

Epidemiology of COVID-19-Associated Hospitalizations, including in Pregnant Persons and Infants

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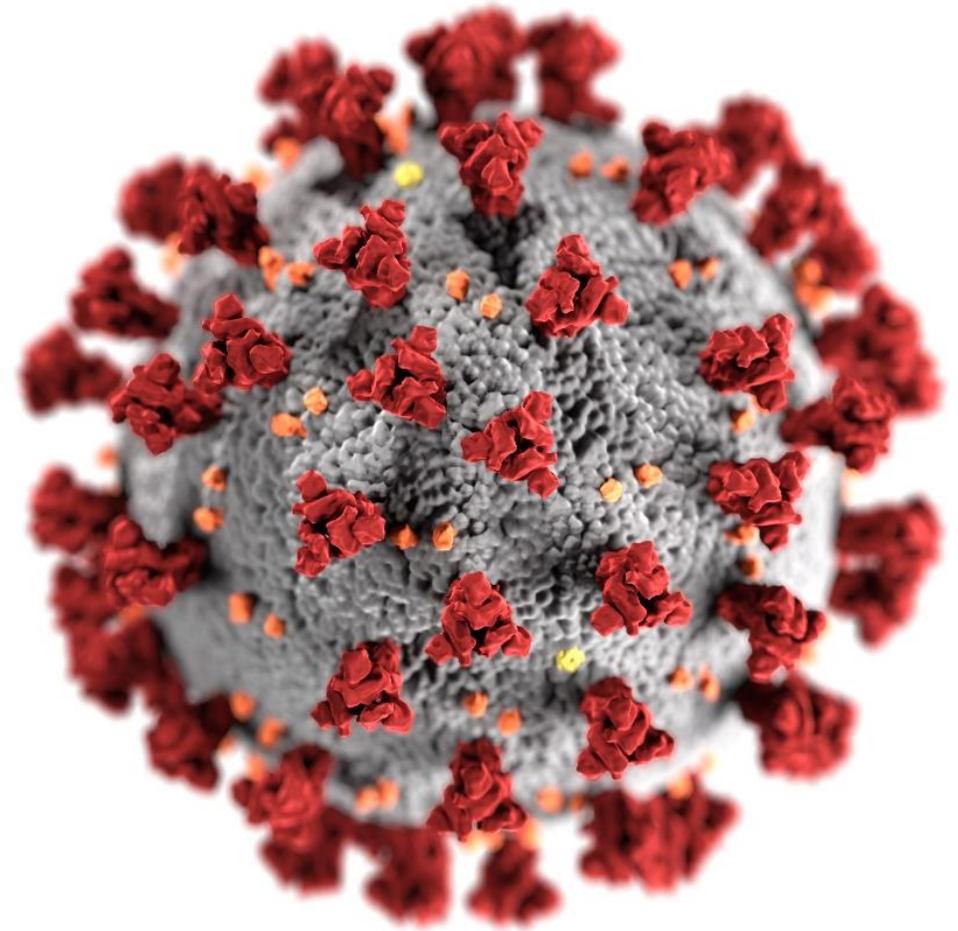
Coronavirus and Other Respiratory Viruses Division

National Center for Immunization and Respiratory Diseases

Centers for Disease Control and Prevention

Advisory Committee on Immunization Practices

June 23, 2023



cdc.gov/coronavirus

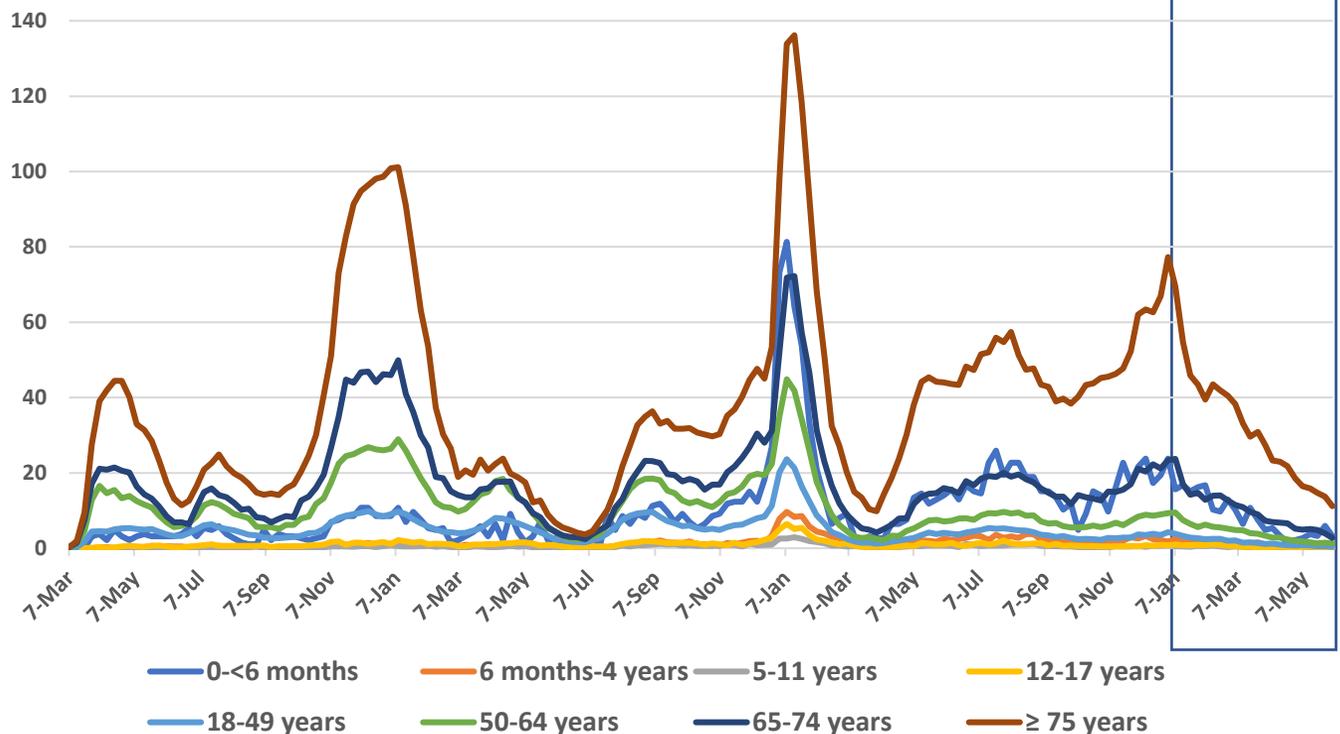
COVID-19-associated hospitalizations

COVID-NET: March 2020 – June 2023

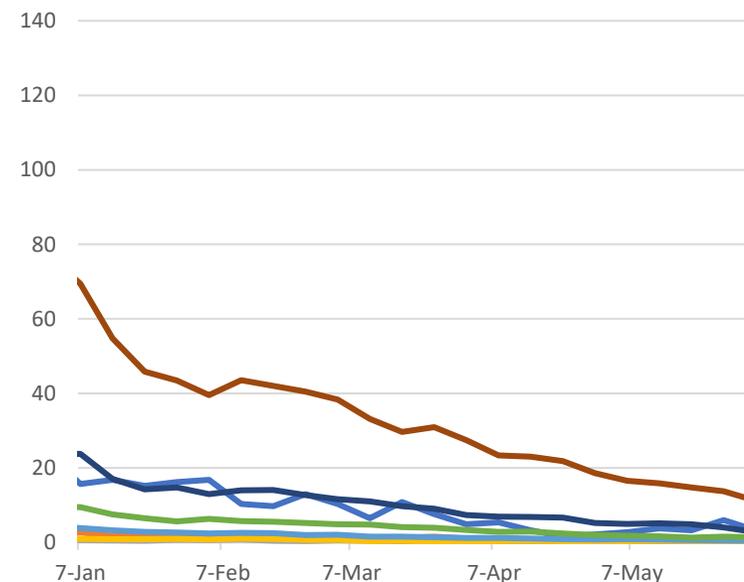


Weekly COVID-19-associated hospitalization rates — COVID-NET, 14 U.S. States

March 1, 2020 – June 3, 2023



January 1 – June 3, 2023

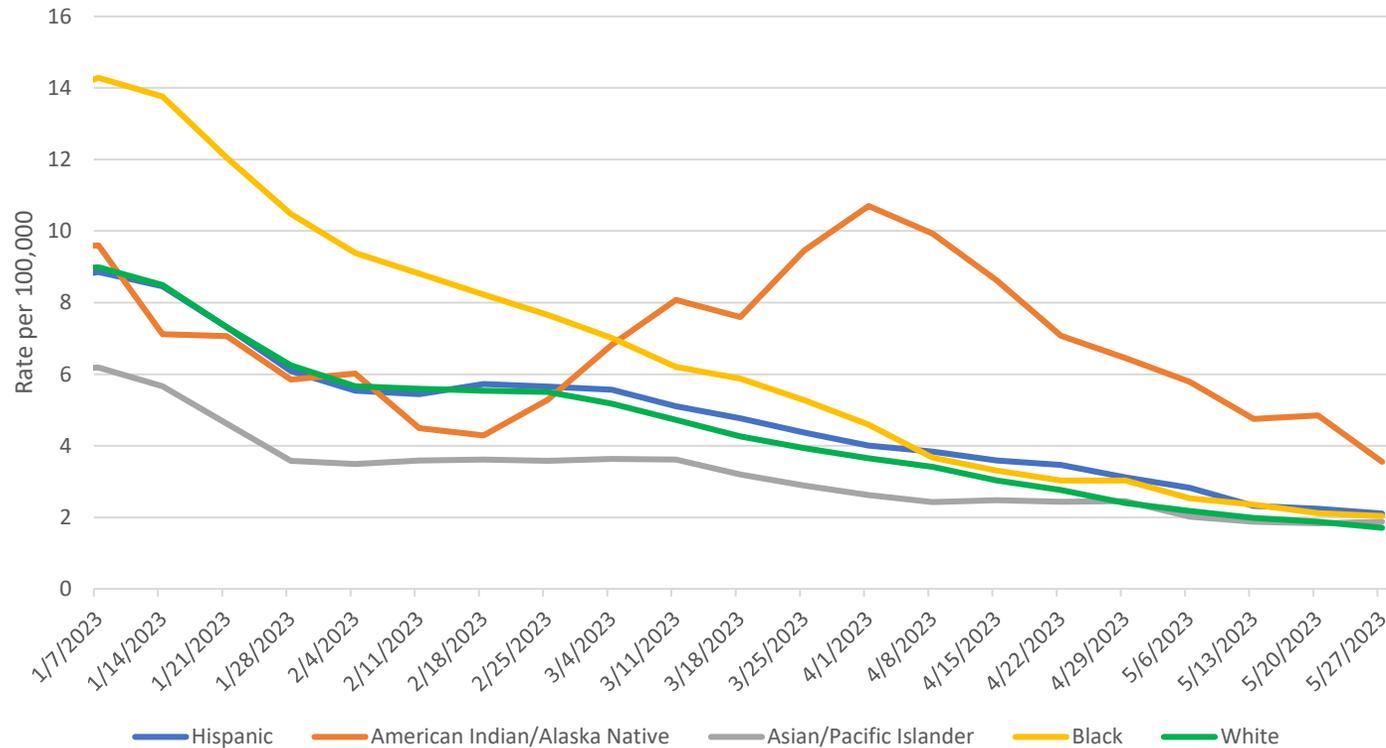


Rates highest in ≥75 years, followed by infants <6 months and those 65 – 74 years

