

Massachusetts Department
of Public Health



Hepatitis B Immunization Trends among Massachusetts Newborns, 2022-2025

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Hepatitis B birth dose vaccine recommendation

- Universal recommendation began in 1991
- High efficacy in preventing perinatal transmission of Hep B, which lowers risk of liver cancer later in life
 - 99% reduction in Hep B infections among US children/teens since adoption
- Wider spread vaccine hesitancy in recent years in addition to softening on this recommendation federally


Massachusetts setting

- Overall, historically high vaccination rates (of all childhood vaccines) at the state level
 - Geographic variation in vaccination coverage
 - Other linguistic, cultural, ideological variation harder to describe using immunization registry data
- *What do we see of Hep B vaccine birth dose trends in Massachusetts?*

Primary data source

- Massachusetts Immunization Information System (MIIS) began 2011, requires all administered vaccines be reported to the registry
 - Dynamic, lifespan registry
 - Limited inter-jurisdictional data sharing
 - 4300+ provider sites
 - 129m+ shots
 - 11m+ patients (MA population ~7m)

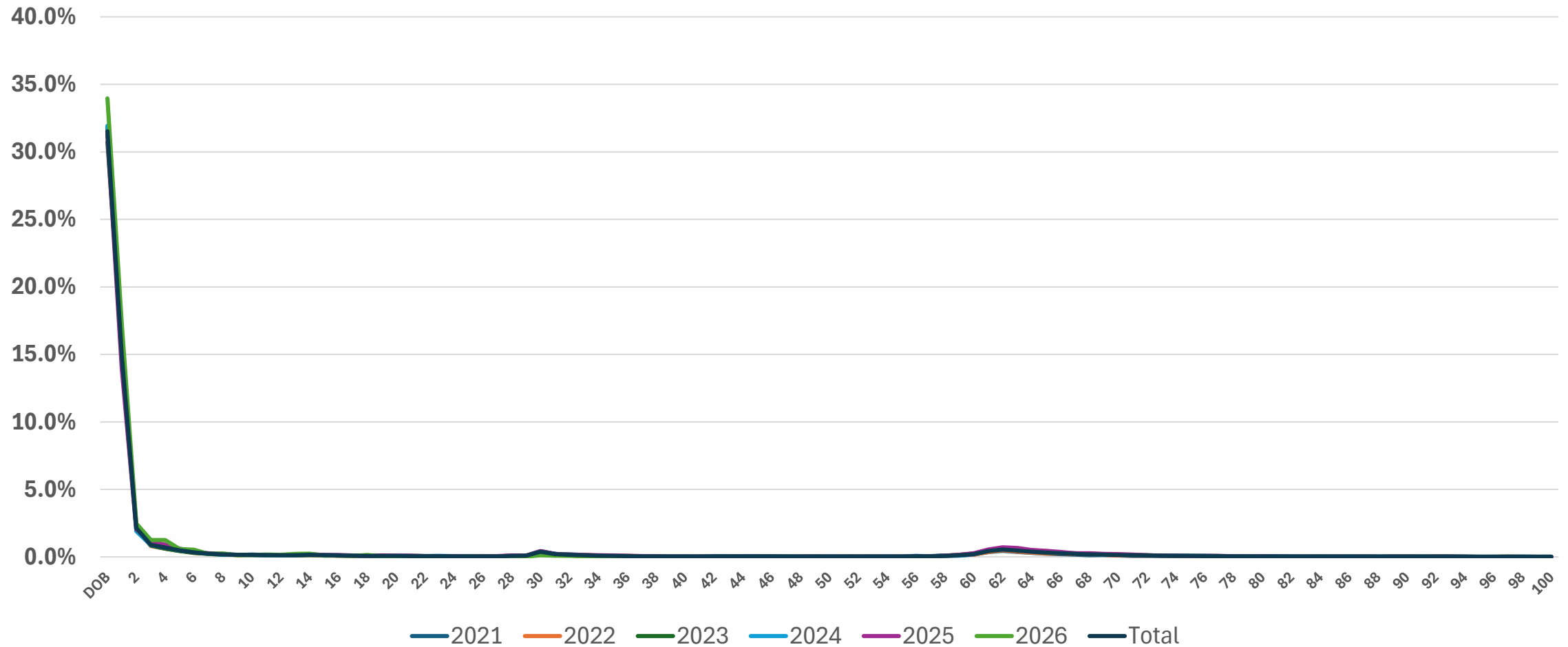
Primary data source (cont'd)

- Massachusetts Immunization Information System (MIIS) began 2011, requires all administered vaccines be reported to the registry
 - Dynamic, lifespan registry
 - Limited inter-jurisdictional data sharing
 - 4300+ provider sites
 - 129m+ shots
 - 11m+ patients (MA population ~7m)  *Denominator inflation*

Numerators

- Examined birth years 2021-2025, divided into Quarters
- Numerators defined as patient records with a Hep B vaccine categorized as
 - “No dose” -- no dose administered before the first birthday
 - “Birth dose” -- a dose administered in the first week of life
 - Vast majority of “birth” doses are administered on the date of birth
 - “Well-child visit” -- a dose administered day 7 to day 89
 - “Late” - a dose administered day 90 to the first birthday

