



# Variation in Mother-Infant Linkage Rates by Jurisdiction in U.S. Medicaid Data

Bradley G. Hammill, DrPH

Department of Population Health Sciences  
Duke University School of Medicine  
Durham, NC, USA

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- All other authors report nothing to disclose
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- The views expressed in this presentation represent those of the presenters and do not necessarily represent the official views of the U.S. FDA or ASPE.

# Co-authors

## **Department of Population Health Sciences, Duke University School of Medicine**

- Michael Stagner
- Jessica Pritchard
- Steve Lippmann
- Pratap Adhikari

## **Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute**

- Judith C. Maro
- Daniel Kiernan
- Laura Shockro
- Alexander Mai

## **Office of Surveillance and Epidemiology, Center for Drug Evaluation and Research, US Food and Drug Administration**

- Sarah K. Dutcher
- David Moeny

## **Health Information Systems Consulting**

- Robert Rosofsky





# Introduction

Within the U.S. FDA's Sentinel System, linkage of mother and infant data is **critical for the assessment of medication safety** during pregnancy.

U.S. Medicaid/CHIP data in the new Transformed Medicaid Statistical Information System (T-MSIS) format were recently converted to the Sentinel Common Data Model and an initial mother-infant linkage was performed.

# Data used for linkage

- 100% Medicaid/CHIP data in the Transformed Medicaid Statistical Information System (T-MSIS) Analytic Files (TAF) format
- We applied data quality-based inclusion/exclusion criteria to exclude jurisdiction-plan-years with “unusable” data quality
- We made two data transformations to the Sentinel Common Data Model (SCDM) prior to linkage
  - First transformation (ETL 1), 2014–2018 data
  - Second transformation (ETL 2), 2014–2020 data

# Identifying live birth deliveries & infants for linkage

## Version 1 Specifications

### Deliveries

- Timing: Deliveries from one year later than the start date of the Medicaid/CHIP data availability to the end of the Medicaid/CHIP data availability
- Encounters: Records with a delivery code to women 10-54 years old at the start of the encounter.
- Washout period: No evidence of delivery for 180 days prior to any identified delivery, during which mothers must have had medical coverage

### Infants

- Timing: Those with a date of birth from one year later than the start date of the Medicaid/CHIP data availability to the end of data availability
- Enrollment: Children must have at least one day of enrollment with medical coverage during their first year of life

## Version 2 Specifications

### Deliveries

- Timing: From ~~one year later than~~ the start date of the Medicaid/CHIP data availability to the end of the Medicaid/CHIP data availability
- Encounters: Records with a delivery code to women 10-54 years old at the start of the encounter.
- Washout period: No evidence of delivery for ~~180~~ 90 days prior to any identified delivery, during which mothers must have had medical coverage

### “Infants”

- Timing: Those with a date of birth from ~~one year later than~~ the start date of the Medicaid/CHIP data availability to the end of data availability
- Enrollment: Children must have at least one day of enrollment with medical coverage during their first ~~1~~ 3 years of life

