
Mixed-Denominator Rates: A Simple Assessment Method for Adult IIS Data

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Overview

IIS are increasingly expected to assess immunization rates, including adult rates.

Using flu as an example, a rate estimation method is presented here that is simple to use in IIS data for any age group.

‘Mixed-denominator (MD) method’

- focuses on generating denominators to match to IIS numerators
- produces comparable rates across different ages and regions
 - even when underlying data capture and accuracy varies
- can generate estimates of how well populations are captured or represented in the IIS

IIS Rate Assessment Challenges

- Many IIS have adopted an all-age perspective.
 - ALERT IIS moved to lifespan in 2009
- Most (or all?) IIS have better child than adult data capture.
- Teen & adult data can have complicated capture issues
- Compounding capture issues, typically IIS have:
 - Variable capture across demographic and geographic strata/areas.
 - Variable actual immunization rates across strata, that can covary with capture.

So What is an Immunization Rate?

Rate = numerator / denominator

- Typically we pull a numerator from the IIS, then use a measure of population (as Census) for a denominator.
- Problems with this approach:
 - IIS numerators and Census population denominators have different biases.
 - Incomplete and variable population capture means that IIS numerators are drawn from a different, typically lessor, population, than Census.
 - Usually rates for recent immunizations as flu will be substantially biased downward.
- Some IIS have also used both IIS numerators and IIS denominators for rates
 - While this can equalized biases, it over-weights for populations that are well-reported to the IIS, and ignores those that are likely less-well immunized.
 - This approach will typically produce a substantially upward-biased rate.

Rates- Change of Numerator Perspective

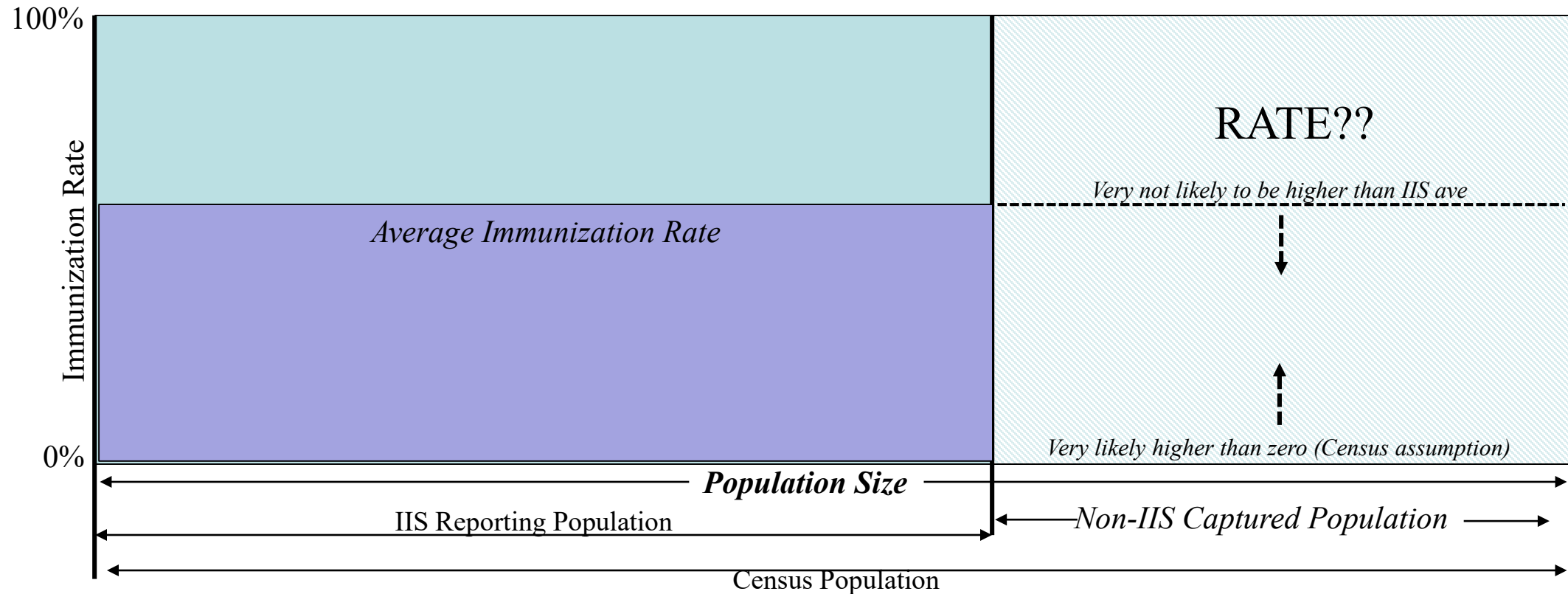
Usual process for immunization rate determination:

- Typically we pick a denominator, then try to work with adjusting numerator to match.
- What if instead, we picked multiple, plausible denominators?
 - Recent IIS reported population (such as last 4 or 5 years)
 - External Census or American Community Survey (ACS)

Graphic Representation of IIS vs Census Denominator Usage

IIS vs Census is really about the rate among non-IIS captured populations

- Census denominator assume “unobserved” rate = 0
- IIS denominator assume “unobserved” rate = IIS average



Mixed Denominator Assumptions

- Generally practices that don't participate in IIS have less of a focus on immunizations and lower immunization rates.
- IIS unobserved populations usually have lower rates than IIS observed populations
- The IIS-denominator based rate is an upper bound to range of plausible, true immunization rates in the whole population
- The Census-denominator based rate is a lower bound to the range of plausible, true rates.
- A rate based on a combination of the two denominators is more accurate than either one alone.

Mixed Denominator Method

- Mixed Denominator (MD) rate: $MD = [x \cdot A + (1-x) \cdot B]$;
 - Where x is a weighting parameter (in case you do have extra information- here it is set to $\frac{1}{2}$ initially)
 - A is an IIS denominator, and B is an Census-ACS denominator
- Not ‘truth and beauty’ but is useful for less-than-perfect IIS (which is everyone)
- Advantages of the Mixed-Denominator method:
 - As IIS capture increases, the two denominators become closer,
 - MD rates estimates are likely closer to true rates than either IIS or Census based rates alone,
 - Allows for fairer comparisons across age groups or geographic areas with different data capture and completeness.

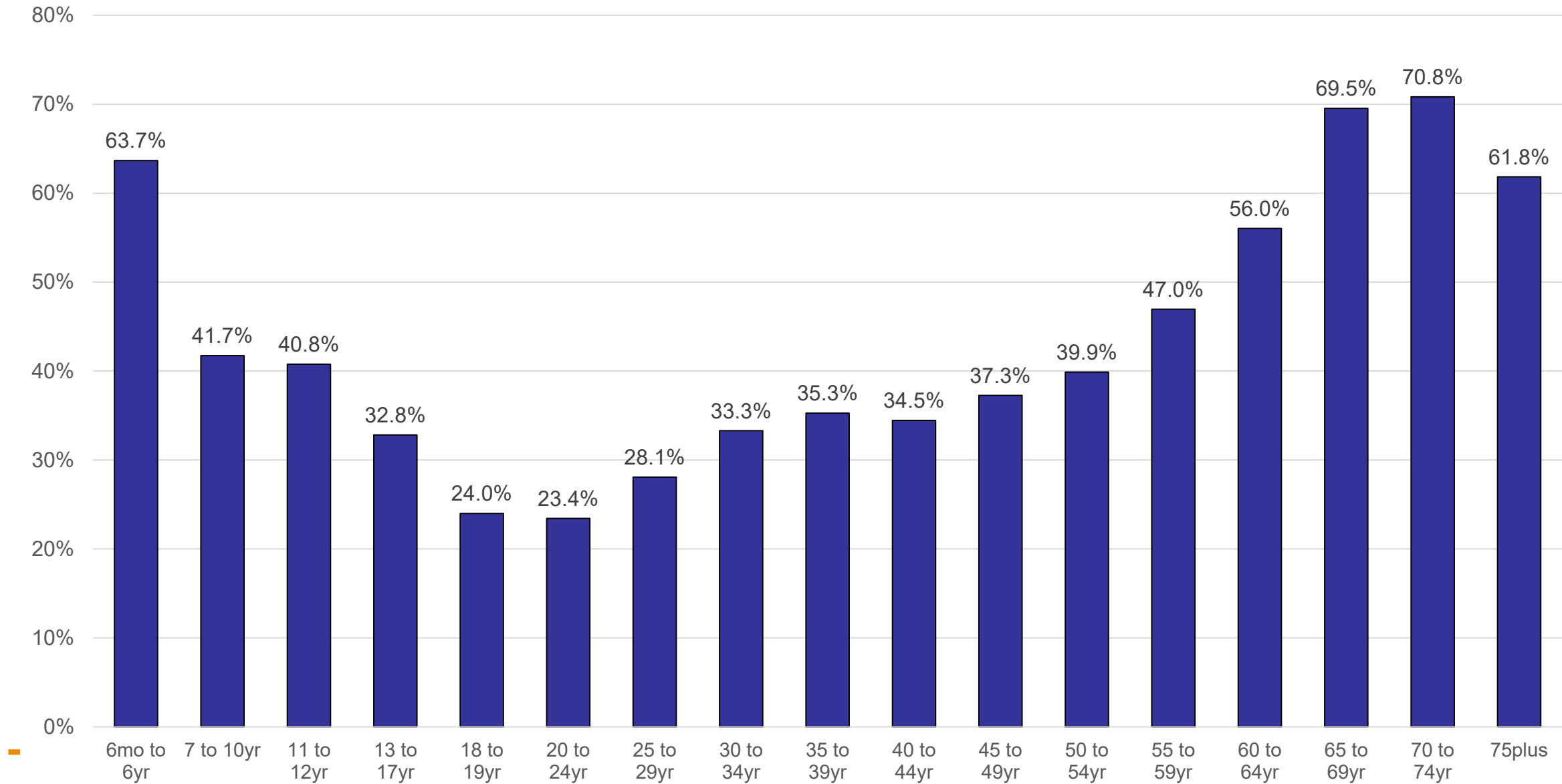
Oregon ALERT IIS Flu Immunization Reporting