Days since DOB for first Hep B dose, 2021-2026



Candidates for denominator

- MIIS
- Census-based estimates
- Vital records

MIIS as denominator

- MIIS birth cohort itself reflects seasonality of births
 - More (27%) in Q3 (Jul-Sep), fewer (24%) in Q1 (Jan-Mar)
 - Inflated population ranges from 100,854 in 2021 down to 81,045 in 2025
- Our work with investigating “bad baby name” data reveals a variably large number of placeholder babies in the birth cohorts 2021-2025:
 - 14% in 2021 and
 - 16% in 2022 and 2023
 - 10% in 2024
 - 7% in 2025
- We suspect that these birth records are likely duplicates of legally named babies also appearing in the registry
- No surefire way to know whether filtering them out of the analysis or including them is more reflective of the truth

Census-based estimates as denominator

- UMass Donahue Institute generates population estimates for Massachusetts by updating Census estimates
 - No estimates for periods of time smaller than a year
 - Years divided by 4 to create quarter estimates
 - From 2021 to 2025, birth cohort fluctuated Y-O-Y from a low of 66,391 in 2023 to a high in 2025 of 68,723

Vital records as denominator

- Registry of Vital Records lags
- Most recent data reported for 2021 and 2022 births in the state:
 - 70,083 (2021)
 - 69,513 (2022)
- *Not enough data to be used for this analysis*

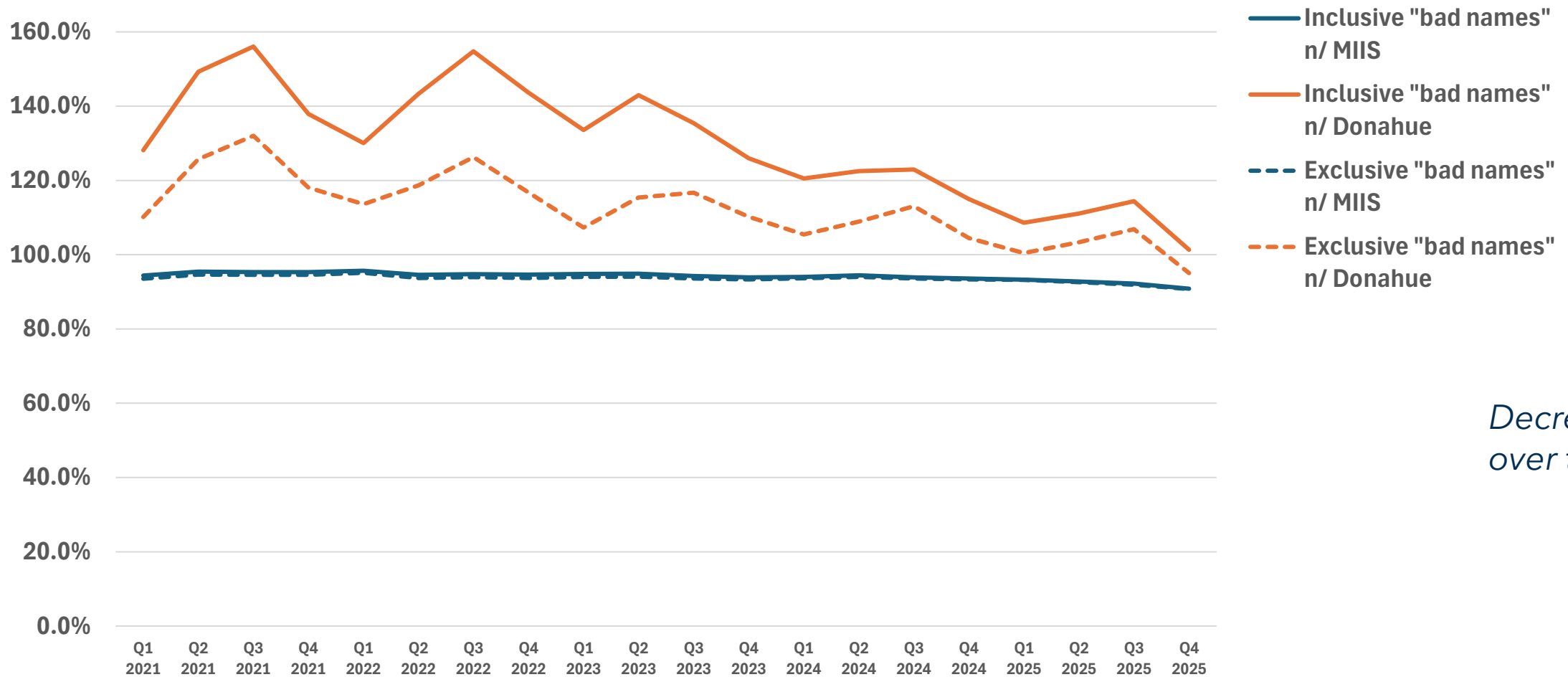
Calculating rates 4 ways

- Compared trends across these 4 ways of calculating rates
- Describe increasing, decreasing, or indeterminate trends over time rather than point estimates of coverage given data quality limitations

