



IIS as Population Representative: How Are We Doing on This Goal?


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IIS as Population Representative

- IIS were implemented to meet the dual goals of provider support and immunization surveillance.
 - A surveillance goal for IIS is to be population representative.
 - Population representation is a carry-over concept from survey research
 - For IIS, population representation and whole population capture can overlap
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Population Representation

To start, I asked a new chat AI that's been in the news lately about this.

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what does "population representative" mean?



"Population representative" refers to a sample or group of individuals that accurately represents a larger population in terms of its demographic, social, economic, or other relevant characteristics.

Are IIS Population Representative?

- I asked the AI this question 10 times.
- 2 clear “No’s”- IIS are for clinical support
- 1 clear “Yes” – IIS are designed to be population representative
- 2 fuzzy “Yes’s” – IIS are mostly pop representative w/caveats
- 3 “Maybe’s”- can be, but usually are not

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Are immunization information systems population representative?



Immunization information systems (IIS) are typically designed to capture information about the immunization status of individuals within a defined geographic area or population. The extent to which an IIS is population representative depends on the degree to which it accurately captures data from all segments of the population it serves.



In general, IIS are designed to be population representative, but there may be variations in the degree of representation depending on factors such as the completeness and accuracy of the data that is entered into the system, as well as the extent to which all individuals within the target population are included in the system.

For example, if certain segments of the population, such as those who receive immunizations from private providers or who do not have access to healthcare, are not well-represented in the IIS, the system may not be fully population representative. Similarly, if there are disparities in the quality of immunization data across different regions or socioeconomic groups, this may impact the representativeness of the system.

Overall, while IIS are designed to be population representative, it is important to consider the potential limitations and biases of the system when using it for research or public health purposes.


Where IIS Are Now

- Over time the population size in IIS has dramatically increased.
- Population capture as the percentage of Census population is over 100% for many IIS and age groups.
- For example, by the 2020 IISSARS data, the average IIS has 124% of Census adolescent populations.