ALERT IIS

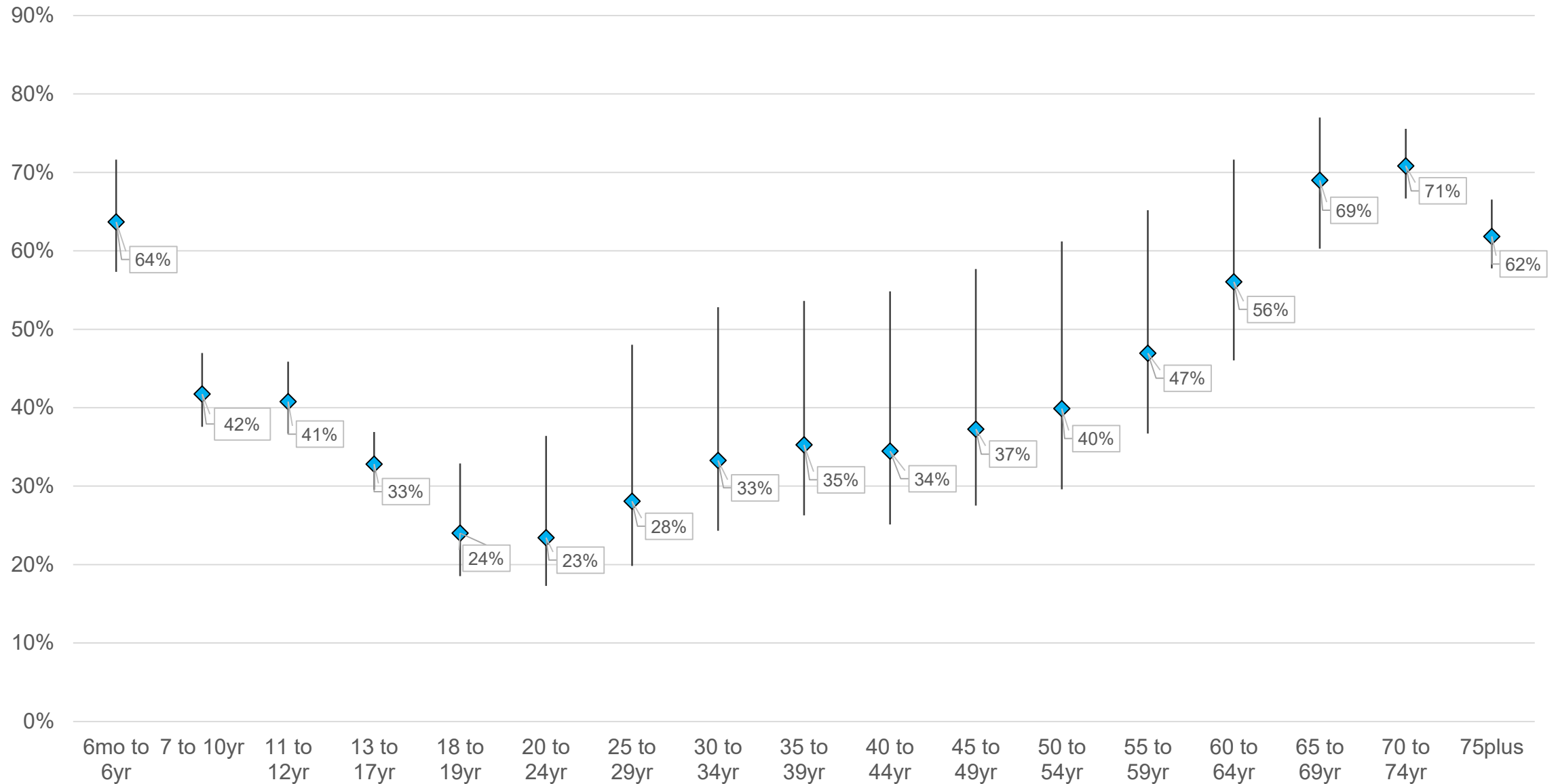
- 1.6 million flu immunization records for Oregon residents in 2018/19