	Numerator includes "bad baby names"	Numerator excludes "bad baby names"
MIIS Denominator	Inclusive n/MIIS	<u>Exclusive n/MIIS</u>
Donahue estimates Denominator	Inclusive n/Donahue	<u>Exclusive n/Donahue</u>

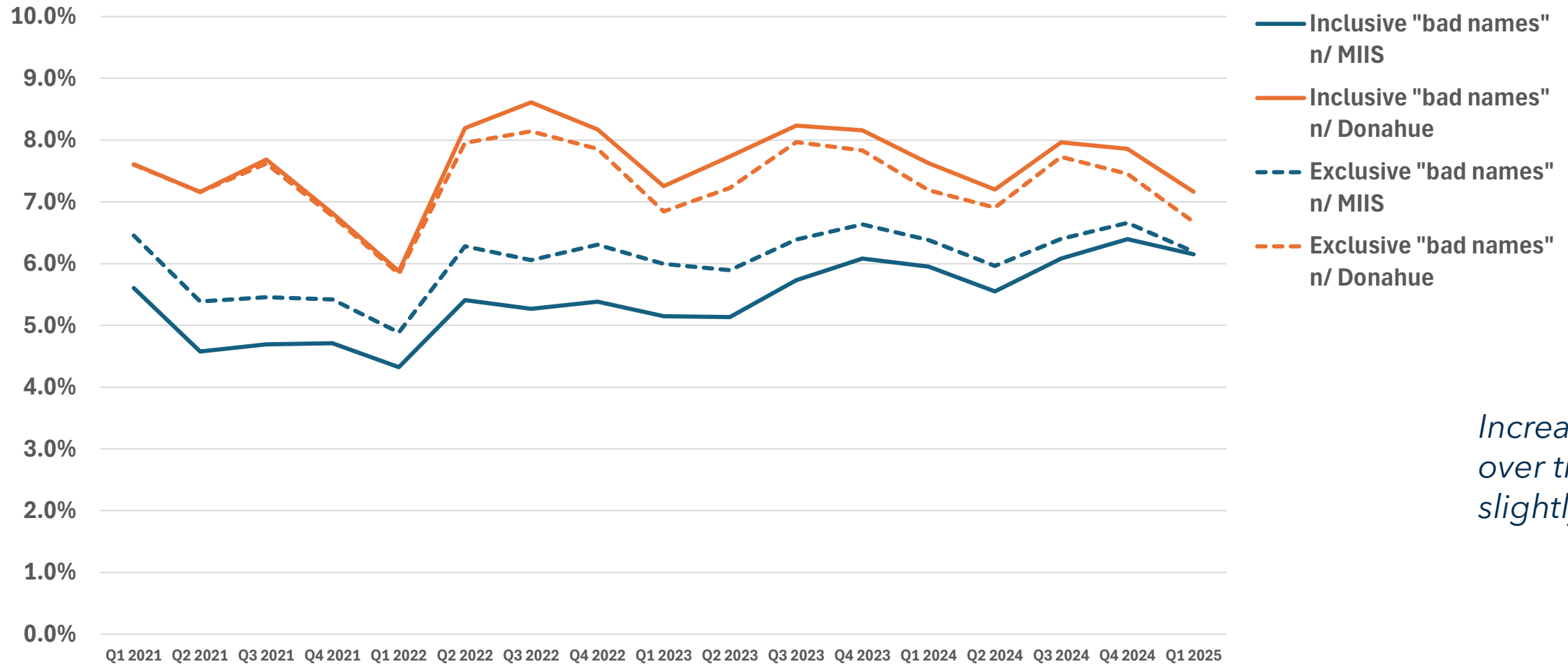
Examples of "bad baby names": BabyGirl, BabyBoy, etc.