# Identified deliveries & infants

## Version 1 / ETL 1

2.9 million deliveries eligible for linkage

7.8 million infants eligible for linkage

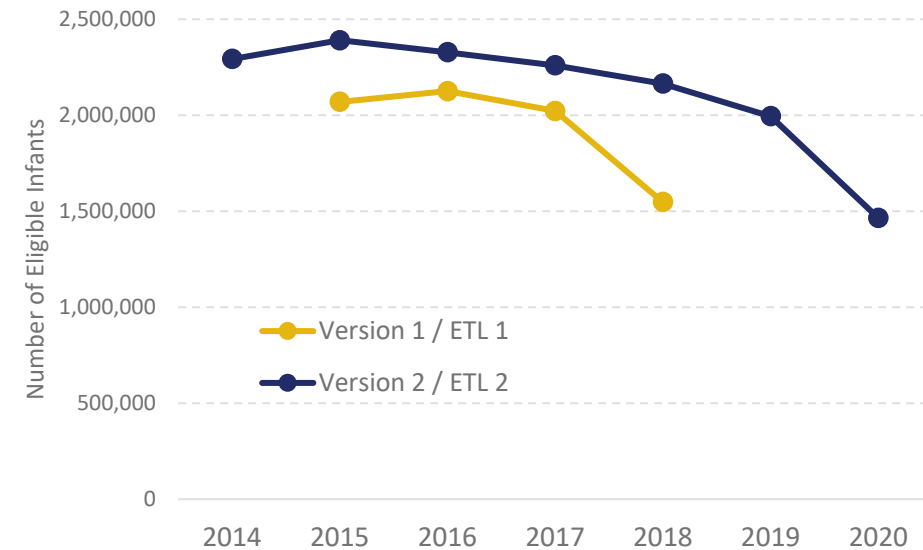
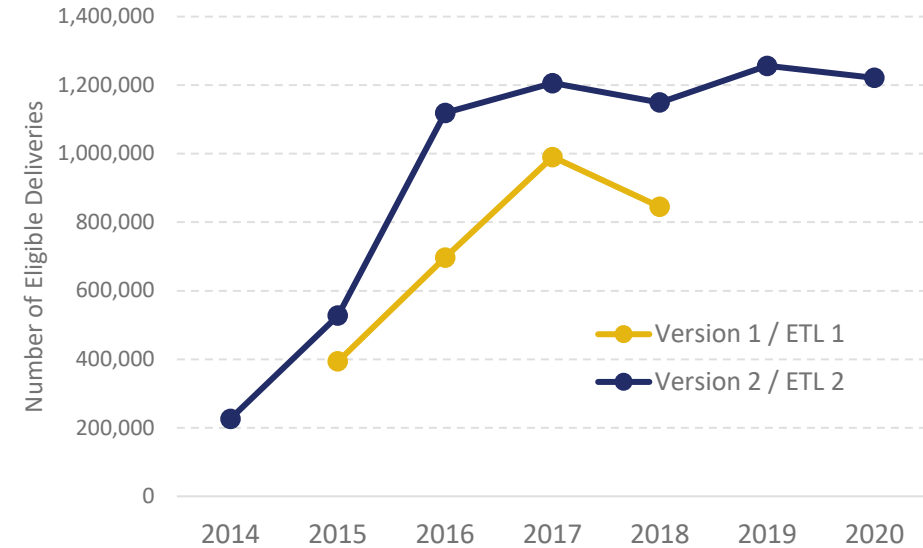
## Version 2 / ETL 2

6.7 million deliveries eligible for linkage

14.9 million infants eligible for linkage

## Example: Illinois eligible deliveries

| Year | Version 1 / ETL 1 | Version 2 / ETL 2 |
|------|-------------------|-------------------|
| 2014 | --                | 56,907            |
| 2015 | 68,135            | 74,150            |
| 2016 | --                | --                |
| 2017 | 32,849            | 51,042            |
| 2018 | 56,899            | 61,968            |
| 2019 | --                | 58,248            |
| 2020 | --                | 55,760            |



# Rules for linking delivery records to infant records

**Objective:** Most accurate linkage

- Both delivery record and infant record must be associated with the *same jurisdiction*
- Both delivery record and infant record must have the *same case number identifier*
  - Case number is a state-assigned number that is often a proxy for a family identifier
- Infant's *date of birth must be close to the admission/discharge dates* on the delivery record. Specifically:
  - Infant's DOB must be within 3 days ( $\pm$ ) of a delivery record's admission date, if discharge date is unknown, or
  - Infant's DOB must be between 3 days prior to the delivery record's admission date and the delivery record's discharge date



