Recent Methodological Updates Adopted for the National Immunization Survey (NIS)

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Outline

- National Immunization Survey (NIS) Overview
- Problems
- Weaknesses/Threats
- Research and Solutions
- Discussion
NIS Overview

- NIS surveys
  - NIS
  - NIS-Teen
  - National Flu Survey

- NIS
  - Centers for Disease Control and Prevention (CDC)
    - National Center for Immunization and Respiratory Diseases (NCIRD)
    - National Center for Health Statistics (NCHS)
  - Assess vaccination coverage of US children 19-35 months
  - Household CATI survey followed by a mailed provider record check study (PRC)
    - Household interview screens for children 19-35 months
    - Landline (LL) RDD sample frame 1994-2010
Weaknesses and Threats

- **Landline sample frame**
  - Declining eligibility rate for children 19-35 months in the LL sample
    - Age eligibility for children 19-35 months higher in cell phone households
  - Not representative of the US population
    - Affected the perceived validity of the survey
    - 2010 CASRO household response rate was 63.8%

- **Dual landline cellular telephone sample frame**
  - Costly
    - Household interview screens for children 19-35 months
    - Lower response rates
      - 2011 CASRO household response rate
        - LL - 61.7%
        - Cell - 25.2%
Problems

- **Landline (LL) surveys**
  - Decreasing coverage

- **Rare population (children 19-35 months)**
  - 4.6% according to 2011 ACS

- **Cellular telephone surveys**
  - Costly

- **Respondent burden**
  - Decreasing consent and cooperation
RESEARCH AND SOLUTIONS (2009-2012)
Research and Solutions

- Dual-frame LL and Cell RDD sample designs
- NIS age-eligibility criterion
- NIS questionnaire redesign
- Weighting methods to minimize MSE in vaccination coverage rates

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<th>New Methods</th>
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DUAL-FRAME RESULTS OF VACCINATION COVERAGE
Dual-Frame\(^*\) vs. Landline Only Vaccination Coverage Rate Estimates, NIS, United States, 2011

* Dual-frame vaccination coverage rate estimates computed using shrinkage weighting to minimize MSE
## NIS and NHIS-PRC, United States, Q3/2011 – Q2/2012

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<tr>
<td></td>
<td>UTD Rate (%)</td>
<td>CI Half-Width (%)</td>
<td>UTD Rate (%)</td>
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<td>4+ DTaP</td>
<td>83.5 ± 1.2</td>
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<td>83.2 ± 2.6</td>
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<td>3+ Polio</td>
<td>93.0 ± 0.8</td>
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<td>92.4 ± 1.8</td>
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<td>1+ MMR</td>
<td>91.3 ± 0.9</td>
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<td>91.3 ± 1.9</td>
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<td>3+ Hib</td>
<td>93.3 ± 0.8</td>
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<td>94.6 ± 1.5</td>
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<td>3+ HepB</td>
<td>90.0 ± 0.9</td>
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<td>91.4 ± 1.9</td>
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<td>1+ Var</td>
<td>90.8 ± 0.8</td>
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<td>91.2 ± 1.9</td>
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<tr>
<td>4+ PCV</td>
<td>82.3 ± 1.2</td>
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<td>81.5 ± 2.8</td>
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<td>4:3:1:3:3:1</td>
<td>76.2 ± 1.3</td>
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<td>77.4 ± 2.9</td>
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<td>4:3:1:3:3:1:4</td>
<td>71.5 ± 1.4</td>
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<td>72.2 ± 3.2</td>
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<tr>
<td>4:3:1:3:3:1:4, excluding Hib</td>
<td>76.8 ± 1.3</td>
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<td>77.7 ± 2.9</td>
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<tr>
<td>4:3:1:3:3:1:4, excluding Hib</td>
<td>71.7 ± 1.4</td>
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<td>72.2 ± 3.2</td>
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<tr>
<td>Influenza vaccine, Method 1</td>
<td>48.1 ± 2.0</td>
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<td>45.0 ± 4.4</td>
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**Statistically significant at the alpha=0.05 level**
Response Rates

Annual CASRO Household Response Rates, NIS, United States, 1994-2011

- Resolution Rate (Landline)
- Screener Completion Rate (Landline)
- Interview Completion Rate (Landline)
- Response Rate (Landline)
- Resolution Rate (Cell)
- Screener Completion Rate (Cell)
- Interview Completion Rate (Cell)
- Response Rate (Cell)
Dual-Frame Results

- Minimized the perceived non-representative sample risk
- Maintained reasonable vaccination coverage estimates
  - Comparable to LL only data and NHIS PRC
- Response rates decreased
- Costs increased
EXPANSION OF NIS AGE ELIGIBILITY CRITERION
### Birth Cohorts Using Any Day of Quarter Design, NIS, United States, 2011