Results - At least 1 dose



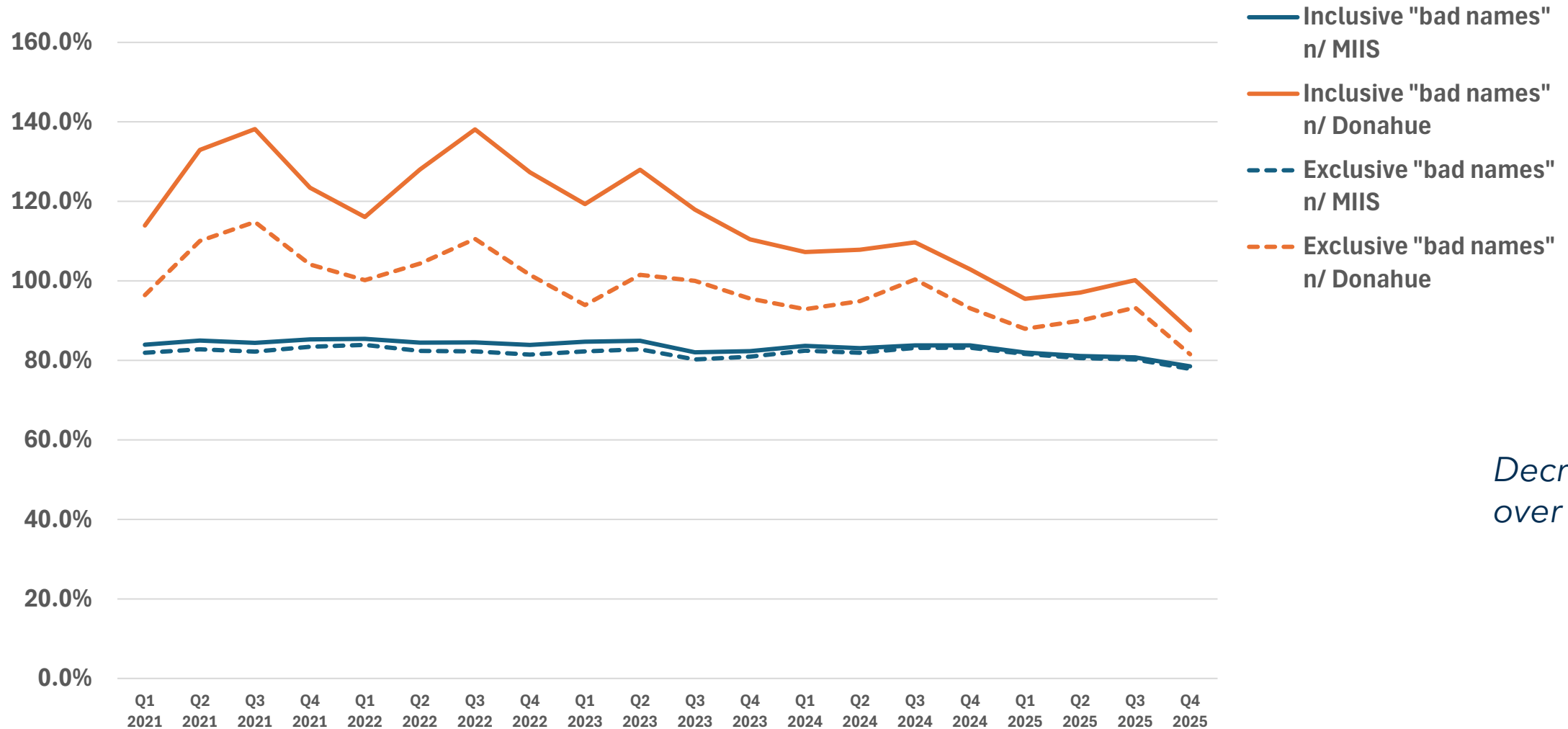
Decreasing over time

Results - No dose before 1 year



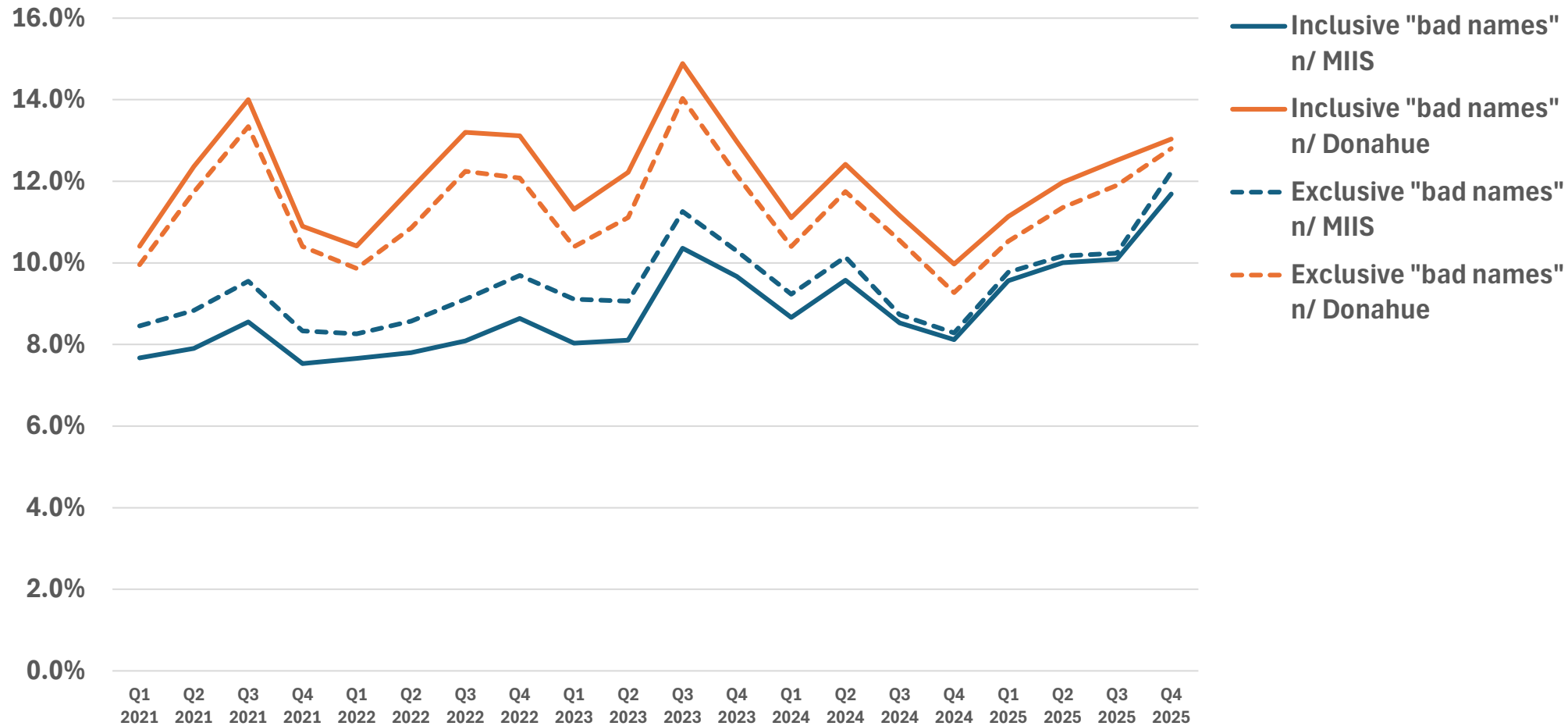