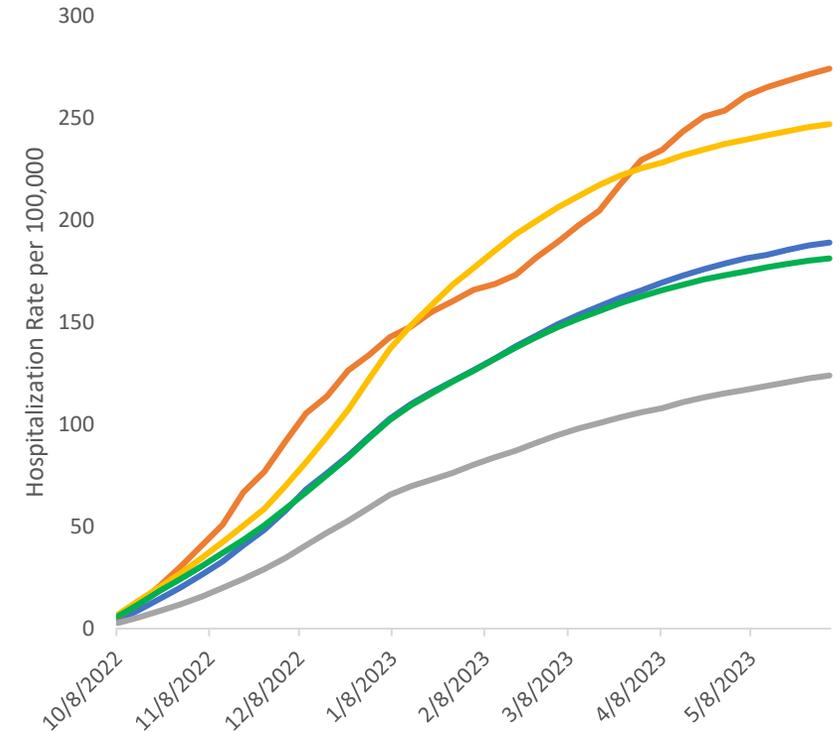


COVID-19-associated hospitalization rates by race and ethnicity* — COVID-NET, 14 U.S. States, October 2022 – May 2023

Age adjusted 3-week moving average rate
January – May 2023



Age adjusted cumulative rates
October 2022 – May 2023



Cumulative hospitalization rates remain highest in American Indian/Alaska Native and Black persons

* Black, White, American Indian/Alaska Native and Asian/Pacific Islander people were categorized as non-Hispanic; Hispanic people could be of any race.



COVID-19-associated hospitalizations in pregnant persons

COVID-NET: January 2021 – April 2023



COVID-19-associated hospitalizations among pregnant persons aged 15–49 years — COVID-NET, 14 U.S. States, January 2021–April 2023

Most pregnant people hospitalized with a positive SARS-CoV-2 test had no respiratory symptoms

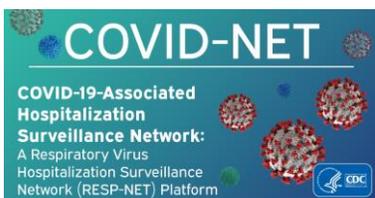
- 363 of 1,651 (21%) had respiratory symptoms recorded
- Proportion without respiratory symptoms increased from 73% to 82%

Among symptomatic patients, the proportion with underlying medical conditions increased

Table 1. Characteristics of COVID-19-associated hospitalized pregnant patients (15–49 years) with **respiratory symptoms**

	January – November 2021 (pre-Omicron) N (%)	December 2021 – June 2022 (early Omicron) N (%)	July 2022 – April 2023 (later Omicron) N (%)
Total number	184	99	80
Age group			
15-24 years	45 (16)	38 (31)	22 (21)
25-34 years	98 (60)	46 (54)	45 (59)
35-49 years	41 (25)	15 (15)	13 (20)
Any underlying medical conditions	72 (33)	32 (33)	46 (56)
Any pregnancy-associated complications*	37 (20)	25 (31)	23 (29)

*Pregnancy-associated complications include hypertensive disorders of pregnancy, gestational diabetes, intrauterine growth restrictions, and pre-eclampsia. Note that percentages are weighted to account for sampling scheme.

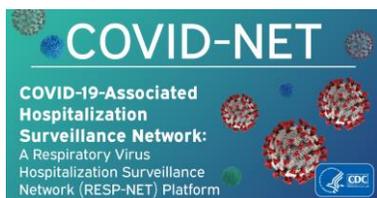


Interventions and outcomes among pregnant patients with respiratory symptoms and a positive SARS-CoV-2 test

The proportion requiring ICU admission and vasopressor support decreased over time

	January – November 2021 (pre-Omicron) N (%)*	December 2021 – June 2022 (early Omicron) N (%)*	July 2022 – April 2023 (later Omicron) N (%) *
Total Number	184	99	80
Interventions			
High flow nasal cannula	20 (12)	2 (2)	0 (0)
BIPAP/CPAP	5 (2)	1 (1)	1 (3)
Mechanical ventilation	15 (7)	3 (2)	1 (2)
Vasopressor	26 (15)	3 (2)	3 (6)
Dialysis or RRT	1 (0.5)	1 (1)	0 (0)
Severe outcomes			
ICU admission	31 (17)	7 (6)	2 (4)
In-hospital death	0 (0)	1 (1)	0 (0)

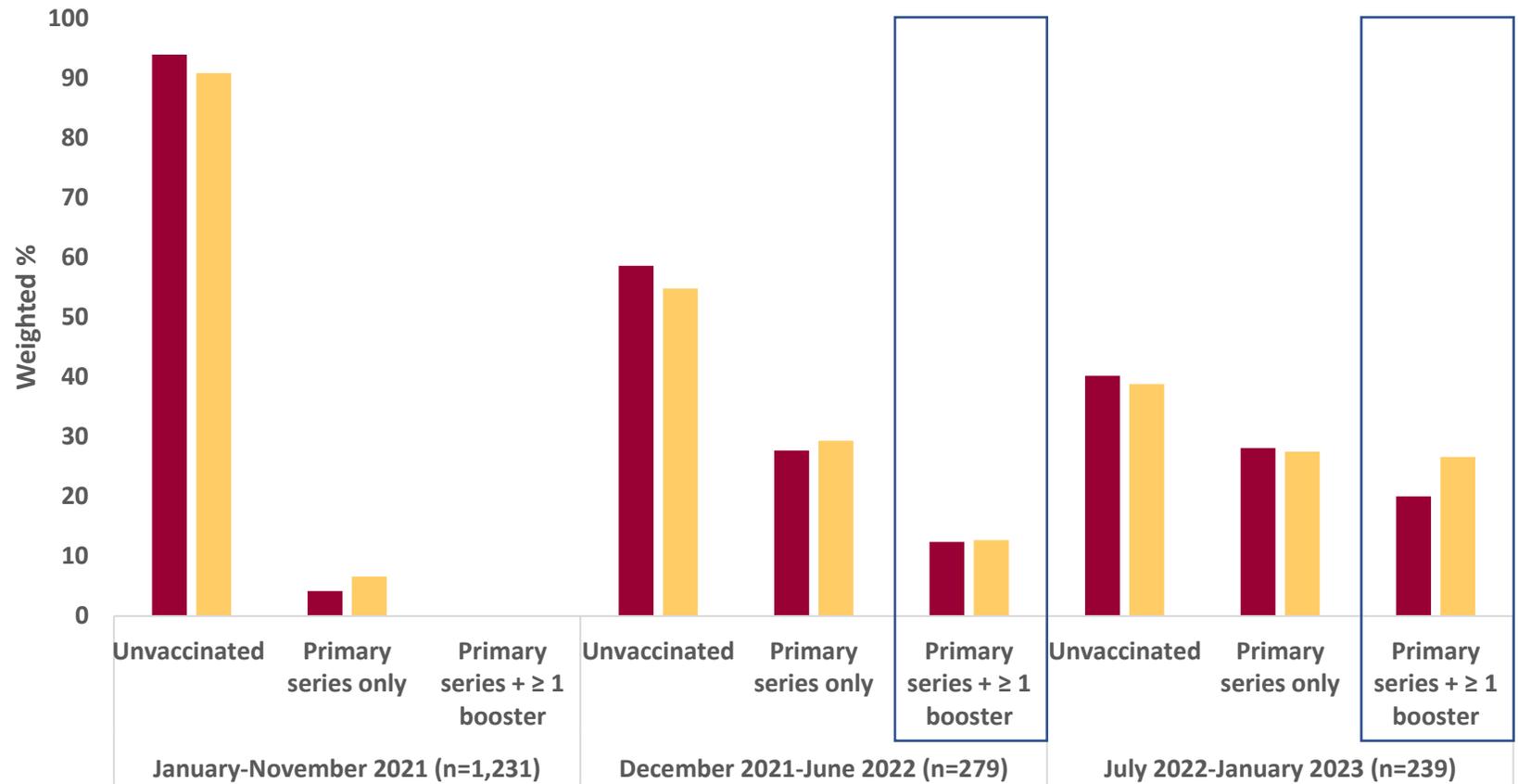
*Note that percentages are weighted to account for sampling scheme.