- This level of reporting has been consistent for the last five flu seasons;
- We have previously estimated ALERT IIS is getting ~3/4ths of all Oregon flu shots.
- Data capture may vary across counties and age groups;
- Rates are highest for young children and seniors;
- Rates are also higher in northern Oregon counties than southern.

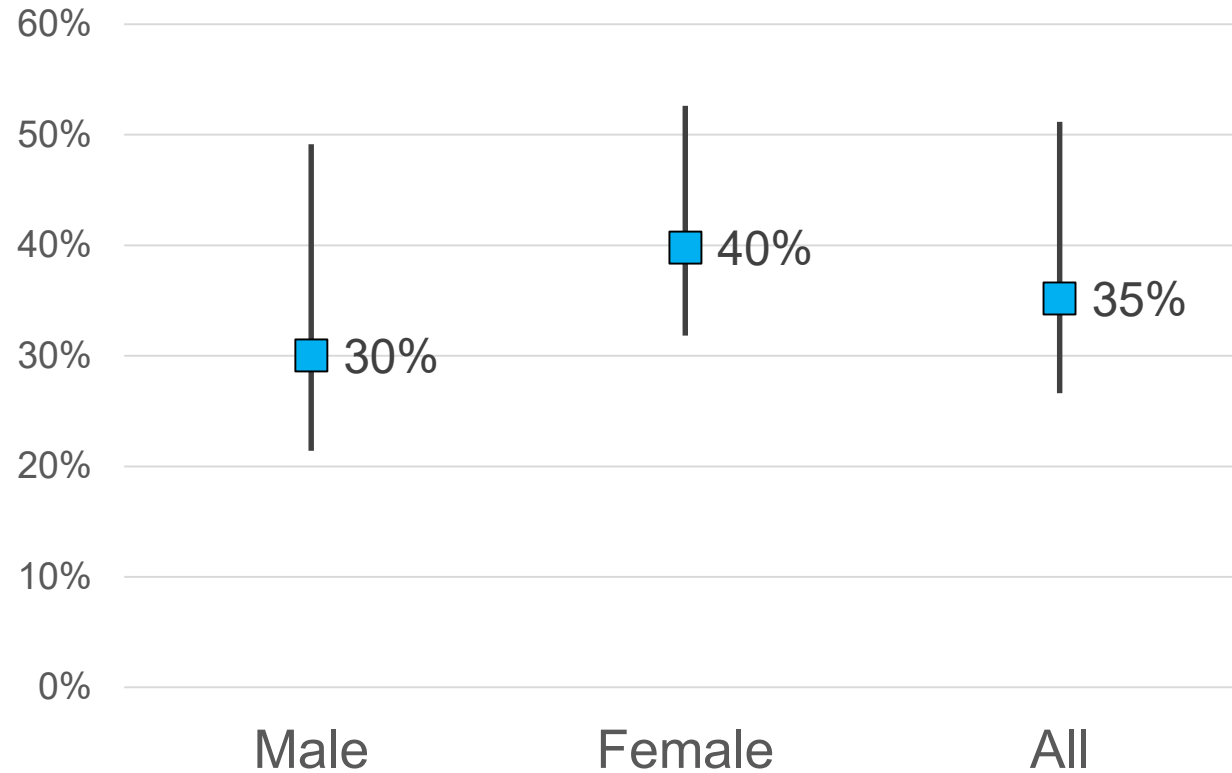
Oregon 2018-19 Mixed Denominator Influenza Immunization Rates by Age Groups