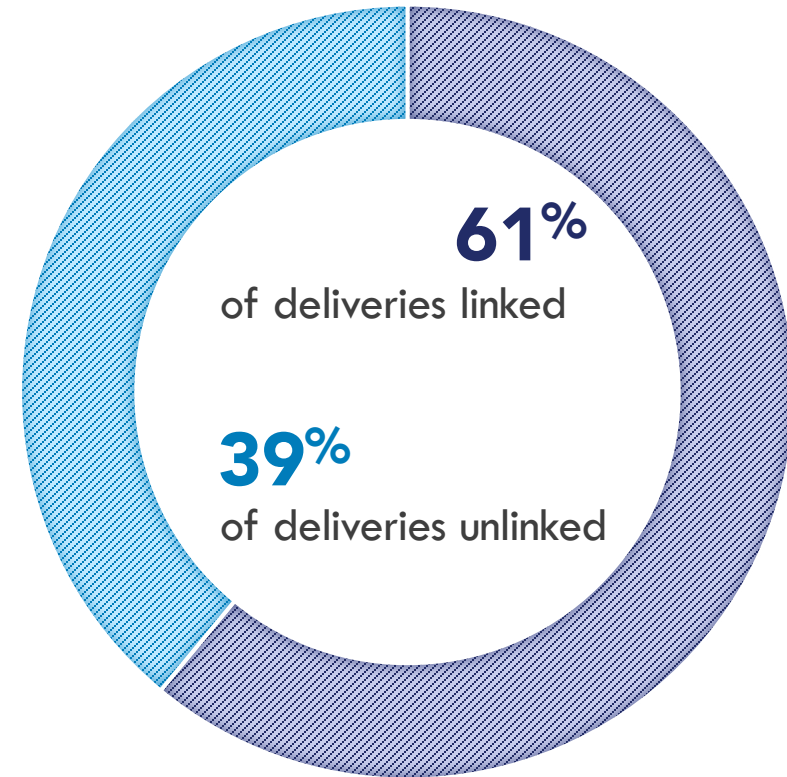
# Linkage results

## Overall

61% of mother's delivery records—**4.1 million of 6.7 million eligible**—from ETL 2 were linked to child records in the Medicaid/CHIP data

This statistic hides substantial variability

*All linkage results should be considered preliminary until approved for use within the Sentinel System.*



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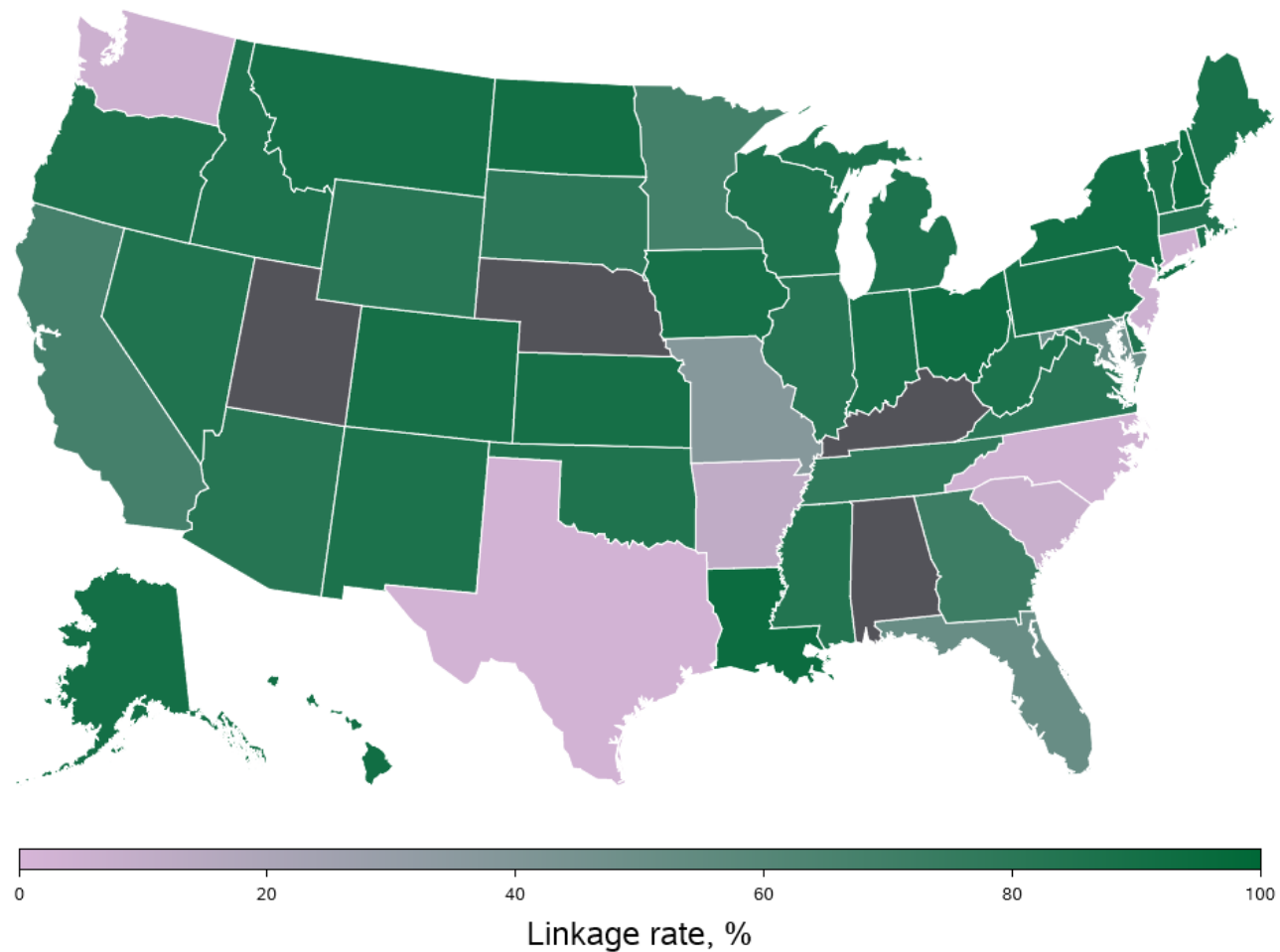
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## By jurisdiction