Vaccination status among pregnant patients hospitalized with laboratory-confirmed SARS-CoV-2 infection by symptom status, COVID-NET, January 2021–April 2023

More asymptomatic pregnant patients received boosters compared with symptomatic patients

Most pregnant patients had not received booster doses



■ Respiratory symptoms ■ No COVID-19 symptoms recorded

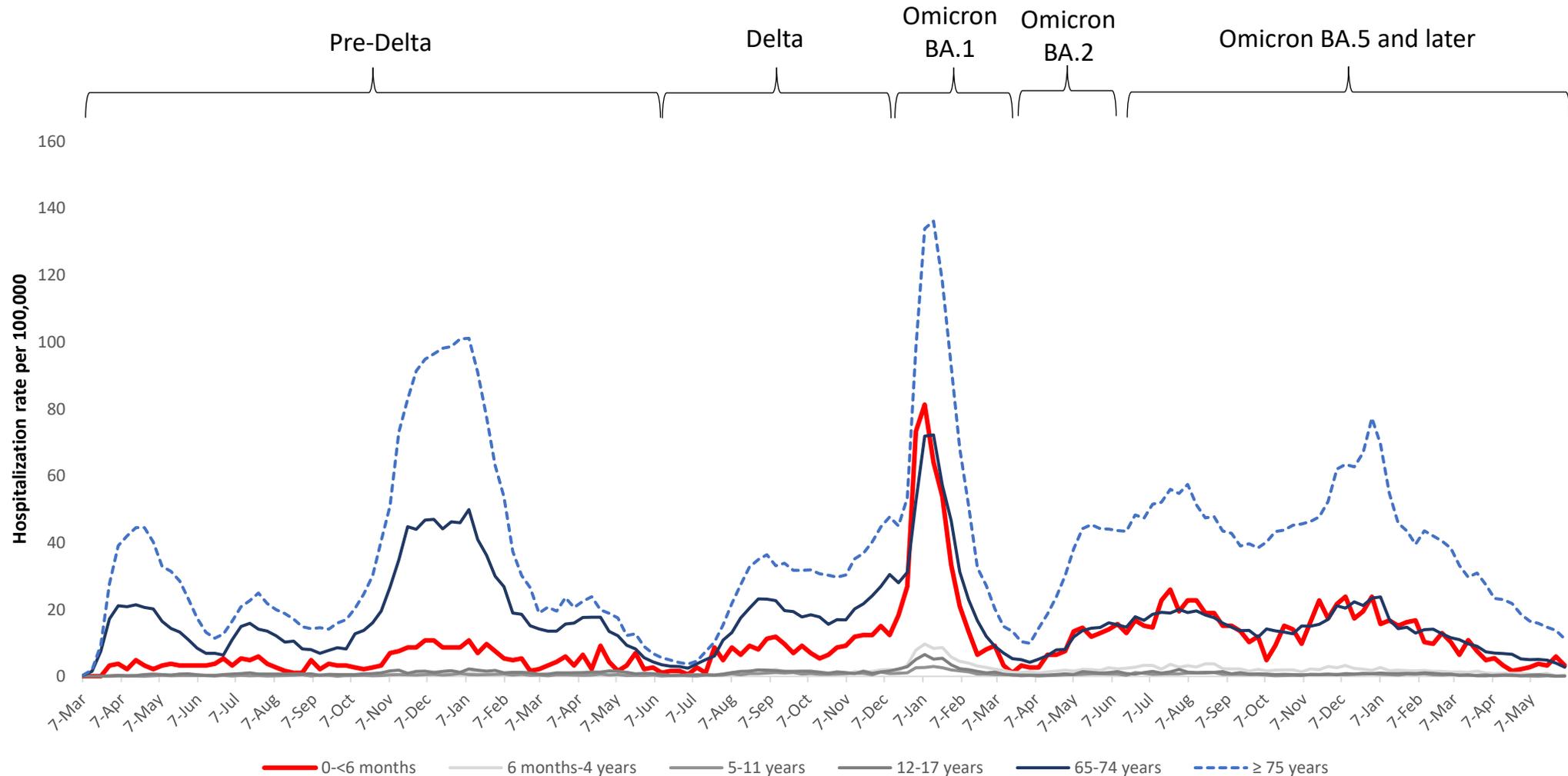


COVID-19-associated hospitalizations in infants <6 months

COVID-NET: March 2020 – May 2023

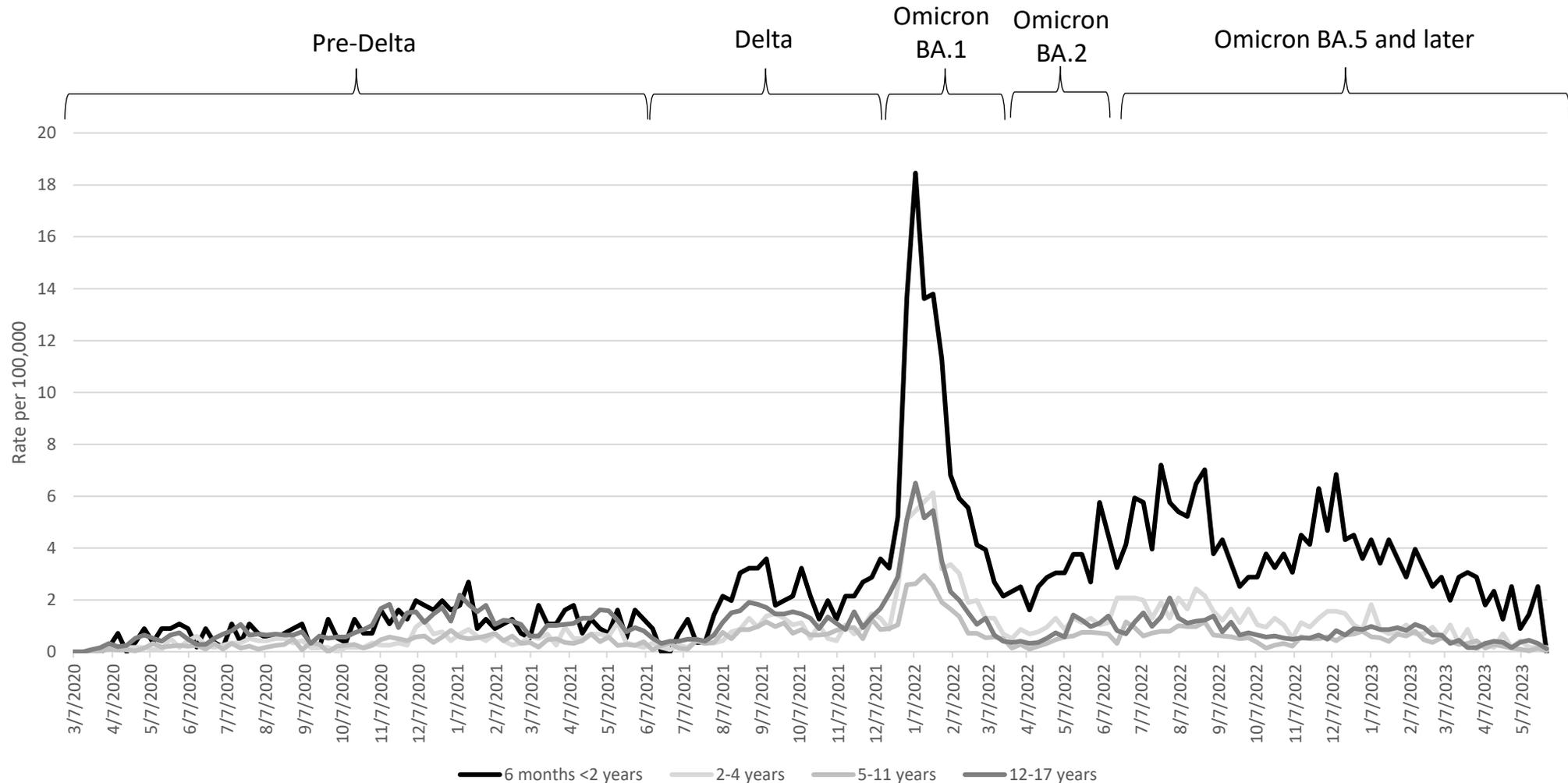


Infants <6 months old had similar COVID-19–associated hospitalization rates to adults aged 65–74 years old



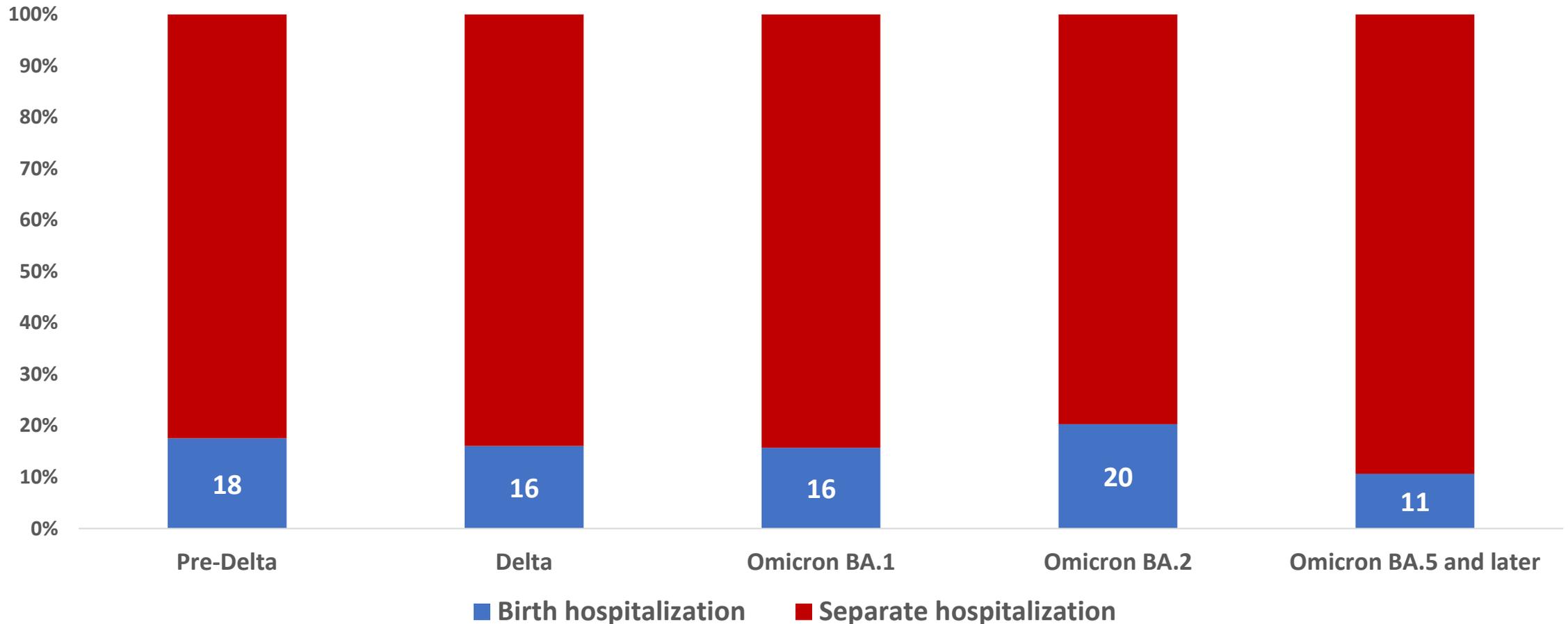
Source: COVID-NET: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html>. Data March 1, 2020 through March 31, 2023. Pre-Delta: March 1, 2020 – June 19, 2021; Delta: June 20–December 18, 2021; Omicron BA.1: December 19, 2021–March 19, 2022; Omicron BA.2: March 20–June 18, 2022; Omicron BA.5 (June 19, 2022–June 3, 2023)