Oregon 2018-19 Influenza Immunization Rate Estimates by Age with High-Low Range for Mixed-Denominator Approach

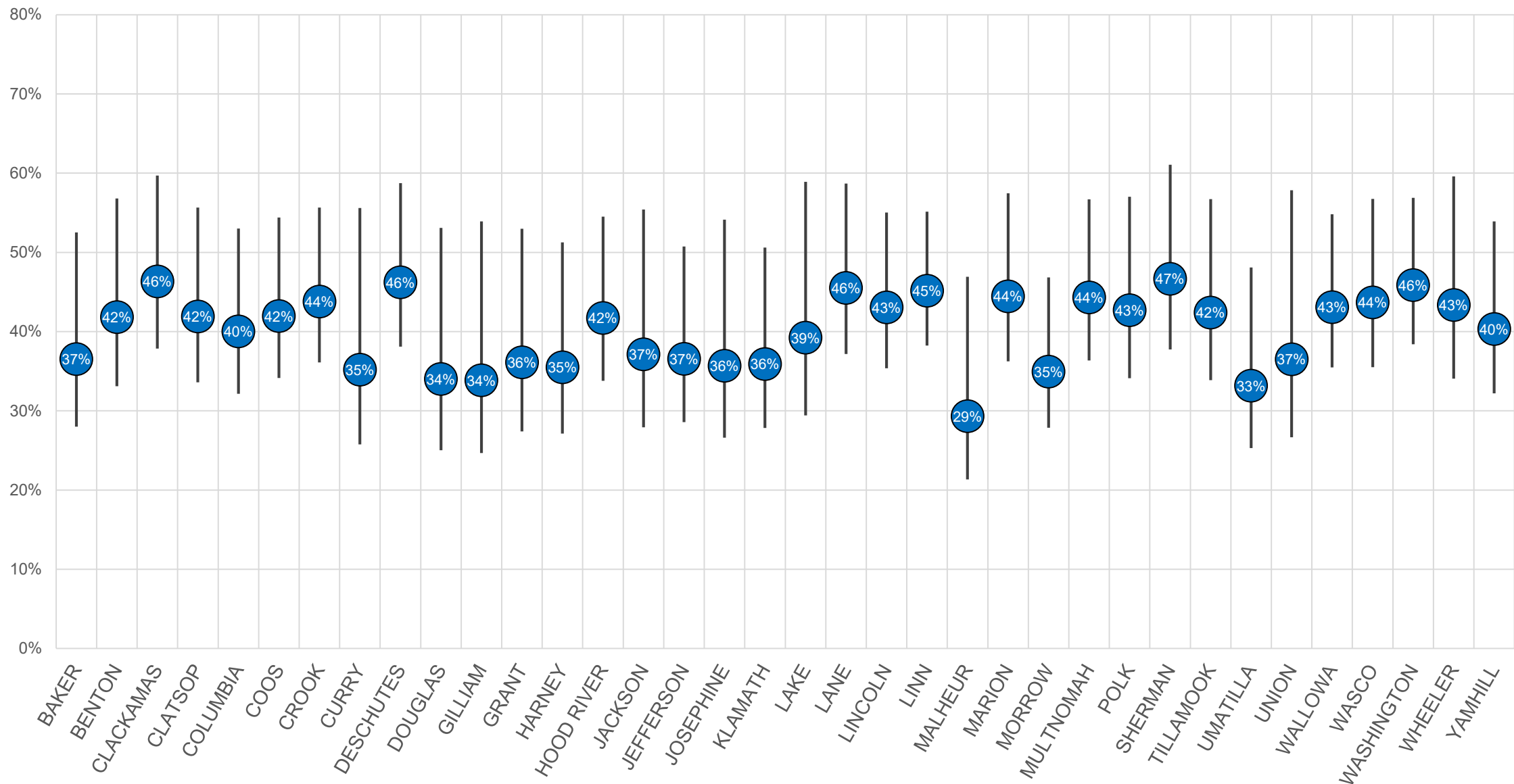


Oregon Adult 18-64 Influenza Immunization Rates by Gender, 2018-19 Season



2018-19 Influenza Immunization Rates by County

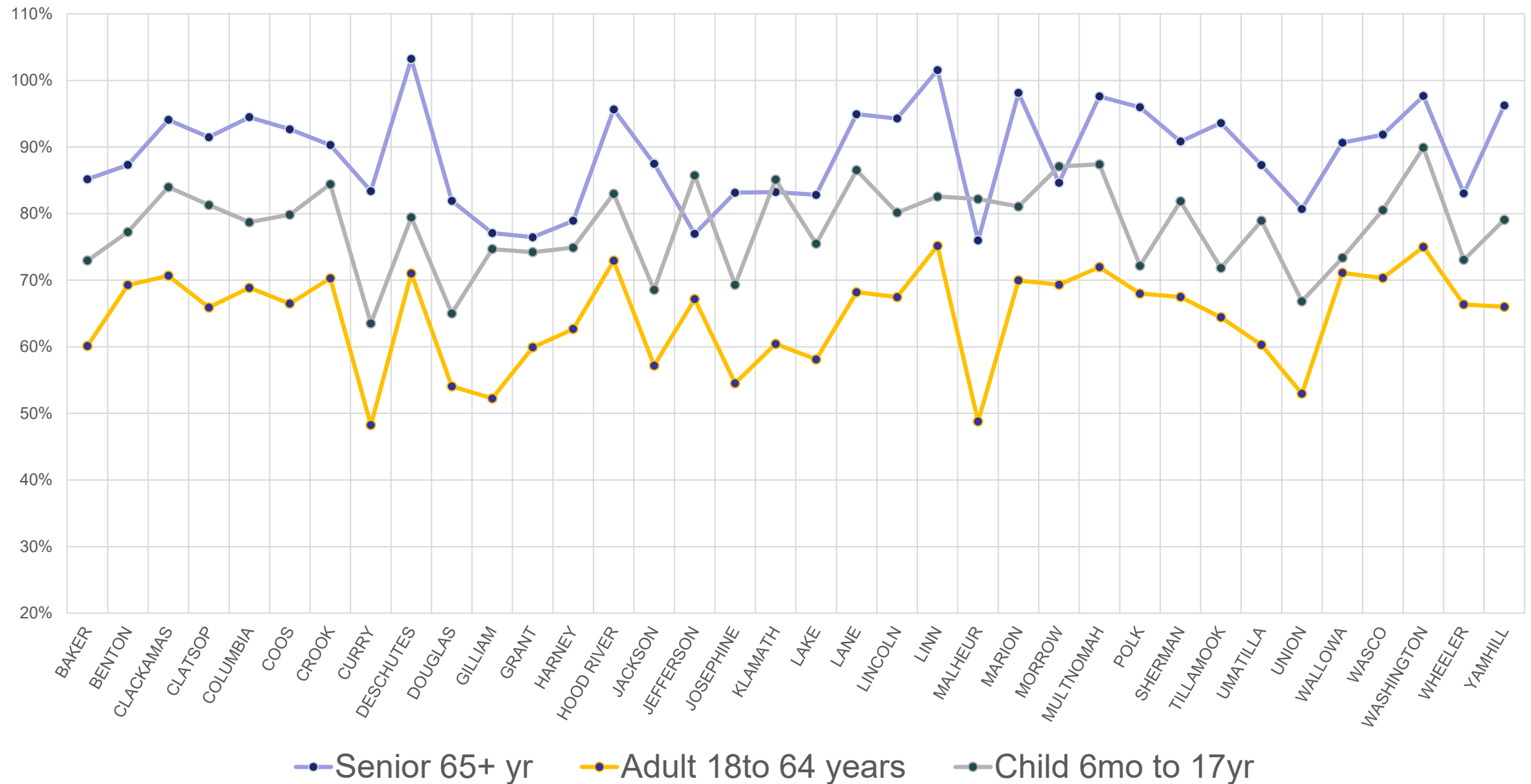
Oregon 2018-19 Influenza Immunization Rates by County, All-Ages.
(High/Low/Mixed Rates)



Evaluating IIS Completeness/Population Representation

- “Completeness’ is a multi-dimensional concept for IIS data.
- A completeness-type measure, for population representation, can be calculated from the MD method.
- This method is based on calculating how much the IIS denominator would have to change for the IIS rate to match the MD rate.
- Overall, ALERT IIS population completeness for flu by MD here is 76%.
- However population completeness varies substantially by age:
 - 6mo to 17 years: completeness = 83%
 - 18 to 64 years: completeness = 69%
 - 65+years: completeness = 94%

