples:**
  - Identify key measures to determine whether an IIS has sufficient population coverage and sufficient contact information for use as a sample frame in the NIS (assessing state-level IIS readiness).
  - Control potential bias at the state level (relative to the NIS).
  - Use cost-savings to increase the precision of state-level estimates.
  - Meet minimum NIS variance requirements at the estimation area level.
  - Investigate an optimum allocation sample design that takes into account population distributions, variance differences and cost differentials.

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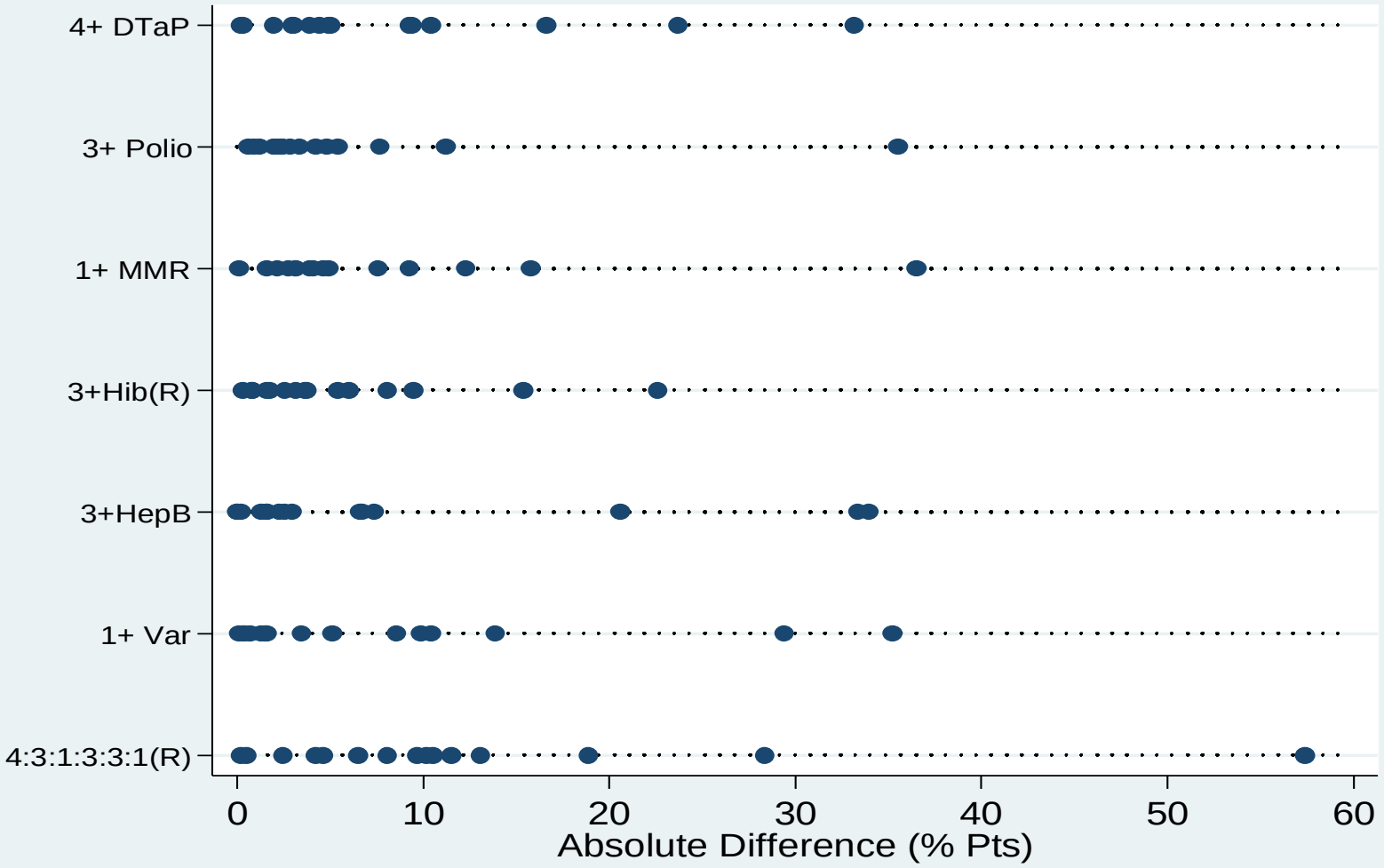
NIS Sample vs. IIS Sample (IIS B): Baseweighted Socio-Demographic Characteristics

Characteristic	IIS (n=1266)	NIS (n=121)	Pop	Pop - IIS	Pop - NIS
Mother's Education					
High school or less	17.8	13.7	34.7	**16.9**	**21.0**
Higher than high school	82.2	86.3	65.3	**-16.9**	**-21.0**
Mother's Age					
≤ 29 years	20.7	27.0	41.6	**20.9**	**14.6**
≥ 30 years	79.3	73.0	58.4	**-20.9**	**-14.6**
Mother's Race/Ethnicity					
Hispanic	6.5	2.6	7.9	1.4	**5.3**
Non-Hispanic black only	5.7	7.1	9.7	4.0	2.6
Non-Hispanic others	87.8	90.3	82.4	**-5.4**	**-7.9**
Household Income to Poverty Ratio					
Ratio < 1.33	20.7	14.1	22.5	1.8	**8.4**
1.33 ≤ Ratio < 4	45.0	46.3	47.7	2.7	1.4
Ratio ≥ 4	34.3	39.7	29.8	-4.5	**-9.9**
Telephone Use Status					
Cell-phone only	36.6	43.0	46.3	**9.7**	3.3
Dual users	60.3	57.0	51.0	**-9.3**	**-6.0**
Landline only	3.1	0.0	1.2	-1.9	1.2

Absolute Difference in Vaccination Coverage Rates within Socio Demographic Subgroups for Combined (NIS-IIS) vs. the NIS, IIS B



Vaccines and Vaccine Series

1. 4+ DTaP - 4 or more doses of Diphtheria and tetanus toxoids and acellular pertussis/Diphtheria and tetanus toxoids and per tussis /Diphtheria and tetanus toxoids vaccine
2. 3+ Pol - 3 or more doses of Polio
3. 1+ MMR - 1 or more doses of Measles, Mumps, and Rubella vaccine
4. Hib (full series) – 3 or more or 4 or more doses of *Haemophilus influenzae* type b vaccine (Hib) of any product type received (primary series and booster dose).

Vaccines and Vaccine Series

5. 3+ HepB - 3 or more Hepatitis B
6. 1+ Var - 1 or more Varicella
7. 4+ PCV - 4 or more Pneumoccocal vaccine
8. Rot – Rotavirus
9. 2+ HepA – 2 or more doses of Hepatitis A vaccine
10. 2+ - 2 or more doses of Hepatitis A vaccine
11. 4:3:1:3:3:1 – Combination of 1 to 6
12. 4:3:1:3:3:1:4 – Combination of 1 to 7