Hospitalization rates in infants, children and adolescents aged 6 months through <18 years



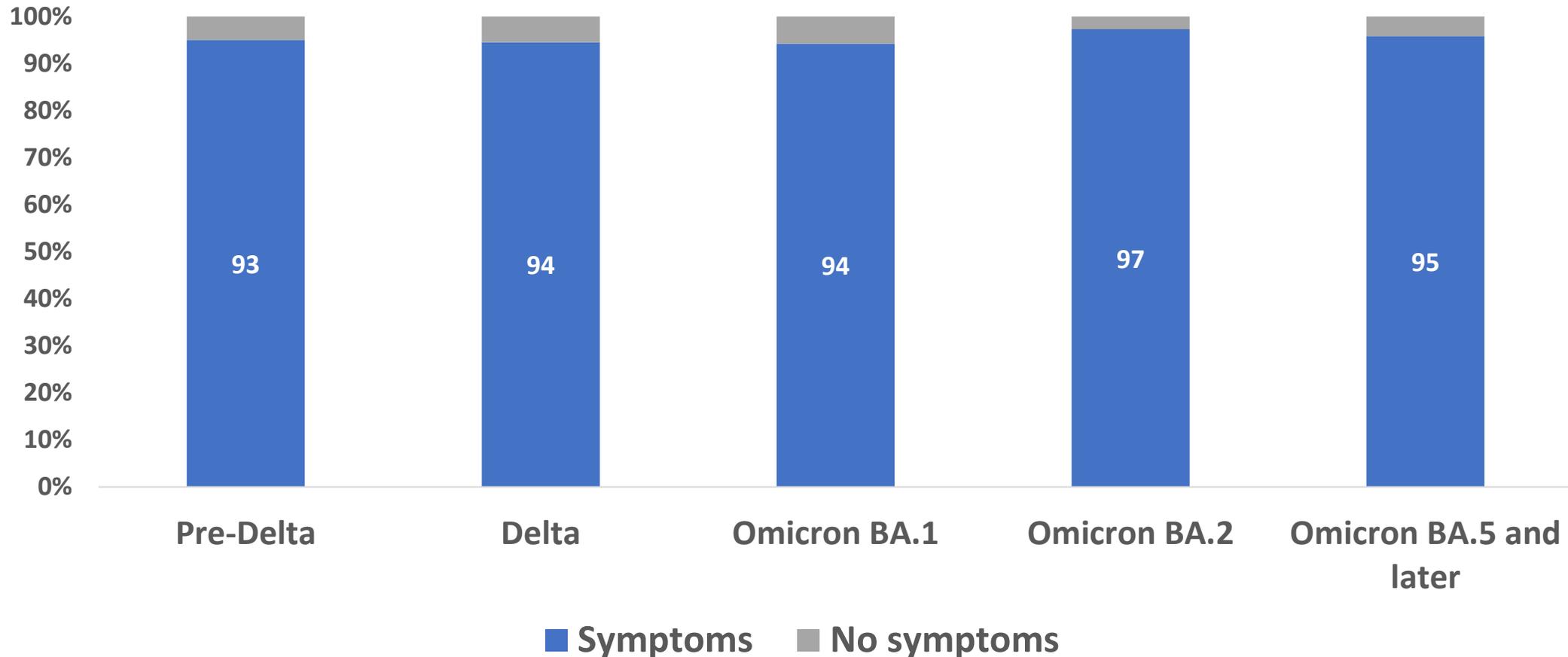
Source: COVID-NET: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html>. Data March 1, 2020 through March 31, 2023. Pre-Delta: March 1, 2020 – June 19, 2021; Delta: June 20–December 18, 2021; Omicron BA.1: December 19, 2021–March 19, 2022; Omicron BA.2: March 20–June 18, 2022; Omicron BA.5 (June 19, 2022–May 27, 2023)

On average, 15% of hospitalized infants <6 months with COVID-19 were identified during their birth hospitalization*

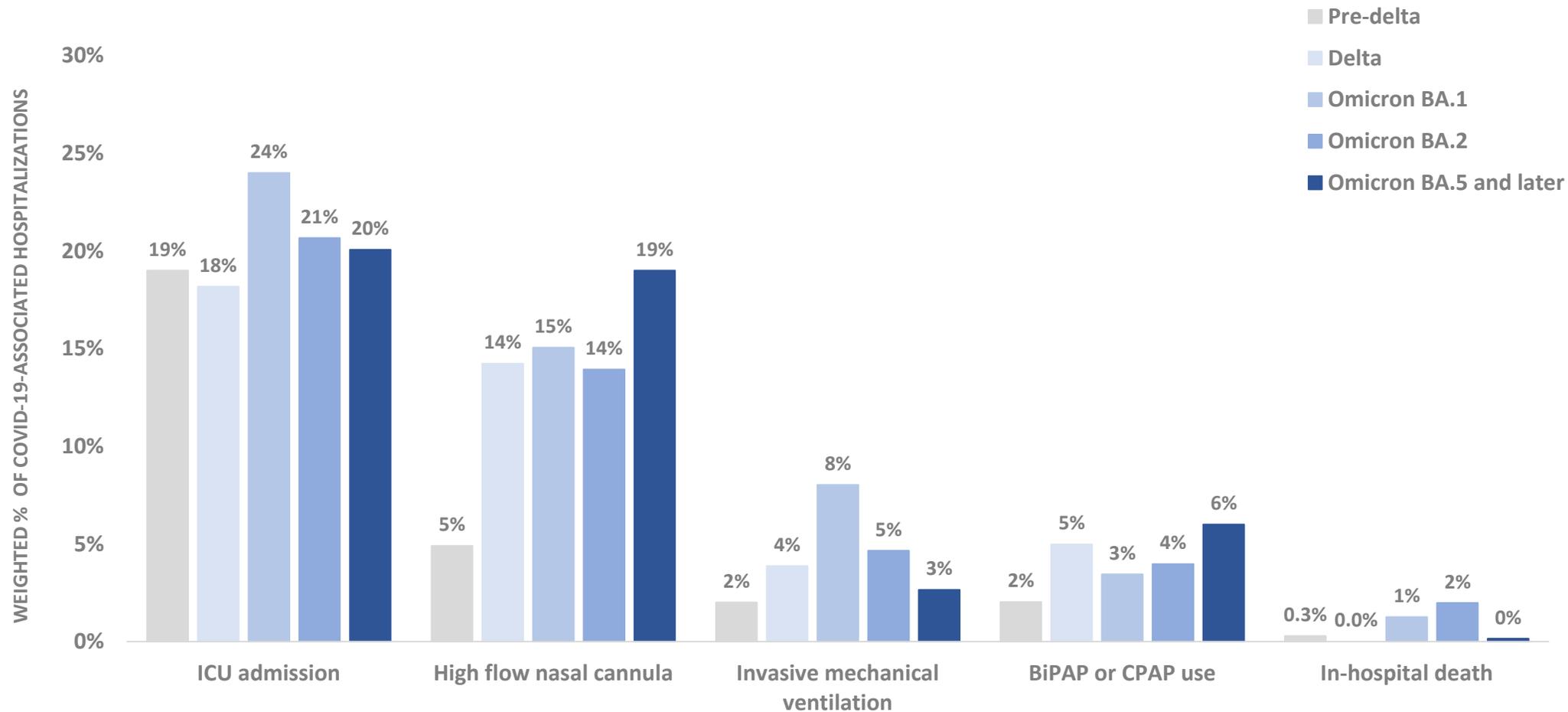


*Birth hospitalization was defined as admission date within 1 day of birth. Source: COVID-NET: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html>. Data March 1, 2020 through March 31, 2023. Pre-Delta: March 1, 2020 – June 19, 2021; Delta: June 20–December 18, 2021; Omicron BA.1: December 19, 2021–March 19, 2022; Omicron BA.2: March 20–June 18, 2022; Omicron BA.5 (June 19, 2022–March 31, 2023) .

95% of infants <6 months old with a separate hospitalization had COVID-19 symptoms during the Omicron BA.5 period



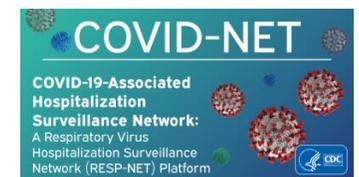
1 in 5 infants < 6 months old with COVID-19 were admitted to the ICU (excluding birth hospitalizations)



Source: COVID-NET: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html>. Data March 1, 2020 through March 31, 2023. Pre-Delta: March 1, 2020 – June 19, 2021; Delta: June 20–December 18, 2021; Omicron BA.1: December 19, 2021–March 19, 2022; Omicron BA.2: March 20–June 18, 2022; Omicron BA.5 (June 19, 2022–March 31, 2023)

Trends in COVID-19-associated hospitalizations – COVID-NET, March 2020 – May 2023

- **General:** Hospitalization rates decreased in all age groups
 - The age distribution of persons hospitalized with COVID-19 has shifted such that the highest rates are in adults aged ≥ 75 years followed by those 65-74 years and infants ages < 6 months
- **Pregnant persons:**
 - Most pregnant persons hospitalized with a positive SARS-CoV-2 test had no symptoms recorded at admission and were likely identified through screening on admission
 - Among those with respiratory symptoms, the proportion with underlying medical conditions has increased and the proportion with severe outcomes has decreased
 - Most hospitalized pregnant persons with a positive SARS-CoV-2 test, regardless of symptoms or reason for testing, were not up to date with vaccinations
- **Infants < 6 months:** Hospitalization rates increased in the Omicron period
 - Most hospitalized with COVID-19-like symptoms
 - Excluding birth hospitalizations, 20% admitted to the ICU since June 2022



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- RESP-NET partners

Thank you.