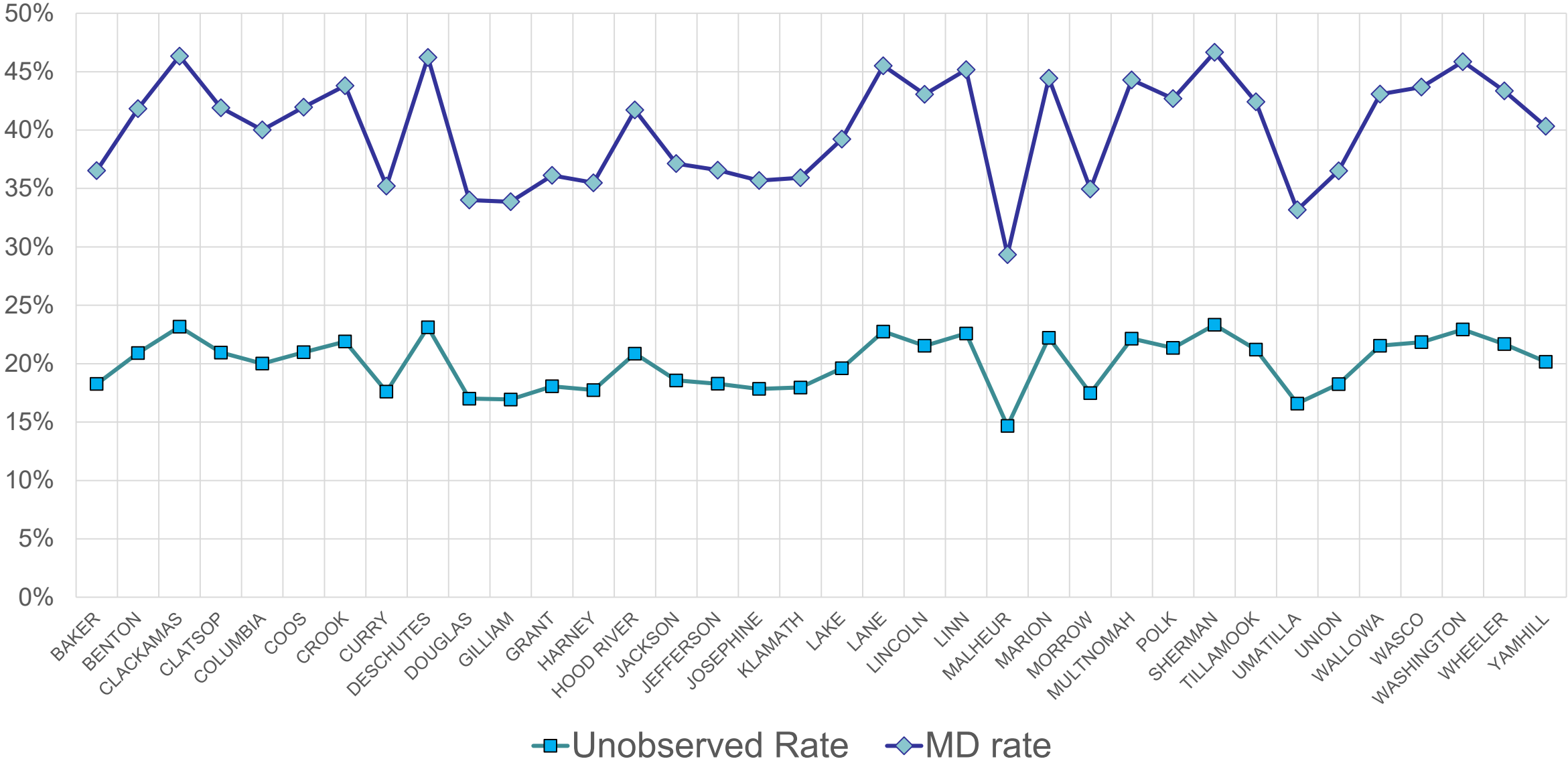
Oregon 2018-19 ALERT IIS Influenza Immunization Population Completeness, Mixed-Denominator Calculation



Unobserved Population Immunization Rates

- It is also possible to estimate the immunization rate among the population that is not being captured (unobserved) in the IIS.
- This is based on calculating what underlying rate, for the Census – IIS population (unobserved) is consistent with the estimated MD rate.