The 'So What' Slide

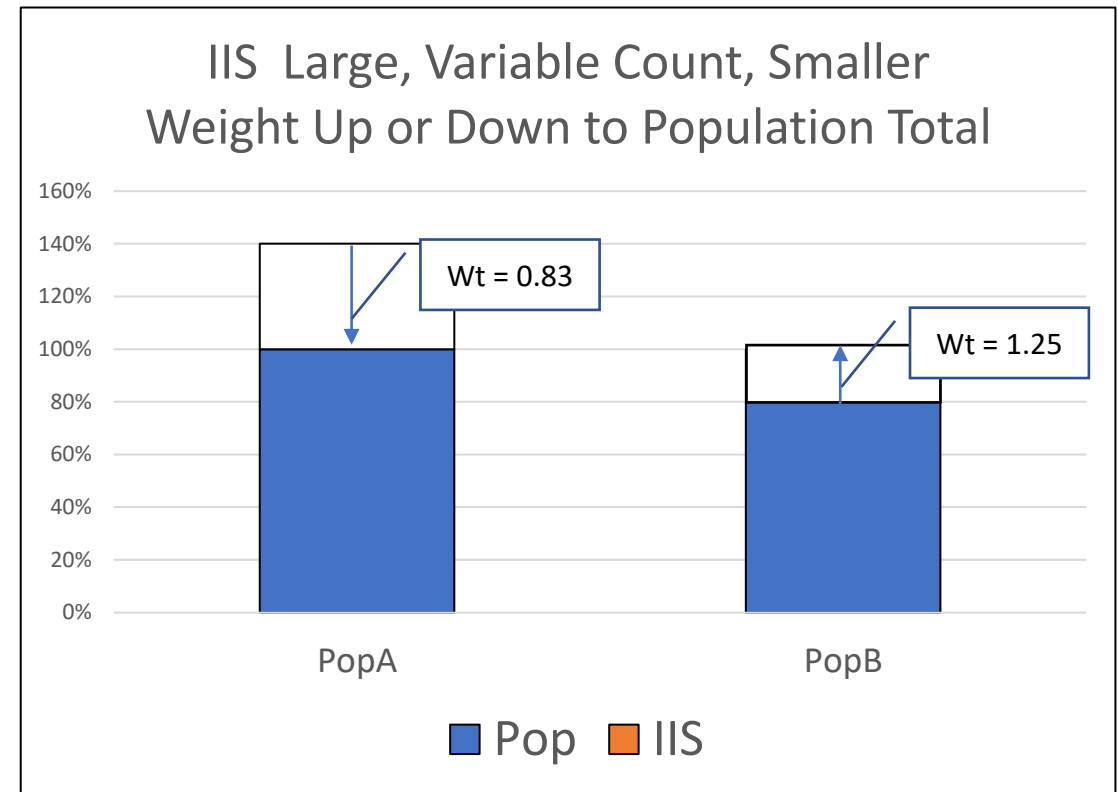
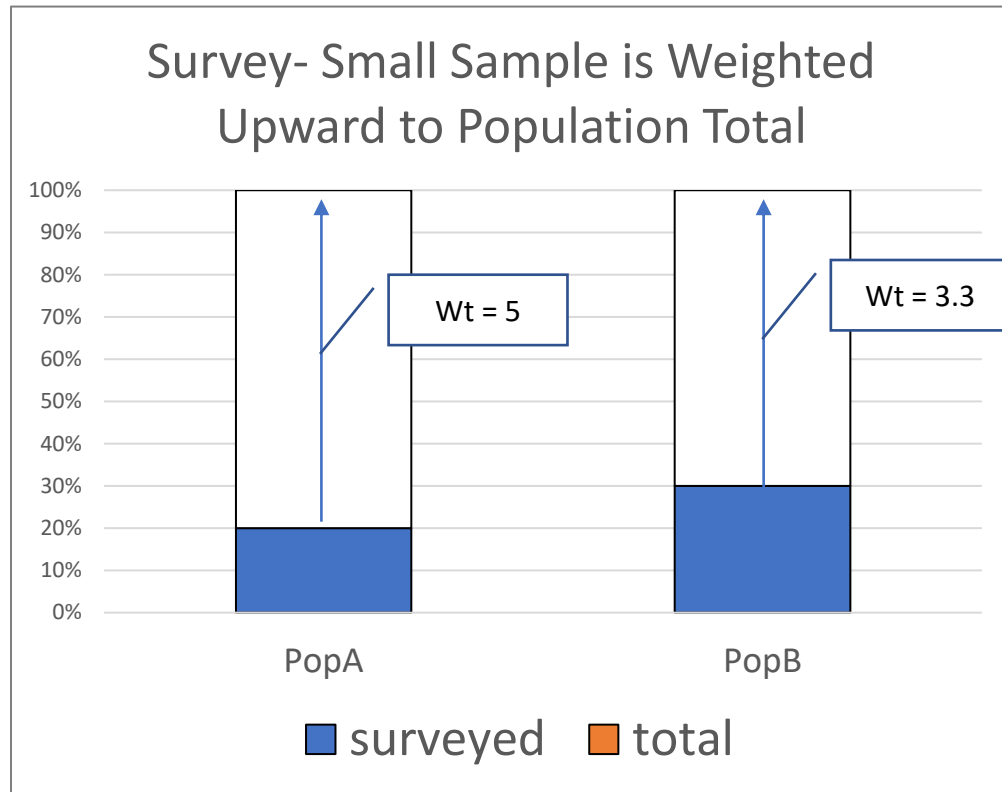
- So why should we care about being population representative?
- Outbreak risk can cluster in populations not well captured into IIS.
- IIS-based rates then may not be predictive of outbreak risks.
- Large measles outbreaks have historically occurred in uncaptured subpopulations:
 - U.S., 1989 (17,850 cases)
 - Brazil, 1997(42,000+ in Sao Paulo)