COVID-19 in pregnant people

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Emergency Preparedness and Response Team

Field Support Branch

Division of Reproductive Health

National Center for Chronic Disease Prevention and Health Promotion



Disease burden and risks to maternal and infant health

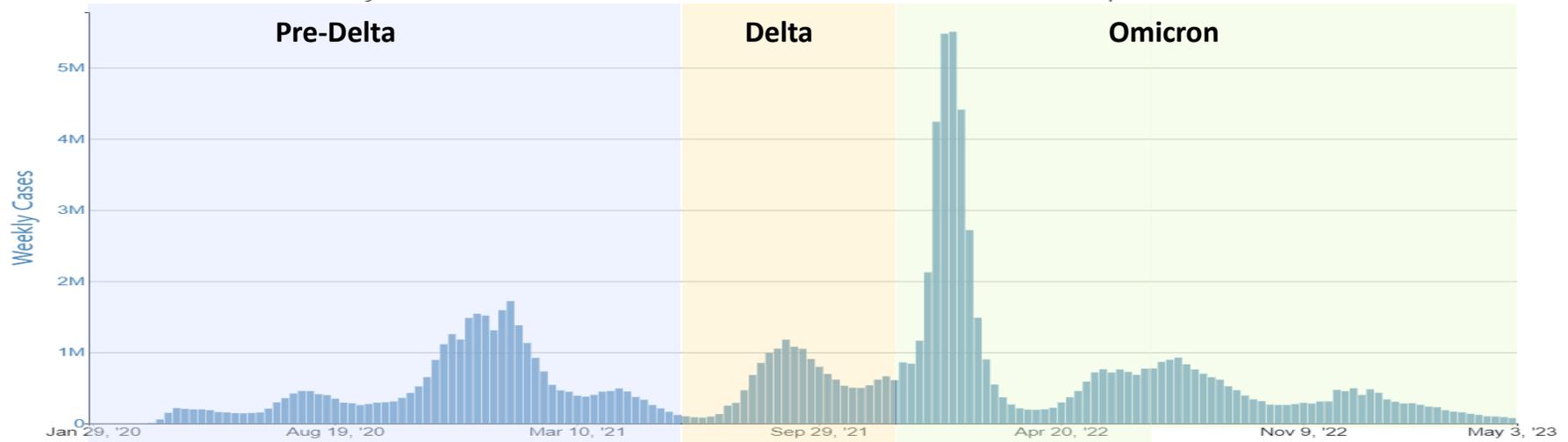
COVID-19 in Pregnant People

- COVID-19 during pregnancy is associated with more severe maternal health outcomes
- COVID-19 during pregnancy is associated with adverse pregnancy outcomes (e.g., preterm birth, stillbirth)
- Adverse maternal, fetal, and infant outcomes differed according to the circulating variant

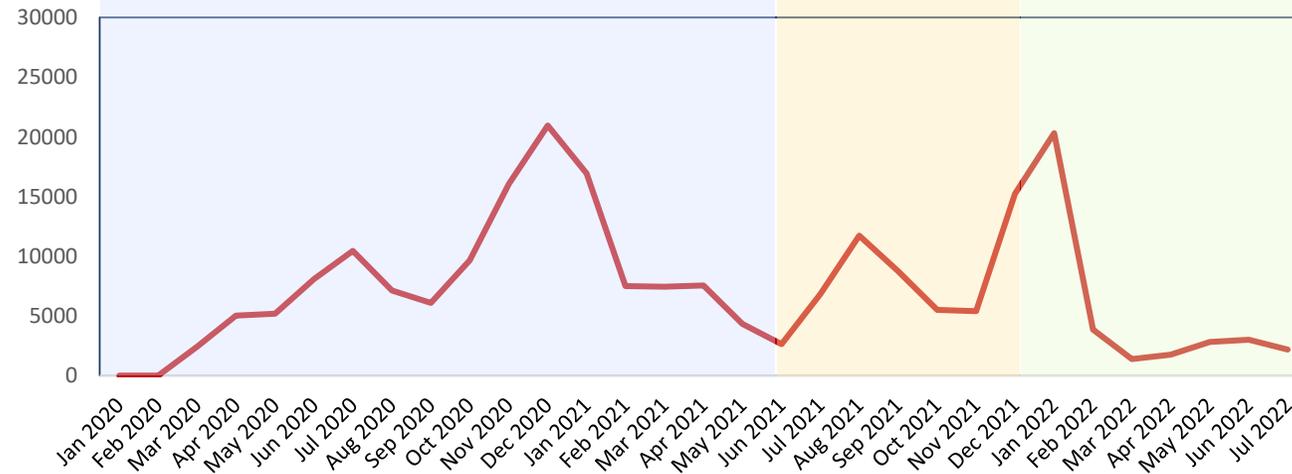
Reported COVID-19 cases overall and among pregnant people in the US (National COVID-19 Case Surveillance Data; Jan 22, 2020–May 3, 2023)

Weekly Trends in Number of COVID-19 Cases in The United States Reported to CDC

Overall Cases



Cases among pregnant people



Total among pregnant people:
226,263 cases
738 ICU admissions
329 Deaths

Among people with COVID-19, pregnancy increased the risk for ICU admission and invasive ventilation

(Living Systematic Review with data from 1 Dec 2019 - 27 Apr 2021)

Outcomes	# Studies	# with event/# in group (%)		Odds ratio (95% CI)
		Pregnant with COVID -19	Non-pregnant with COVID-19	
All cause mortality	11	242/122 222 (0.2)	5252/2 138 726 (0.2)	1.48 (0.62 to 3.49)
ICU admission	10	912/118 403 (0.8)	11 513/1 908 957 (0.6)	2.61 (1.84 to 3.71)
Invasive ventilation	8	310/116 458 (0.3)	3607/1 772 716 (0.2)	2.41 (2.13 to 2.71)
ECMO	5	19/30 694 (0.1)	122/432 623 (0.0)	3.71 (0.71 to 19.41)
ARDS	4	22/197 (11.2)	45/418 (10.8)	1.19 (0.24 to 5.95)
Major organ failure	4	5/197 (2.5)	28/418 (6.7)	0.39 (0.15 to 1.04)

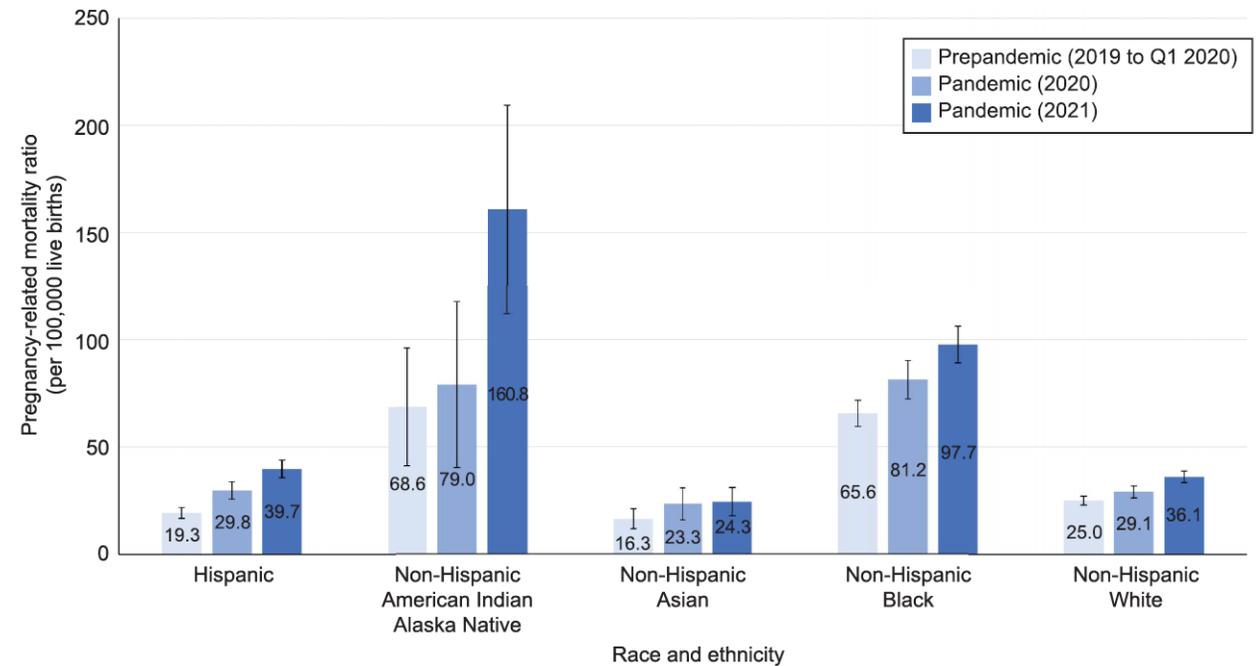
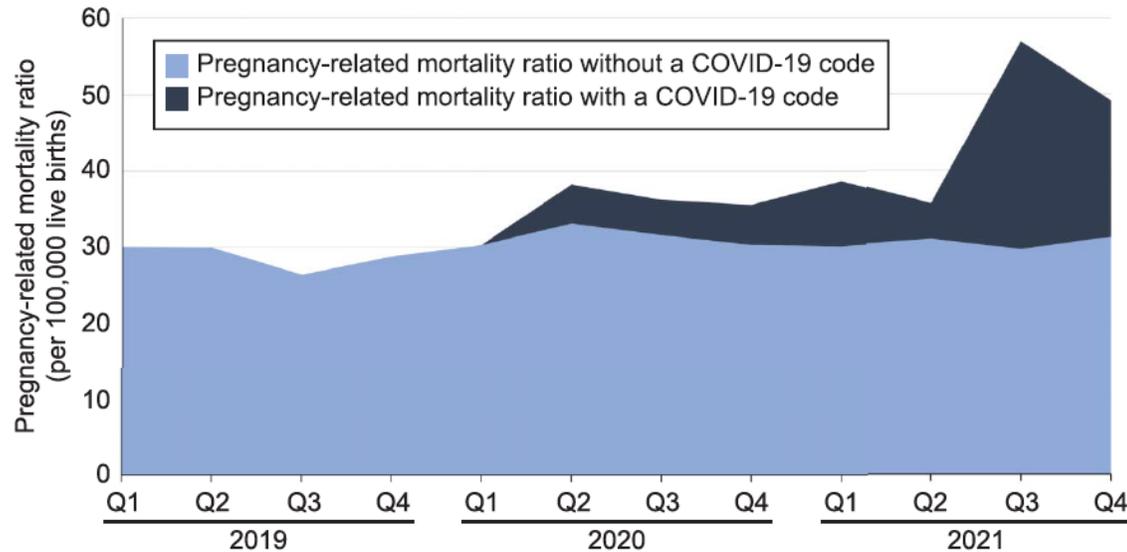
ECMO: extracorporeal membrane oxygenation; ARDS: Acute respiratory distress syndrome

Among pregnant people, COVID-19 increased the risk for adverse maternal, fetal, and infant outcomes

(Living Systematic Review with data from 1 Dec 2019 - 27 Apr 2021)