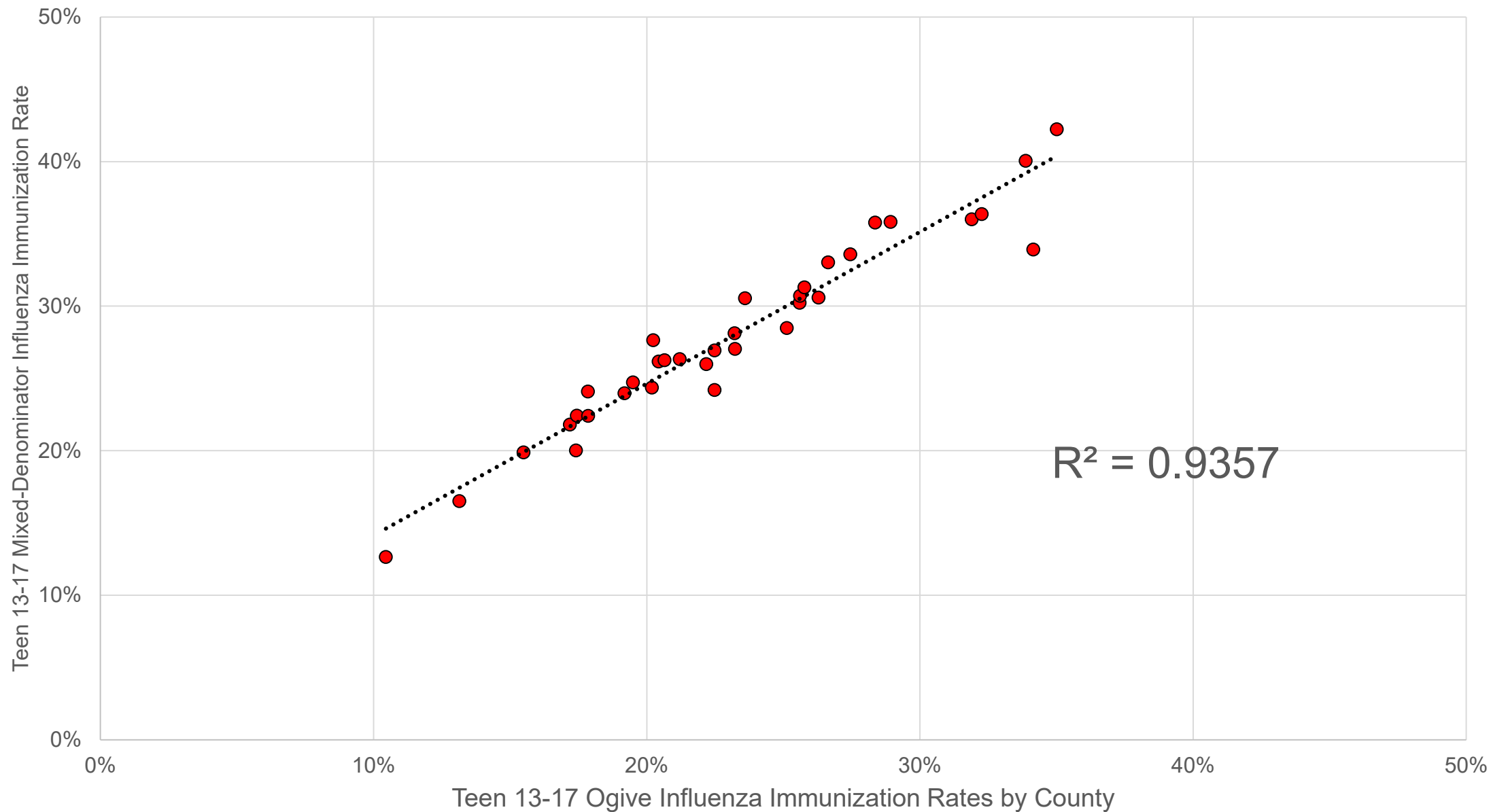
County 2018-19 Influenza Immunization MD Rate Vs Unobserved Population Rate



Evaluation of MD Rates for Teen Populations

- Practically there are no whole-population rates to compare to MD rates
- One option is to use Oregon's ogive-weighted teen influenza rates for comparison
- Ogive weighting provides a good translation of IIS populations to external (school or Census) populations.

Teen Age 13-17 Influenza Immunization Rate Estimates by Oregon County in 2018-19, (Pair-Matched Ogive and Mixed-Denominator Estimates)



Caveats

The following are a few items that can bias MD rates (and other rates as well)

- Lag in Census capture of population changes.
- High levels of mobility.
- Large amounts of duplicate immunization reports.
- Mortality can bias senior rates.

Other concerns:

- Denominator from flu-only- adding other immunizations may increase accuracy.
- Designed for recent immunizations- further development needed for longer periods.
- Not appropriate for clinic evaluation- only for populations with external (Census) data.