Increasing over time, slightly

Results - Birth dose (< 7 days)



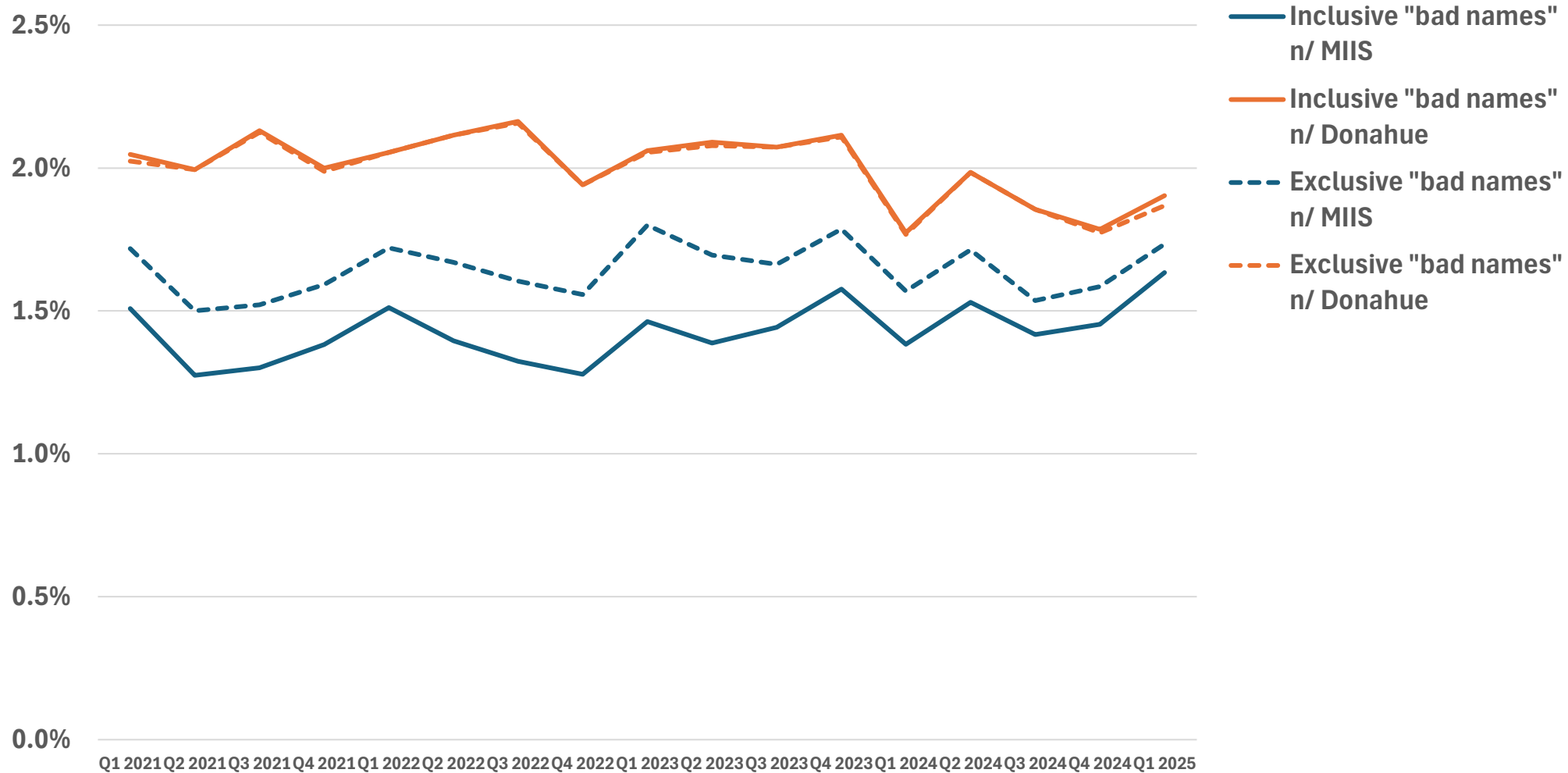
Decreasing over time

Results - Well-child visit dose (7-<90 days)