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Changing The Paradigm for IIS

- IIS need to change the population representation paradigm developed for surveys.
 - Surveys: small samples weighted/projected upwards to whole population.
 - IIS: large data that needs to be both weighted up and down to match to population.
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Survey vs IIS Comparison



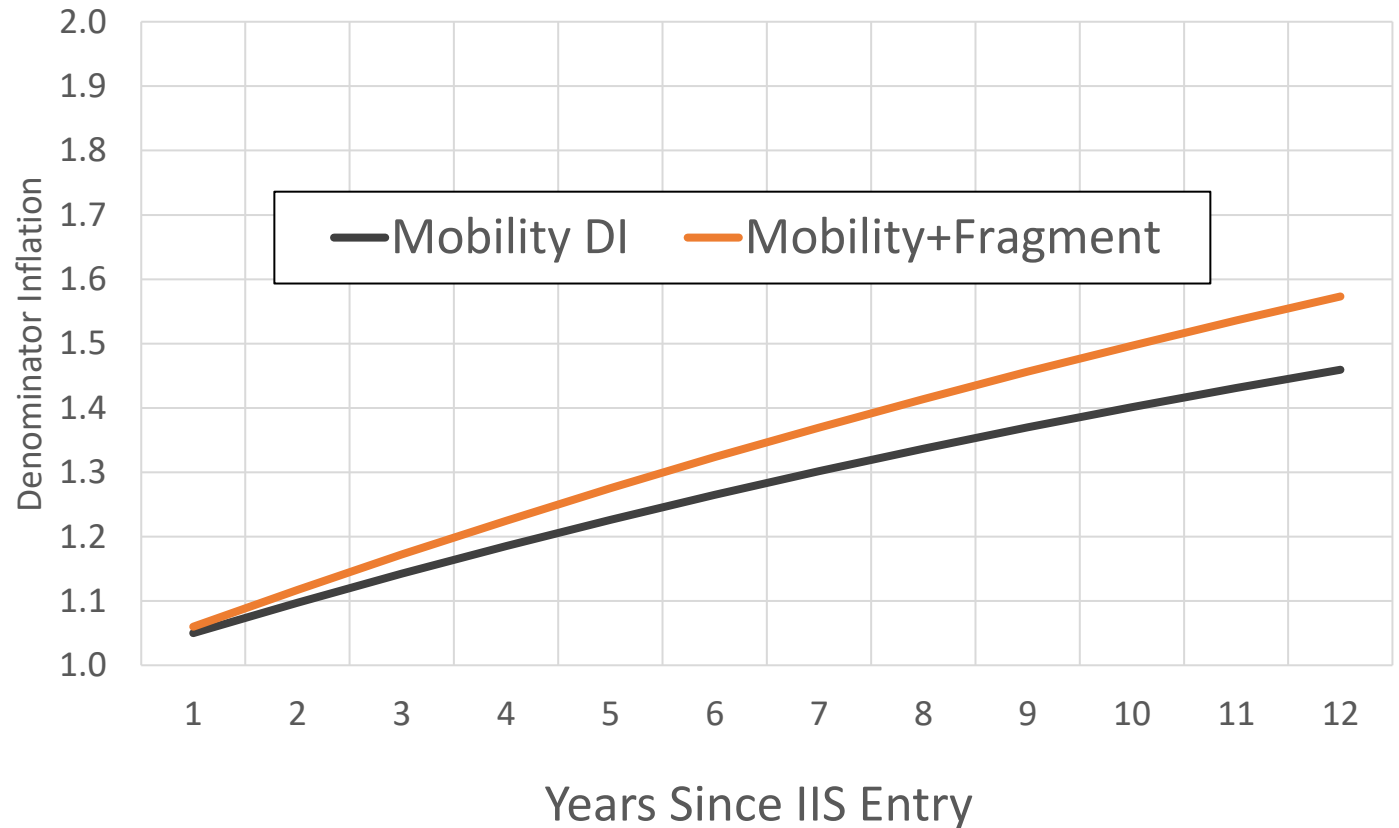
Starting Principles

- A claim that an IIS has all of the shots & population for their jurisdiction is an extraordinary claim
- Extraordinary claims require strong evidence to support.
- Size of IIS data alone is not strong evidence for representation or complete data.
- One time size of population capture is better evidence.
- Factors to consider in weighting:
 - Denominator Inflation (DI) &
 - Mobility (In, Out, and Local)
 - Lack of reporting vs lack of immunization

IIS DI Dynamics

- Every IIS is affected by DI.
- Even small population dynamics add up over time.
- As an example for a stable population, IIS pops after 10 years are 150% of Census

Denominator Inflation over Time, for Balanced In-Out Mobility = 5% per Year, and Record Fragmentation Chance = 1% per Year