<table>
<thead>
<tr>
<th>Month of Interview</th>
<th>Q1 2011</th>
<th>Q2 2011</th>
<th>Q3 2011</th>
<th>Q4 2011</th>
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<td>Dec-11</td>
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### Color Key
- **Age Eligible Day of Screening**
- **Age Eligible Any Day of Quarter (Old)**
- **Age Eligible Any Day of Quarter (Young)**
Age Eligibility Criterion Results

- The yield of age-eligible children 19-35 months in the 2011 NIS increased by 17% under new Any Day of the Quarter (DOQ) eligibility.
  - Decreased telephone calls
  - Decreased costs
- **Savings rolled over into cell sample**
Shortened Questionnaire Experiment

- **Problem**
  - Questionnaire additions over the years and few deletions increased survey length

- **Hypothesis**
  - A shorter interview and interviewer-quoted time estimate would improve interview completion rate
  - An engaging topic, the Parental Concerns (PC) module, early would increase respondent interest, reducing breakoff, and improving interview completion
  - These changes would result in reduced costs and improved response rates

- **Reasoning**
  - Increasing response rates
    - Reduces hours spent interviewing
    - Reduces the number of sample lines necessary to achieve target number of completes
    - Minimizes risk of survey errors (bias, variance)
No significant differences in screener completion or provider consent rates

- Interview completion rate for experimental groups all significantly higher than *Control* at the p<0.01 level
- *No PC* interview completion rate significantly higher than all other conditions at the p <0.01 level

### Shortened Questionnaire Experiment

<table>
<thead>
<tr>
<th>Key Rates</th>
<th>Control</th>
<th>Early PC</th>
<th>Late PC</th>
<th>No PC</th>
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<tbody>
<tr>
<td>Screener Completion Rate</td>
<td>78.0%</td>
<td>77.8%</td>
<td>78.1%</td>
<td>77.8%</td>
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<tr>
<td>Interview Completion Rate</td>
<td>75.1%</td>
<td>80.2%</td>
<td>81.8%</td>
<td>86.4%</td>
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<tr>
<td>Provider Consent Rate</td>
<td>78.9%</td>
<td>78.4%</td>
<td>77.0%</td>
<td>75.4%</td>
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## Shortened Questionnaire Experiment

<table>
<thead>
<tr>
<th>Projected Reduction in Sample Lines Needed</th>
<th>Control</th>
<th>Early PC</th>
<th>Late PC</th>
<th>No PC</th>
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<tbody>
<tr>
<td>% Reduction in Sample Lines</td>
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<td>5.8%</td>
<td>6.7%</td>
<td>10.5%</td>
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- No significant differences in distribution of responses to most key questions
- A shorter instrument and interview-quoted time improved interview completion rate
  - Response rates were improved without sacrificing data quality
- Placing an engaging topic earlier was not as critical as a shorter instrument.
- Costs were reduced with a shorter instrument.
  - Fewer interviewer hours and sample lines needed.
- Savings rolled over into cell sample
WEIGHTING METHODS TO MINIMIZE MSE IN VACCINATION COVERAGE RATES
Weighting Methods to Minimize MSE in Vaccination Coverage Rates

- In 2011, cell sample was undersampled, due to higher cost per complete.
  - This could have resulted in:
    - Increased variability in weights between landline and cell samples if cell-phone-only children were weighted up fully to the total cell-phone-only population. (*Full weighting*)
    - Decreased precision of vaccination coverage rates

- Applied Shrinkage Weighting
  - Attenuating cell sample weights to improve precision
    - *Dual User Domain*: Composited landline and cell sample dual user domain to attenuate weights and minimize variance
    - *Cell Only Domain*: Composited a direct estimator and a synthetic estimator derived from the landline sample; increased weights for a subset of the landline sample and decreased weights for cell only sample
      - *Identified a selected subset of landline sample to use as proxy cell only sample to minimize the MSE*
Comparison of Bias and Variance of Shrinkage Weighting to Full Weighting, NIS, United States, Q2-Q4 2011

No statistically-significant differences at the $\alpha=0.05$ level.

Reduction in width of 95% confidence intervals.
Discussion

- The NIS was successfully expanded to an RDD dual-frame design.
  - Costs equivalent to an RDD single-frame landline design with the same reliability constraints.
  - Expansion was supported by cost savings associated with the following methodological changes:
    - Expansion of the NIS-Child age-eligibility criteria
    - Shortening the household telephone questionnaire
    - Incorporating efficient sample weighting methods via shrinkage weighting
Thank you
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The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.