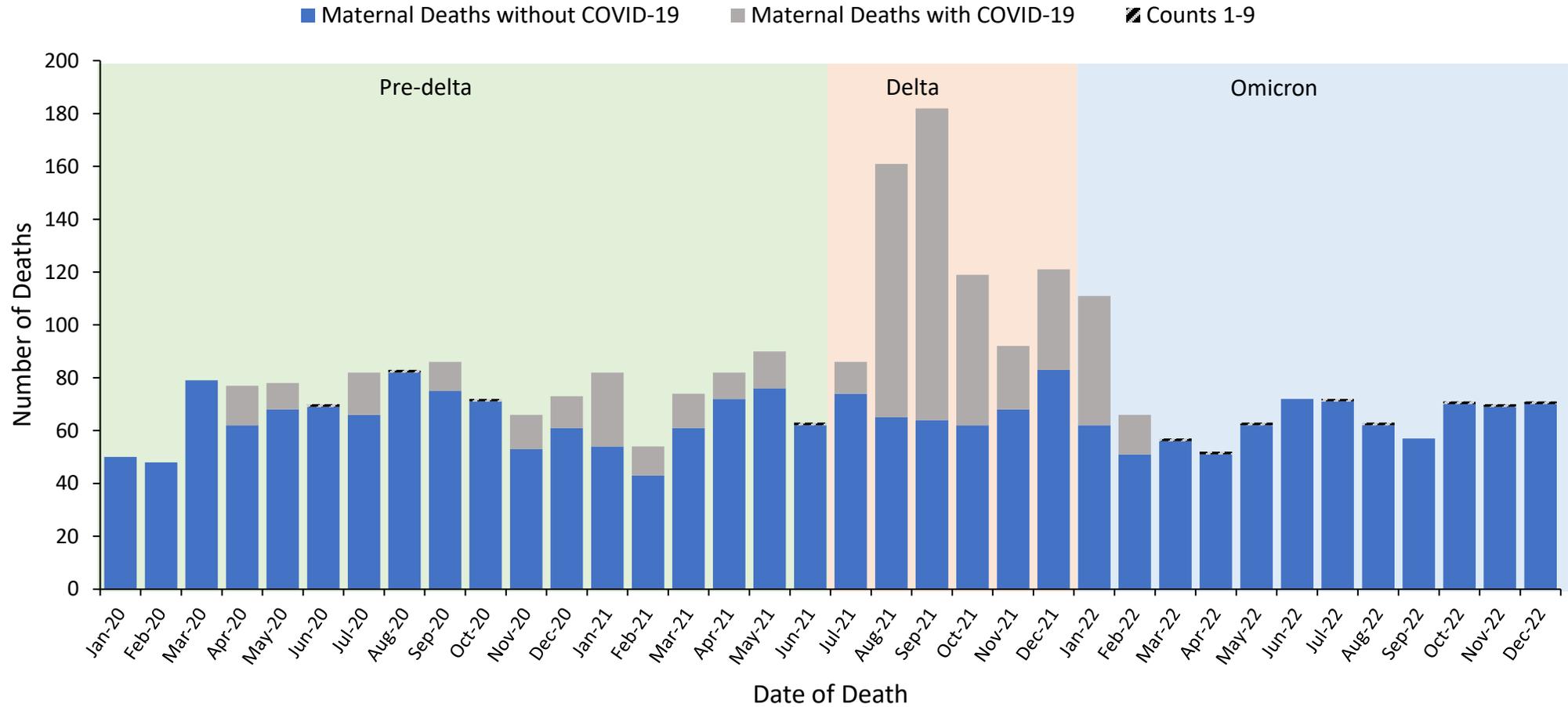
Outcomes	# Studies	# with event/# in group (%)		Odds ratio (95% CI)
		Pregnant with COVID-19	Pregnant without COVID-19	
Maternal outcomes:				
All cause mortality	21	47/11 362 (0.4)	37/411 126 (0.0)	6.09 (1.82 to 20.38)
ICU admission	21	447/12 957 (3.4)	1962/459 359 (0.4)	5.41 (3.59 to 8.14)
Preterm birth <37 weeks	48	1306/12 076 (10.8)	26 068/436 964 (6.0)	1.57 (1.36 to 1.81)
Perinatal outcomes:				
Stillbirth	25	76/9338 (0.8)	1397/414 139 (0.3)	1.81 (1.38 to 2.37)
Neonatal death	21	16/3153 (0.5)	28/9 263 (0.3)	2.35 (1.16 to 4.76)
Admission to neonatal unit	29	687/4072 (16.9)	6968/193 124 (3.6)	2.18 (1.46 to 3.26)
Fetal distress	6	131/1073 (12.2)	246/3933 (6.3)	2.22 (1.45 to 3.41)

Pregnancy-related mortality increased rapidly in 2021 (pre-Omicron), consistent with rising rates of COVID-19 associated mortality



Have risks evolved by COVID-19 variant?

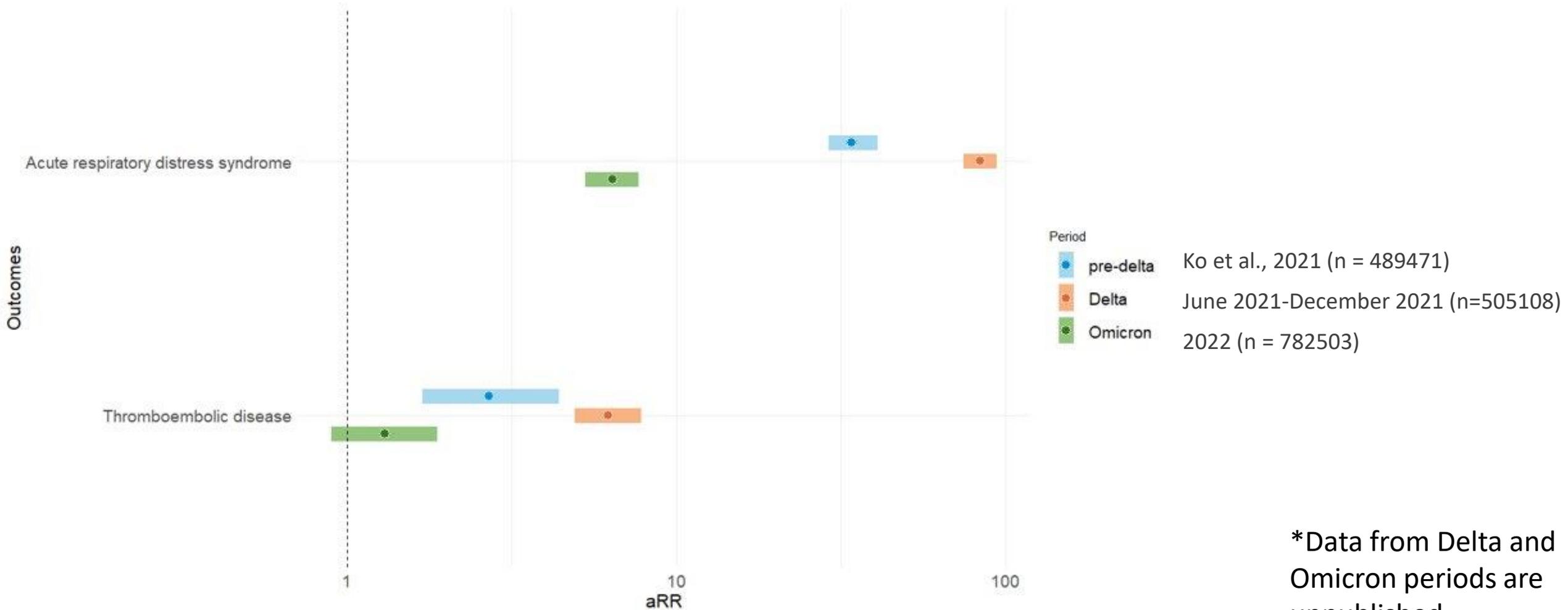
Figure 1. Maternal deaths and maternal deaths mentioning COVID-19, by count, US 2020-2022



Note: Data for 2020-2021 are final and data for 2022-2023. Death counts between 1-9 are suppressed in accordance with NCHS confidentiality standards. Weeks with COVID-19 death counts 1-9 are noted on the figure with black and grey diagonal lines.

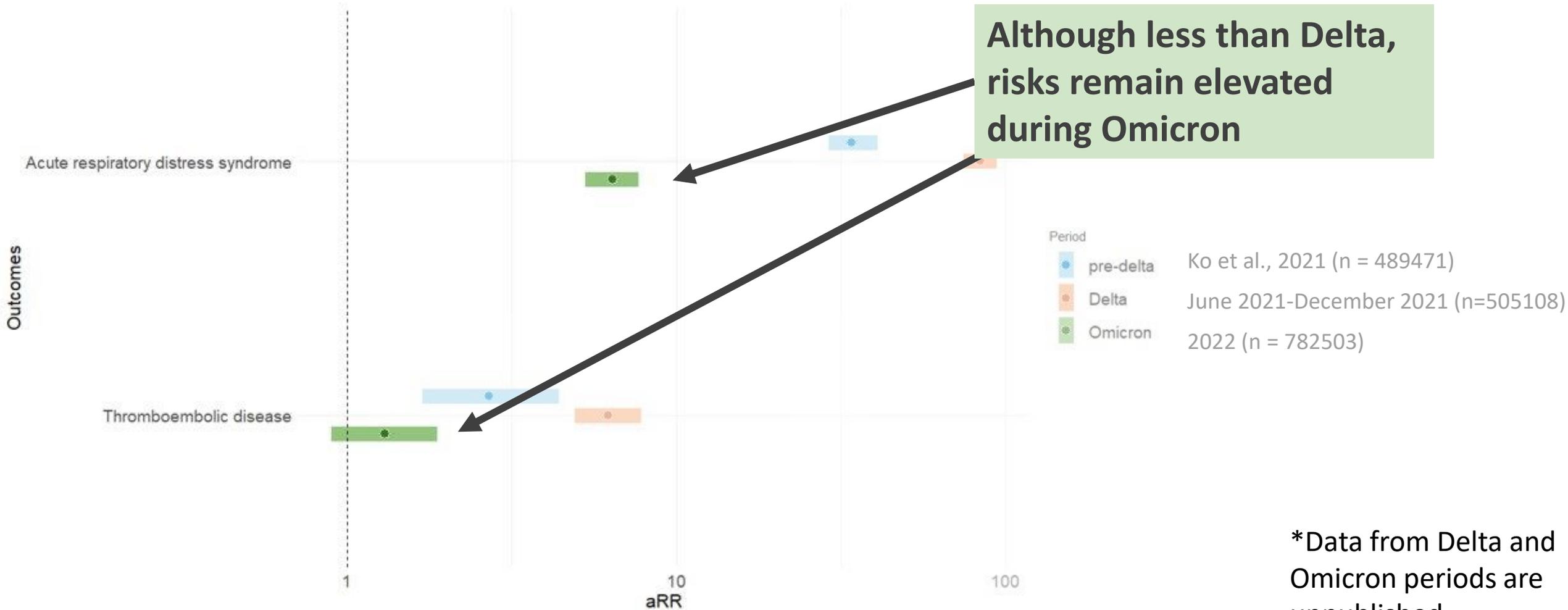
Source: CDC, National Center for Health Statistics. National Vital Statistics System, Provisional Mortality on CDC WONDER Online Database. Accessed at <http://wonder.cdc.gov/mcd-icd10-provisional.html>