Among 49 jurisdictions included in ETL 2 (46 states, DC, PR, VI):

- 34 had linkage rates **over 75%**
- 7 had linkage rates **under 15%**



*Not shown: Puerto Rico, 74% linkage; U.S. Virgin Islands, 79% linkage.*

# Linkage results

## By year of delivery

| Age Group | % of Deliveries | Linkage rate |
|-----------|-----------------|--------------|
| 2014      | 3.4%            | 65.6%        |
| 2015      | 7.9%            | 60.2%        |
| 2016      | 16.7%           | 60.7%        |
| 2017      | 18.0%           | 63.6%        |
| 2018      | 17.1%           | 62.0%        |
| 2019      | 18.7%           | 63.0%        |
| 2020      | 18.2%           | 54.2%        |

## By age of mother at delivery

| Age Group   | % of Deliveries | Linkage rate |
|-------------|-----------------|--------------|
| 10–19 years | 9.4%            | 58.8%        |
| 20–44 years | 90.5%           | 61.1%        |
| 45–54 years | 0.1%            | 49.1%        |

*For comparison, overall linkage rate was 60.8%*

# Linkage results

## By encounter type

| Healthcare setting           | % of Deliveries | Linkage rate |
|------------------------------|-----------------|--------------|
| Inpatient                    | 88.7%           | 62.0%        |
| Other (ED, outpatient, etc.) | 11.3%           | 51.3%        |

## By number of children delivered

| Birth type | % of Deliveries | Linkage rate |
|------------|-----------------|--------------|
| Singleton  | 87.3%           | 62.6%        |
| Multiple   | 1.1%            | 62.3%        |
| Unknown    | 11.6%           | 47.6%        |

*For comparison, overall linkage rate was 60.8%*

# Reasons for poor linkage

## Unique or nearly unique case numbers

Case numbers will be unique when a jurisdiction does not use them to identify family groups