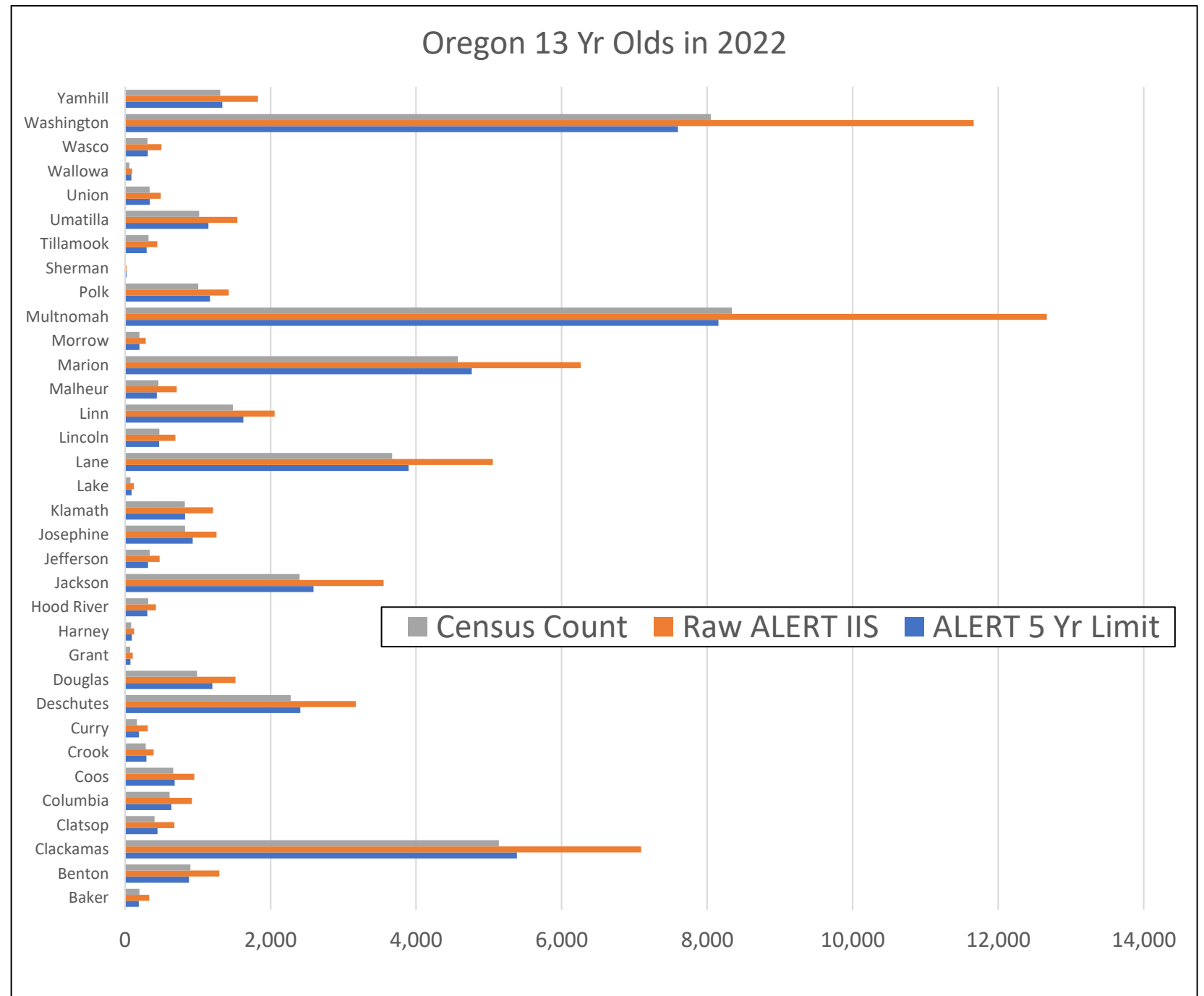


Example 1: Teen IIS Populations

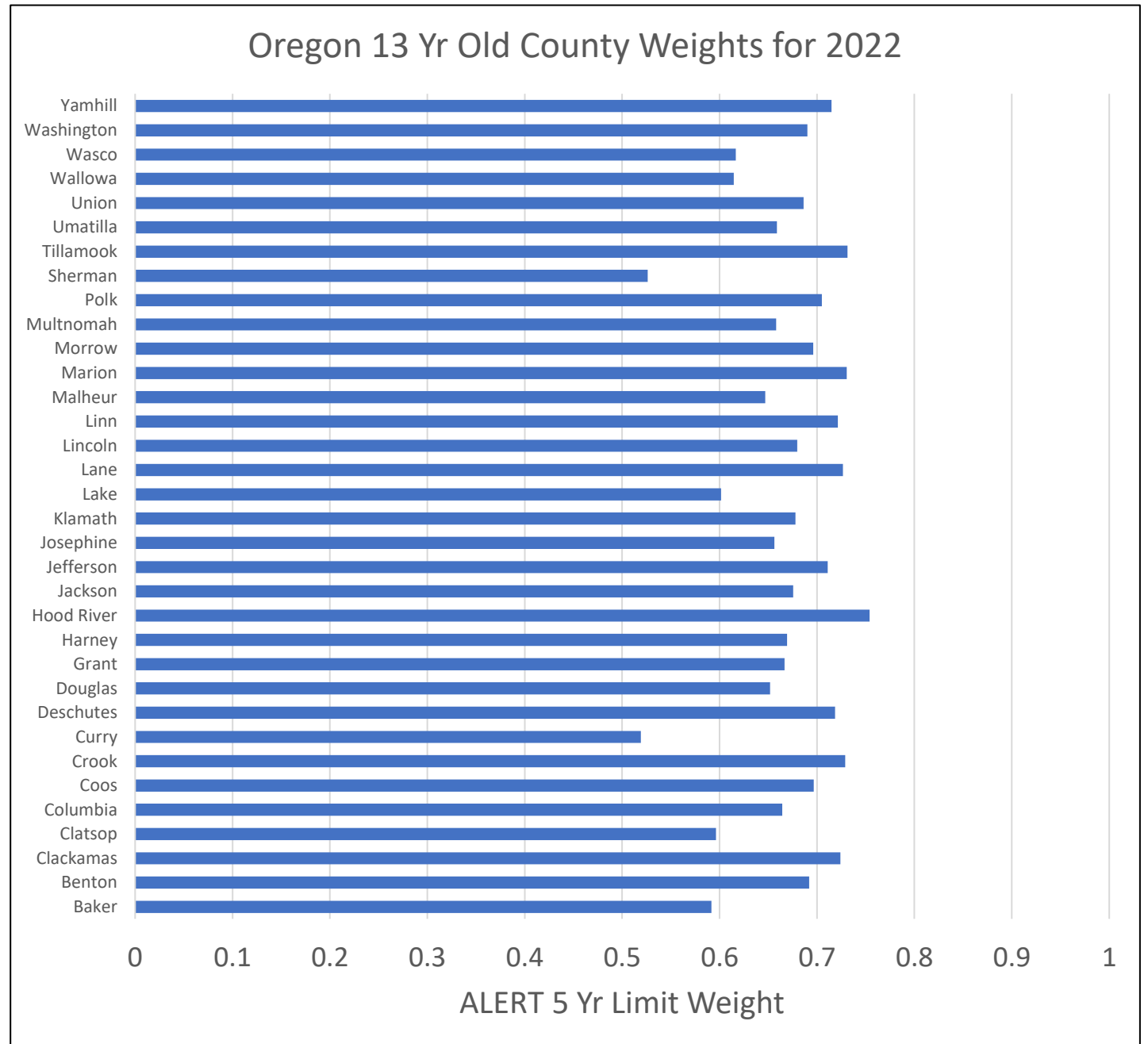
- A popular IIS trend is to limit denominators to those with shots in the last 5 years.
- This adjusts over-Census denominators down to reasonable sizes for most IIS.
- On a county level, is this population-representative?