Updated Premier: Pregnant Person Complications Associated With a Documented COVID-19 Diagnosis at Delivery Hospitalization— United States, Pre-delta, Delta, and Omicron



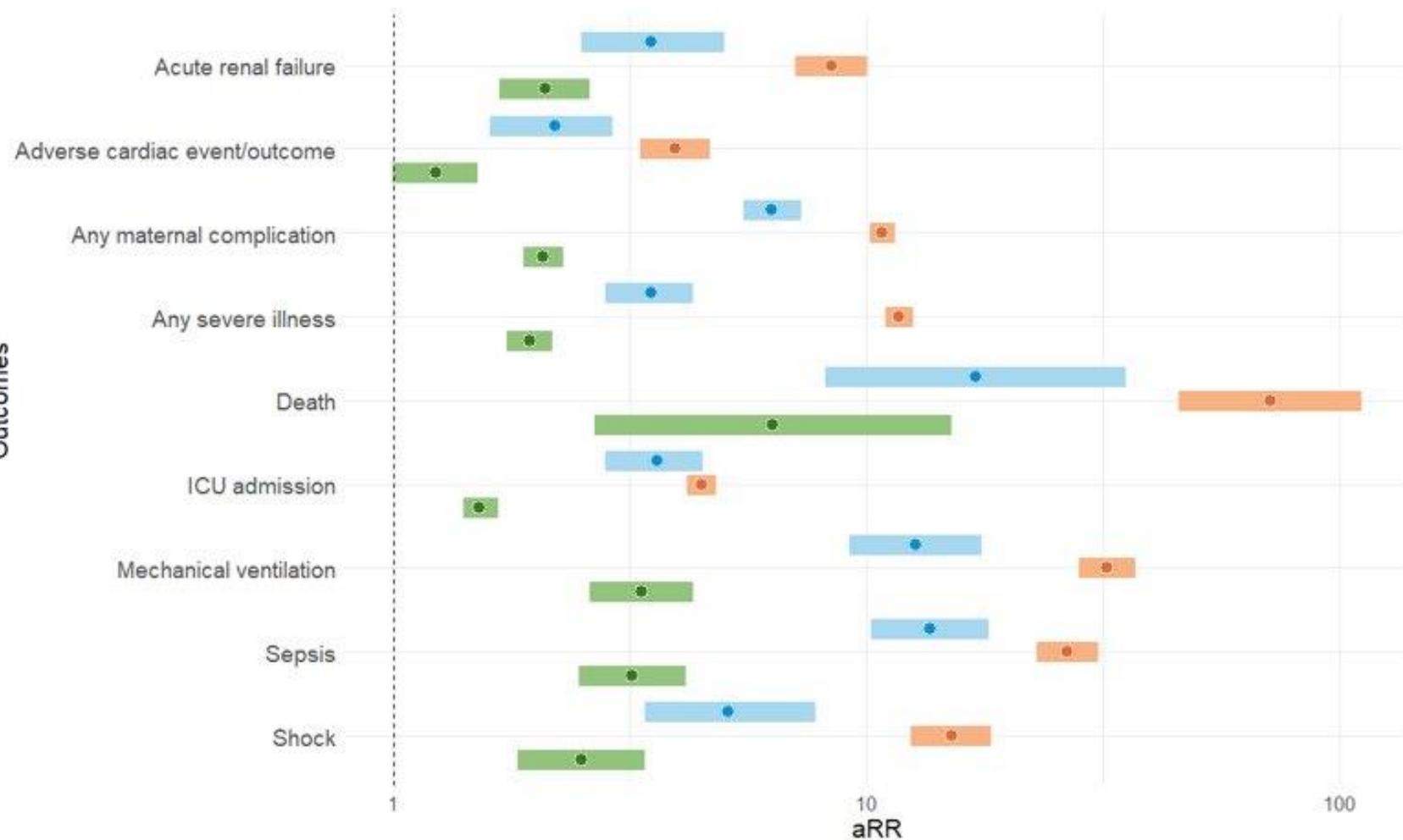
*Data from Delta and Omicron periods are unpublished

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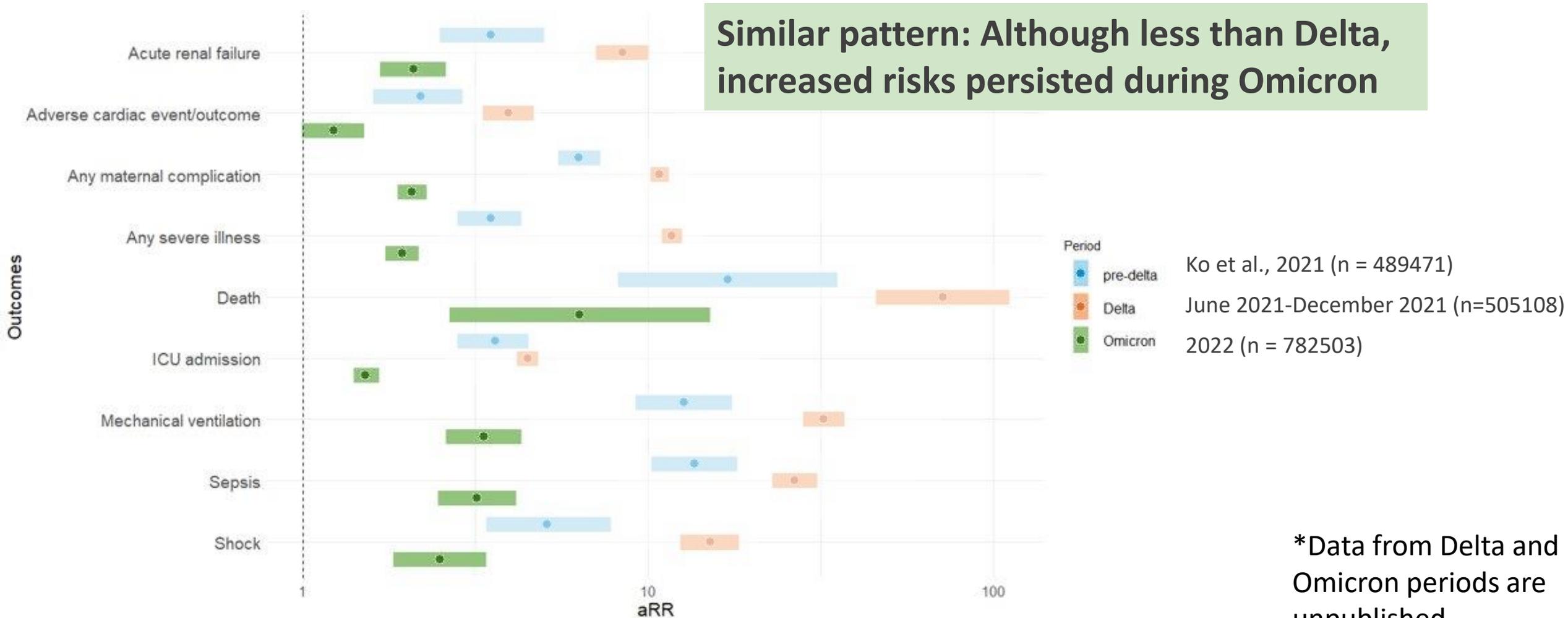
Period
● pre-delta
● Delta
● Omicron

Ko et al., 2021 (n = 489471)
 June 2021-December 2021 (n=505108)
 2022 (n = 782503)

*Data from Delta and Omicron periods are unpublished

Updated Premier: Pregnant Person Complications Associated With a Documented COVID-19 Diagnosis at Delivery Hospitalization— United States, Pre-delta, Delta, and Omicron

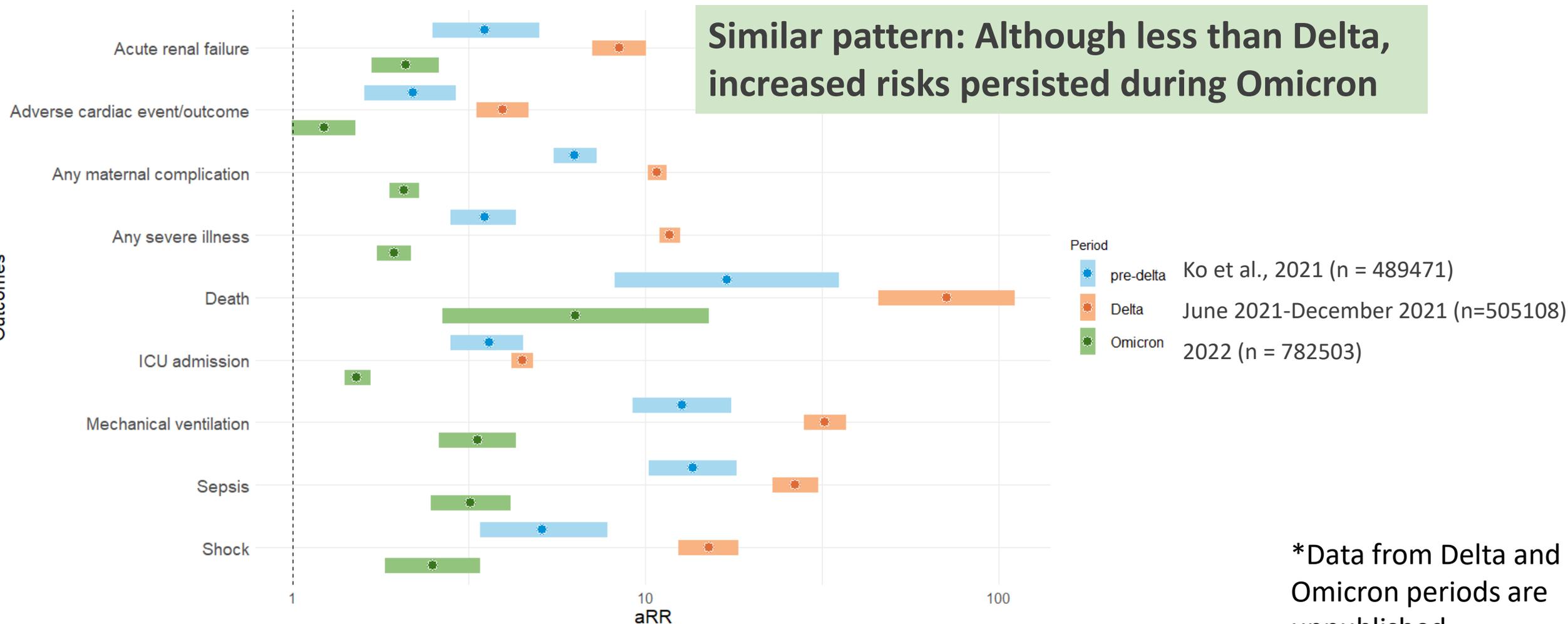
Similar pattern: Although less than Delta, increased risks persisted during Omicron