Increasing over time

Results - Late dose (90 days to 1 year)



About the same over time

Results summary

- Hep B coverage is higher if “bad baby names” are included than if excluded (for birth dose)
- Hep B coverage is higher with Donahue denominators than with MIIIS denominators

Across all 4 numerator/denominator rates

- Proportion of infants receiving **birth dose** decreased:
 - Q1 2021 ranged 81.9% to 113.9% → Q4 2025 ranged 77.9% to 87.6%
- Proportion receiving first dose late enough to be a **well-child visit** increased:
 - Q1 2021 ranged 7.7% to 10.4% → Q4 2025 ranged 11.7% to 13.0%
- Proportion receiving **no dose** by first birthday showed no consistent trend
 - *but* inclusive baby names with MIIIS denominator increased Q1 2021 5.6% → Q1 2025 6.2%
- Proportion receiving their first Hep B dose **late** showed no consistent trend over time

Limitations

- Without meaning to, this question uncovered complexity in how “bad baby name” data contribute to birth dose vaccine coverage
 - Examples of “bad baby names”: BabyGirl, BabyBoy, etc.
- Uncertain whether excluding them helps or hinders population monitoring
- Not enough time has gone by to learn whether youngest infants will continue not to be vaccinated throughout their first year

Next steps

- Stratify these data by race/ethnicity and geography to further understand trends in Hep B uptake in these most recent years
- Seek steps to improve baby name data quality to reduce duplicate and fragmented records that disproportionately affect Hep B immunizations given to unnamed infants

Acknowledgments

- Kind thanks to Boudu Bingay and Joshua Norville, epidemiologists of the Data Assessment Unit who extracted MIIIS data and assisted with this analysis
- And additional appreciation to Alyson Marcinkowski for her MIIIS data quality expertise

- Questions?

Note on the Donahue estimates

- Population estimates from 2011-present were created by the UMASS Donahue Institute (UMDI).
- The same categorizations were applied to the 2010 census data to make a consistent dataset from 2010-present.
- Data are updated annually with summary census files that incorporate lagging birth data. These more accurate and up-to-date rates may differ somewhat from previously released rates.
- UMDI estimates were created by a team of expert demographers using novel modifications of an existing and well-accepted methodology. UMDI created estimates by sex, age, race, and ethnicity at the census tract and community levels. These estimates are controlled to the annual county level Census estimates on a yearly basis, so they become more accurate over time.
- To read the full methodology, please refer to the report created by UMDI:
 - Strate, S., Renski, H., Peake, T., Murphy, J.J., Zaldonis, P. (2016). Small area population estimates for 2011 through 2020. [White Paper]. Population Estimates Program, Economic and Public Policy Research, University of Massachusetts Donahue Institute.

Calculating rates

- Compared trends across these 4 ways of calculating rates
- Numerators (inclusive of "bad baby names")
MIIS Denominators
- Numerators (exclusive of "bad baby names")
MIIS Denominators
- Numerators (inclusive of "bad baby names")
Donahue estimate Denominators
- Numerators (exclusive of "bad baby names")
Donahue estimate Denominators

Results -- inclusive of "bad baby names"