- Census counts are not perfect, but are still useful to compare to IIS data.
- 13 Yr-old counts by county in the ALERT IIS varied from 96% to 176% of Census counts.
- Applying a 5-year limit to ALERT population counts led to a close match to Census.



This table shows the
county-level
aggregate weights
from the 5 year-limit
on ALERT data



Caveats

- In Oregon, ~2% of kids never get shots.
- A larger group of kids, (~5%) start but drop out of shot seeking before age 9.
- So the five year limit may ignore ~7% of the population.
- A worry is if this ignored population is clustered by county.
- For accuracy, need to add a small weighting of all those under the 5 year cutoff back to county totals.
 - Such a second-stage weight could be validated for teens against school exemption rates for Tdap, or by other non-shot evidence of population presence.

Outside Population Validation Sources

- In the 13 year old example, a Census county population was used as an outside source of population data to validate an IIS weighting.
- Can also use outside rate sources in the same way.
- A caveat is that this can introduce sets of biases from the outside data.
- In an ideal world, would only use IIS data, but have weighting rules that are periodically validated against external sources.

Example 2: Adult Influenza

- In Oregon, not all flu shots are reported to the ALERT IIS.
- Example- Oregon adult age 18-64 flu rate of 30% in 2020, using a Census denominator.
- CDC estimate of 42% for 2020 in this age range.
- Implies that ALERT is getting 73% capture of flu shots?
 - Can use this 73% capture to leverage further sub-population rates.

Flu Example (cont)

- Extending the example with a 73% shot capture rate
- simple probability model is that, over 5 years, ALERT captures 83% of adult 18-64 populations that ever seeks flu shots: $n = 1 - (1 - .3)^5$
- CDC prob model- over 5 years, 91% of population will get at least 1 flu shot in five years: $n = 1 - (1 - .42)^5$
- This implies that among the adult 18-64 population that ALERT doesn't capture, estimated 14% rate of flu shots per year- $1/3^{\text{rd}}$ of the 42% overall rate.

Refinement

- Examples so far are ad hoc methods of producing IIS weighting based on comparing aggregates (counts or rates)
- A refinement is to link individual level records across IIS to external data sources- either for rate estimate sources (small survey), or to large, comprehensive population data.
- Examples-
 - Linking NIS survey (child or panel adult) to IIS; the unlinked/unmatched records in each can drive capture statistics for subpops.
 - Linking IIS addresses to the National Address Database (or other state property registry)- generate local area rates of IIS address capture.
 - Use of DMV data (by name or address) to link to IIS adults.