## Missing case numbers

Missing case numbers also prevent proper linkage between deliveries and infants

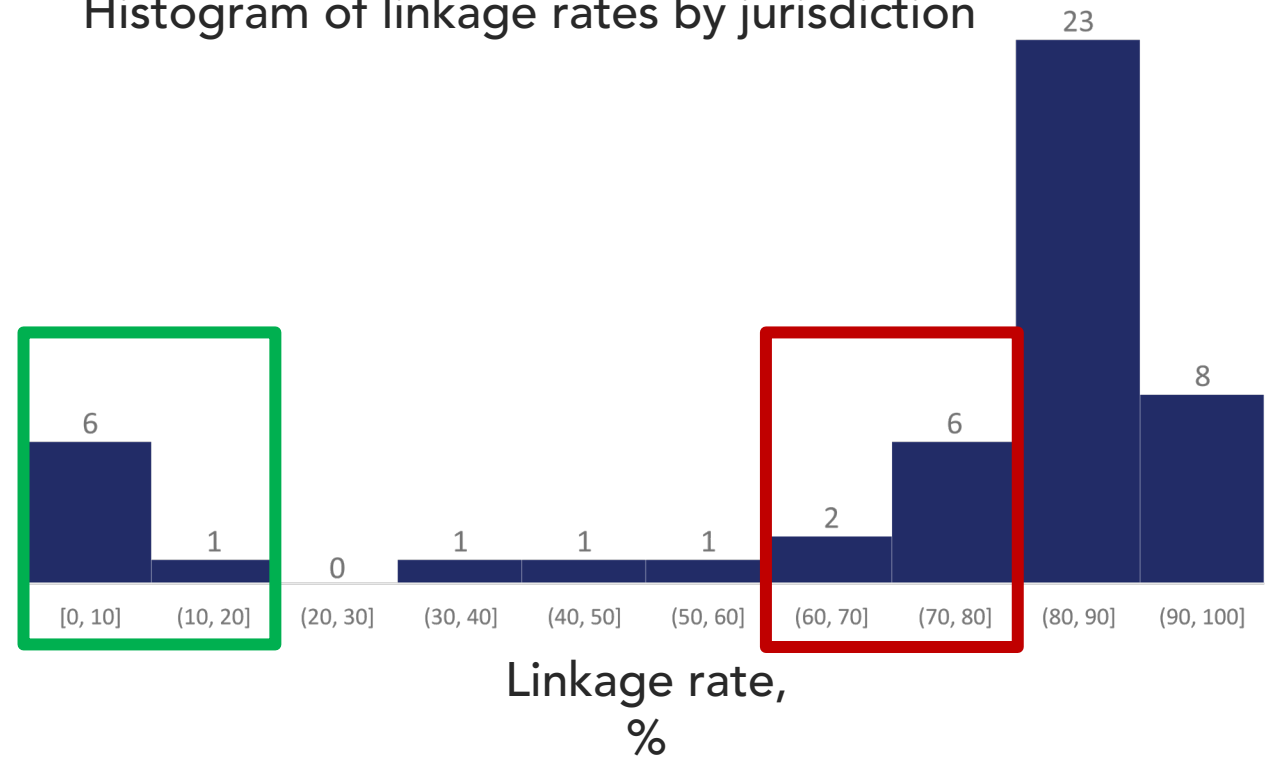
### Of these 7 jurisdictions:

- 7 had case numbers that were unique 85% or more of the time
- 2 had case number missing over 10% of the time

### Of these 8 jurisdictions:

- 4 had case number missing over 10% of the time

Histogram of linkage rates by jurisdiction



# Notable differences from prior linkage in MAX data

## Better linkage in TAF data

| Jurisdiction | MAX Linkage Rate | TAF Linkage Rate | $\Delta$ [TAF – MAX] |
|--------------|------------------|------------------|----------------------|
| Montana      | 0.0%             | 90.0%            | +90.0%               |
| New York     | 49.5%            | 92.0%            | +42.5%               |
| Georgia      | 32.6%            | 74.2%            | +41.6%               |
| Maryland     | 9.3%             | 47.7%            | +38.4%               |
| Louisiana    | 62.6%            | 94.3%            | +31.7%               |
| Indiana      | 58.8%            | 89.0%            | +30.2%               |

*5 more jurisdictions with linkage rates 20–30% higher in TAF than in MAX*

MAX results from: Palmsten K, Huybrechts KF, Mogun H, Kowal MK, Williams PL, Michels KB, Setoguchi S, Hernández-Díaz S. Harnessing the Medicaid Analytic eXtract (MAX) to evaluate medications in pregnancy: design considerations. PLoS one. 2013 Jun 26;8(6):e67405.

# Notable differences from prior linkage in MAX data

## Worse linkage in TAF data

| Jurisdiction   | MAX Linkage Rate | TAF Linkage Rate | $\Delta$ [TAF – MAX] |
|----------------|------------------|------------------|----------------------|
| Washington     | 78.0%            | 4.6%             | -73.4%               |
| New Jersey     | 68.9%            | 4.3%             | -64.6%               |
| Missouri       | 51.6%            | 37.4%            | -14.2%               |
| Minnesota      | 82.3%            | 68.6%            | -13.7%               |
| North Carolina | 16.6%            | 3.5%             | -13.1%               |
| South Dakota   | 89.6%            | 79.3%            | -10.3%               |

MAX results from: Palmsten K, Huybrechts KF, Mogun H, Kowal MK, Williams PL, Michels KB, Setoguchi S, Hernández-Díaz S. Harnessing the Medicaid Analytic eXtract (MAX) to evaluate medications in pregnancy: design considerations. PLoS one. 2013 Jun 26;8(6):e67405.



## Conclusion

In the U.S. Medicaid/CHIP TAF data, mother-infant linkage was **successful for most jurisdictions**.

In other jurisdictions, alternative methods for linkage would need to be explored.





# Thank You

Brad Hammill

Duke University

[brad.hammill@duke.edu](mailto:brad.hammill@duke.edu)