o	MIIS denominator	Donahue denominator (yr/4)	At least 1 dose			"No dose" (before 1 yr)			"Birth dose" (<7d)			"Well-child" (7-<90d)			"Late" (90d-<1yr)		
			n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue
Q1 2021	22,802	16,801	21,524	94.4%	128.1%	1,278	5.6%	7.6%	19,139	83.9%	113.9%	1,749	7.7%	10.4%	344	1.5%	2.0%
Q2 2021	26,280	16,801	25,077	95.4%	149.3%	1,203	4.6%	7.2%	22,334	85.0%	132.9%	2,077	7.9%	12.4%	335	1.3%	2.0%
Q3 2021	27,510	16,801	26,219	95.3%	156.1%	1,291	4.7%	7.7%	23,217	84.4%	138.2%	2,353	8.6%	14.0%	358	1.3%	2.1%
Q4 2021	24,310	16,801	23,165	95.3%	137.9%	1,145	4.7%	6.8%	20,738	85.3%	123.4%	1,831	7.5%	10.9%	336	1.4%	2.0%
Q1 2022	22,619	16,643	21,641	95.7%	130.0%	978	4.3%	5.9%	19,322	85.4%	116.1%	1,733	7.7%	10.4%	342	1.5%	2.1%
Q2 2022	25,224	16,643	23,860	94.6%	143.4%	1,364	5.4%	8.2%	21,310	84.5%	128.0%	1,967	7.8%	11.8%	352	1.4%	2.1%
Q3 2022	27,193	16,643	25,760	94.7%	154.8%	1,433	5.3%	8.6%	22,985	84.5%	138.1%	2,200	8.1%		360	1.3%	2.2%
Q4 2022	25,264	16,643	23,904	94.6%	143.6%	1,360	5.4%	8.2%	21,194	83.9%	127.3%	2,183	8.6%	13.1%	323	1.3%	1.9%
Q1 2023	23,378	16,598	22,174	94.8%	133.6%	1,204	5.2%	7.3%	19,801	84.7%	119.3%	1,878	8.0%	11.3%	342	1.5%	2.1%
Q2 2023	25,010	16,598	23,726	94.9%	142.9%	1,284	5.1%	7.7%	21,237	84.9%	128.0%	2,028	8.1%	12.2%	347	1.4%	2.1%
Q3 2023	23,850	16,598	22,483	94.3%	135.5%	1,367	5.7%	8.2%	19,573	82.1%	117.9%	2,471	10.4%	14.9%	344	1.4%	2.1%
Q4 2023	22,265	16,598	20,911	93.9%	126.0%	1,354	6.1%	8.2%	18,337	82.4%	110.5%	2,153	9.7%	13.0%	351	1.6%	2.1%
Q1 2024	21,826	17,029	20,527	94.0%	120.5%	1,299	6.0%	7.6%	18,265	83.7%	107.3%	1,891	8.7%	11.1%	302	1.4%	1.8%
Q2 2024	22,093	17,029	20,867	94.5%	122.5%	1,226	5.5%	7.2%	18,361	83.1%	107.8%	2,115	9.6%	12.4%	338	1.5%	2.0%
Q3 2024	22,292	17,029	20,936	93.9%	122.9%	1,356	6.1%	8.0%	18,677	83.8%	109.7%	1,901	8.5%	11.2%	316	1.4%	1.9%
Q4 2024	20,918	17,029	19,580	93.6%	115.0%	1,338	6.4%	7.9%	17,528	83.8%	102.9%	1,698	8.1%	10.0%	304	1.5%	1.8%
Q1 2025	20,009	17,181	18,663	93.3%	108.6%	1,231	6.2%	7.2%	16,406	82.0%	95.5%	1,913	9.6%	11.1%	327	1.6%	1.9%
Q2 2025	20,568	17,181	19,084	92.8%	111.1%	n/a	n/a	n/a	16,680	81.1%	97.1%	2,058	10.0%	12.0%	346 (so far)	1.7%	2.0%
Q3 2025	21,311	17,181	19,652	92.2%	114.4%	n/a	n/a	n/a	17,214	80.8%	100.2%	2,150	10.1%	12.5%	288 (so far)	1.4%	1.7%
Q4 2025	19,163	17,181	17,409	90.8%	101.3%	n/a	n/a	n/a	15,045	78.5%	87.6%	2,240	11.7%	13.0%	123 (so far)	0.6%	0.7%
			<i>subtle trend decreasing</i>			<i>subtle trend increasing</i>			<i>subtle trend decreasing</i>			<i>subtle trend increasing</i>			<i>indeterminate</i>		

Results -- exclusive of "bad baby names"