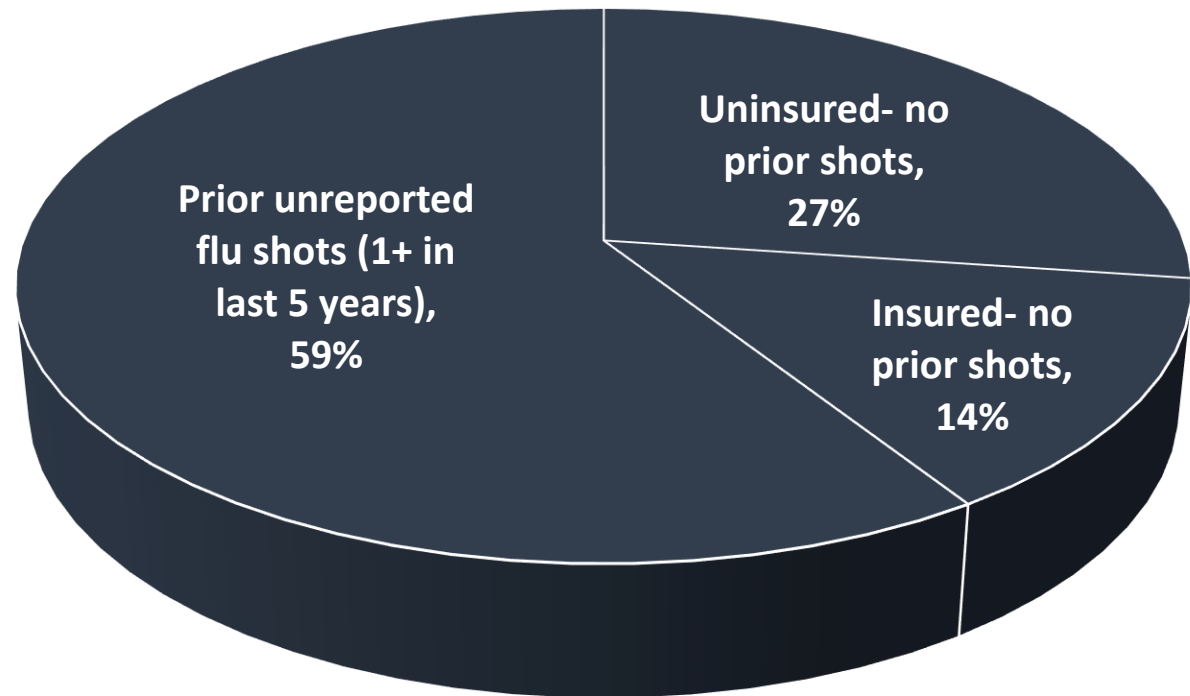
So What About COVID?

- COVID immunizations drove a surge of new clients into IIS.
- Mandatory reporting as a condition of provider vaccine-access and close lot/dose tracking was a factor.
- Heightened sense of risk around COVID was another factor that may have driven shot seeking among those who previously avoided shots.
- So which was the bigger factor? Or were they equal?

COVID IIS Effects

- In Oregon, virtually all adults with prior flu shots got COVID shots in 2021(95%+).
- Also in Oregon, ~3 times as many extra new adult clients age 18-64 in 2021 above previously levels.
- Estimate here combines insurance, flu capture dynamics, and COVID immunization demographics.
- Majority of surge (59%) among adults was from the increase in data capture that went with COVID immunization.

COVID Surge in New ALERT Adult 18-64
Clients- Estimated Prior Shot-Seeking



Summary

- The recommended process here is to develop IIS rules for weighting IIS population and capture data
- Such weights can be either greater than or less than one, depending on data capture and DI effects.
- Any inclusion approach can be taken as a form of 'weighting'.
- Weighted results should be evaluated periodically against external population or rate data to assess if weighting rule is 'reasonable'.