	MIIS denominator	Donahue denominator (yr/4)	At least 1 dose			"No dose" (before 1 yr)			"Birth dose" (<7d)			"Well-child" (7-<90d)			"Late" (90d-<1yr)		
			n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue	n	n/ MIIS	n/ Donahue
Q1 2021	19,785	16,801	18,508	93.5%	110.2%	1,277	6.5%	7.6%	16,203	81.9%	96.4%	1,673	8.5%	10.0%	340	1.7%	2.0%
Q2 2021	22,326	16,801	21,123	94.6%	125.7%	1,203	5.4%	7.2%	18,485	82.8%	110.0%	1,972	8.8%	11.7%	335	1.5%	2.0%
Q3 2021	23,461	16,801	22,181	94.5%	132.0%	1,280	5.5%	7.6%	19,292	82.2%	114.8%	2,241	9.6%	13.3%	357	1.5%	2.1%
Q4 2021	20,972	16,801	19,835	94.6%	118.1%	1,137	5.4%	6.8%	17,493	83.4%	104.1%	1,748	8.3%	10.4%	334	1.6%	2.0%
Q1 2022	19,875	16,643	18,904	95.1%	113.6%	971	4.9%	5.8%	16,676	83.9%	100.2%	1,642	8.3%	9.9%	342	1.7%	2.1%
Q2 2022	21,080	16,643	19,756	93.7%	118.7%	1,324	6.3%	8.0%	17,366	82.4%	104.3%	1,807	8.6%	10.9%	352	1.7%	2.1%
Q3 2022	22,373	16,643	21,018	93.9%	126.3%	1,355	6.1%	8.1%	18,406	82.3%	110.6%	2,038	9.1%	12.2%	359	1.6%	2.2%
Q4 2022	20,740	16,643	19,432	93.7%	116.8%	1,308	6.3%	7.9%	16,895	81.5%	101.5%	2,010	9.7%	12.1%	323	1.6%	1.9%
Q1 2023	18,944	16,598	17,808	94.0%	107.3%	1,136	6.0%	6.8%	15,588	82.3%	93.9%	1,726	9.1%	10.4%	341	1.8%	2.1%
Q2 2023	20,349	16,598	19,150	94.1%	115.4%	1,199	5.9%	7.2%	16,847	82.8%	101.5%	1,844	9.1%	11.1%	345	1.7%	2.1%
Q3 2023	20,689	16,598	19,367	93.6%	116.7%	1,322	6.4%	8.0%	16,599	80.2%	100.0%	2,329	11.3%	14.0%	344	1.7%	2.1%
Q4 2023	19,592	16,598	18,292	93.4%	110.2%	1,300	6.6%	7.8%	15,856	80.9%	95.5%	2,016	10.3%	12.1%	350	1.8%	2.1%
Q1 2024	19,178	17,029	17,954	93.6%	105.4%	1,224	6.4%	7.2%	15,813	82.5%	92.9%	1,771	9.2%	10.4%	301	1.6%	1.8%
Q2 2024	19,728	17,029	18,552	94.0%	108.9%	1,176	6.0%	6.9%	16,160	81.9%	94.9%	2,001	10.1%	11.8%	338	1.7%	2.0%
Q3 2024	20,565	17,029	19,249	93.6%	113.0%	1,316	6.4%	7.7%	17,095	83.1%	100.4%	1,796	8.7%	10.5%	316	1.5%	1.9%
Q4 2024	19,055	17,029	17,786	93.3%	104.4%	1,269	6.7%	7.5%	15,855	83.2%	93.1%	1,579	8.3%	9.3%	302	1.6%	1.8%
Q1 2025	18,517	17,181	17,261	93.2%	100.5%	1,147	6.2%	6.7%	15,114	81.6%	88.0%	1,809	9.8%	10.5%	321	1.7%	1.9%
Q2 2025	19,183	17,181	17,759	92.6%	103.4%	n/a	n/a	n/a	15,462	80.6%	90.0%	1,951	10.2%	11.4%	346 (so far)	1.8%	2.0%
Q3 2025	19,975	17,181	18,357	91.9%	106.8%	n/a	n/a	n/a	16,026	80.2%	93.3%	2,045	10.2%	11.9%	286 (so far)	1.4%	1.7%
Q4 2025	17,996	17,181	16,330	90.7%	95.0%	n/a	n/a	n/a	14,011	77.9%	81.6%	2,200	12.2%	12.8%	118 (so far)	0.7%	0.7%
			<i>more pronounced decreasing trend</i>			<i>indeterminate</i>			<i>indeterminate</i>			<i>more pronounced increasing trend</i>			<i>indeterminate</i>		

Comparison between "inclusive" and "exclusive"

Differences between Inclusive and Exclusive											
BIRTH_QUARTER	MIIS_DENOMINATOR	%Change	AT_LEAST_1_DOSE	%Change	NO_DOSE_BEFORE_1YR	DOSE_LT_7D	%Change	DOSE_7D_LT90D	%Change	DOSE_90_D_LT1YR	REMAINDER
2021-1Q	3016	13.2%	3015	13.2%	1	2935	12.9%	76	0.3%	4	0
2021-2Q	3954	15.0%	3954	15.0%	0	3849	14.6%	105	0.4%	0	0
2021-3Q	4049	14.7%	4038	14.7%	11	3925	14.2%	112	0.4%	1	0
2021-4Q	3339	13.7%	3331	13.7%	8	3246	13.3%	83	0.3%	2	0
2022-1Q	2744	12.1%	2737	12.1%	7	2646	11.7%	91	0.4%	0	0
2022-2Q	4144	16.4%	4104	16.3%	40	3944	15.6%	160	0.6%	0	0
2022-3Q	4819	17.7%	4741	17.4%	78	4578	16.8%	162	0.6%	1	0
2022-4Q	4524	17.9%	4472	17.7%	52	4299	17.0%	173	0.7%	0	0
2023-1Q	4434	18.9%	4366	18.7%	68	4213	18.0%	152	0.6%	1	0
2023-2Q	4661	18.6%	4576	18.3%	85	4390	17.5%	184	0.7%	2	0
2023-3Q	3160	13.2%	3115	13.1%	45	2974	12.5%	141	0.6%	0	0
2023-4Q	2673	12.0%	2619	11.8%	54	2481	11.1%	137	0.6%	1	0
2024-1Q	2648	12.1%	2573	11.8%	75	2452	11.2%	120	0.5%	1	0
2024-2Q	2365	10.7%	2315	10.5%	50	2201	10.0%	114	0.5%	0	0
2024-3Q	1727	7.7%	1687	7.6%	40	1582	7.1%	105	0.5%	0	0
2024-4Q	1863	8.9%	1794	8.6%	69	1673	8.0%	119	0.6%	2	0
2025-1Q	1491	7.4%	1401	7.0%	84	1291	6.4%	104	0.5%	6	6
2025-2Q	1383	6.7%	1323	6.4%	n/a	1218	5.9%	105	0.5%	0	60
2025-3Q	1335	6.3%	1294	6.1%	n/a	1187	5.6%	105	0.5%	2	41
2025-4Q	1164	6.1%	1077	5.6%	n/a	1030	5.4%	40	0.2%	7	87
2026-1Q	195	1.1%	183	1.0%	n/a	165	0.9%	18	0.1%	0	12