Ko et al., 2021 (n = 489471)
 June 2021-December 2021 (n=505108)
 2022 (n = 782503)

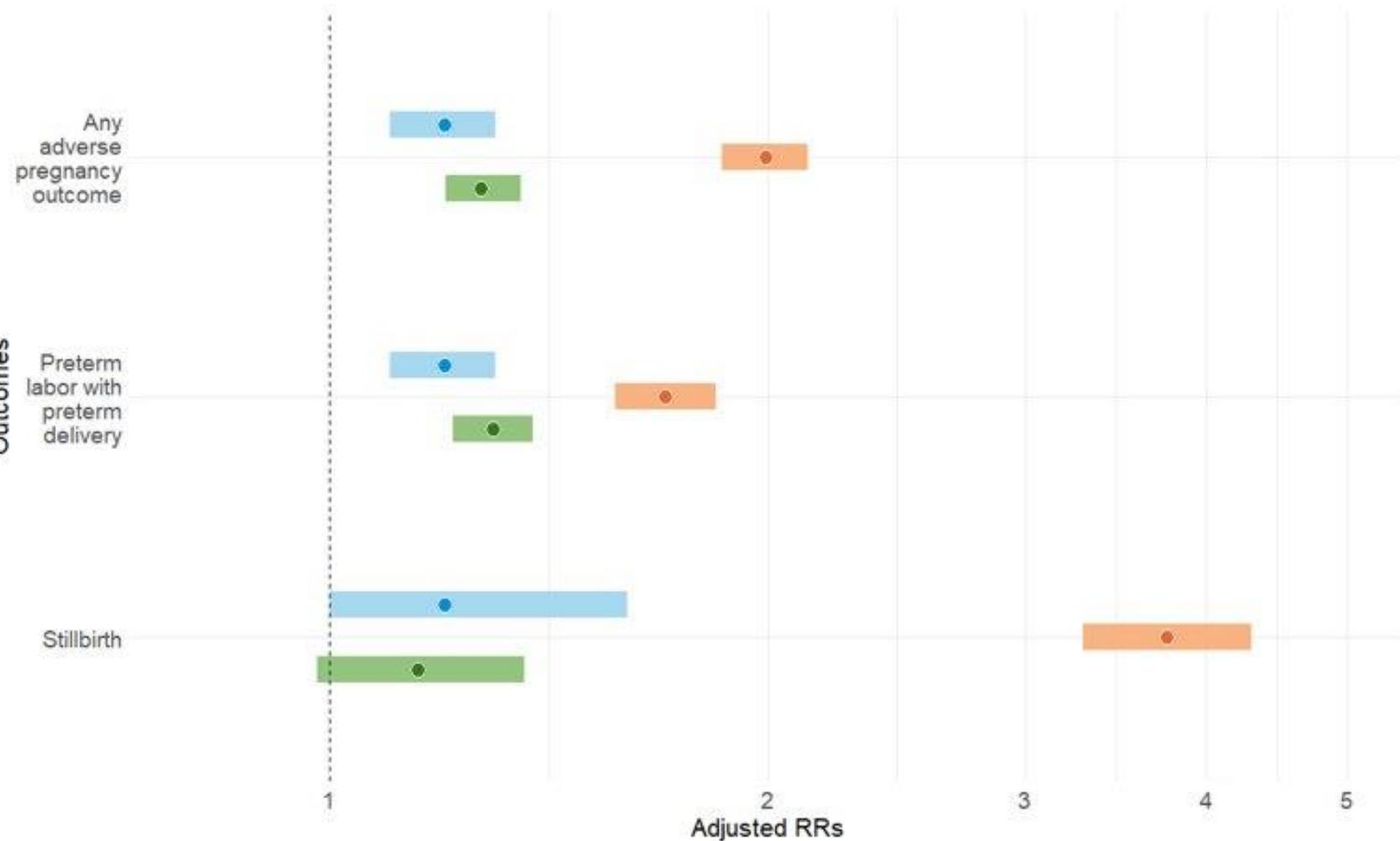
*Data from Delta and Omicron periods are unpublished

Updated Premier: Pregnant Person Complications Associated With a Documented COVID-19 Diagnosis at Delivery Hospitalization— United States, Pre-delta, Delta, and Omicron



*Data from Delta and Omicron periods are unpublished

Adverse Pregnancy Outcomes Associated With a Documented COVID-19 Diagnosis at Delivery Hospitalization—United States, Pre-delta, Delta, and Omicron Periods, Premier

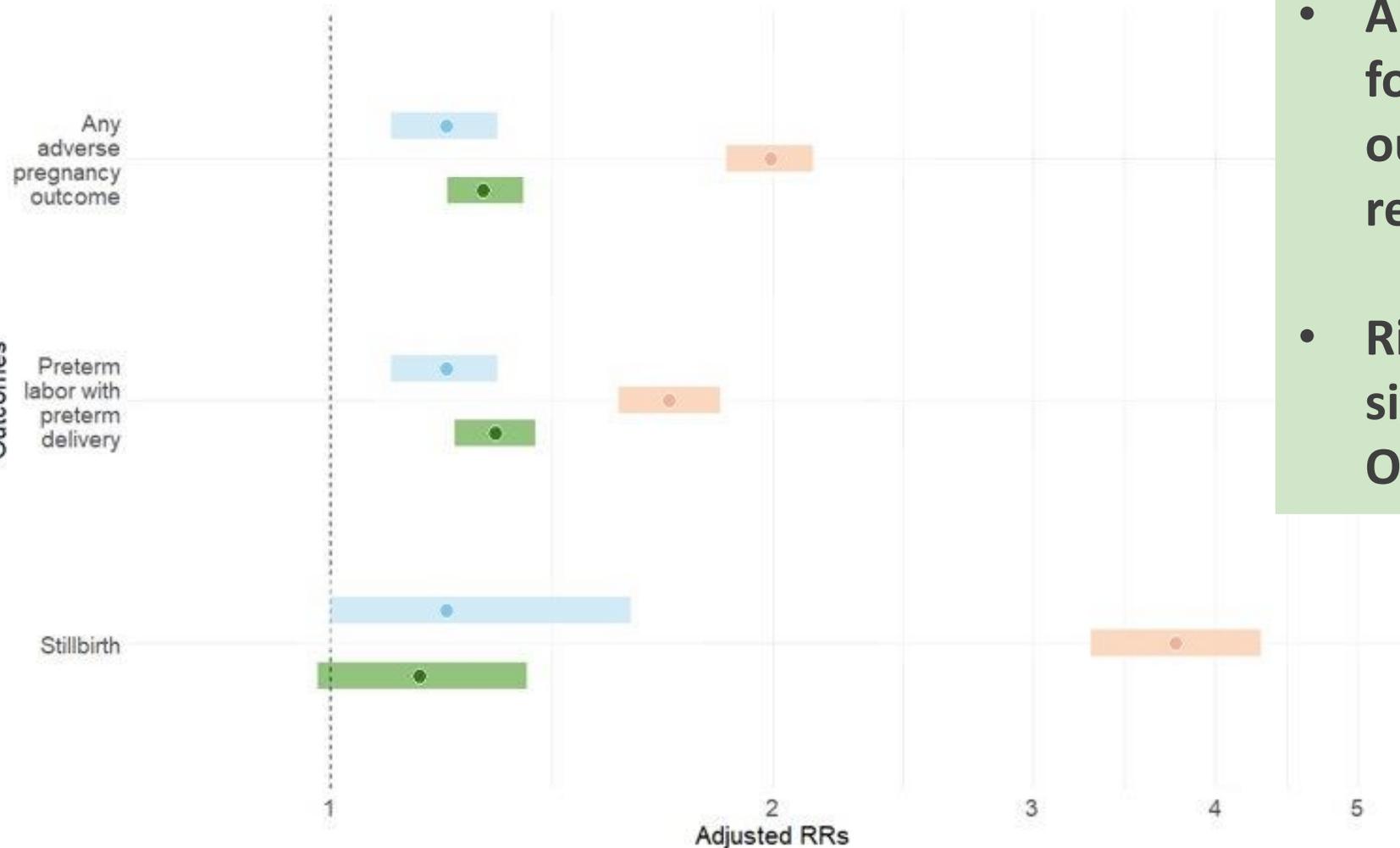


Period

- pre-delta Ko et al., 2021 (n = 489471)
- Delta June 2021-December 2021 (n=505108)
- Omicron 2022 (n = 782503)

*Data from Delta and Omicron periods are unpublished

Adverse Pregnancy Outcomes Associated With a Documented COVID-19 Diagnosis at Delivery Hospitalization—United States, Pre-delta, Delta, and Omicron Periods, Premier



- Although less than Delta, risks for adverse pregnancy outcomes and preterm delivery remain elevated during Omicron
- Risk for stillbirth not significantly elevated during Omicron

*Data from Delta and Omicron periods are unpublished

Trends (%) in pregnancy outcomes by maternal COVID-19 status: 14 states and the District of Columbia (July 2020-December 2022)

	pre-Delta July 2020-June 2021		Delta July 2021 - December 2021		Omicron January 2022 - December 2022	
	COVID-19 ¹	No COVID-19	COVID-19 ¹	No COVID-19	COVID-19 ¹	No COVID-19
ICU admission	0.6	0.1	1.2	0.2	0.2	0.2
NICU admission	10.3	8.7	10.9	8.5	9.0	8.7
Total preterm ²	11.9	9.9	13.0	10.1	10.3	10.1
Early preterm	3.2	2.6	3.8	2.7	2.4	2.7
Late preterm	8.8	7.2	9.2	7.4	7.9	7.4
Total low birthweight ³	8.8	7.9	9.8	8.1	7.9	8.2
Very low birthweight ⁴	1.5	1.3	1.6	1.3	1.1	1.3

¹ Confirmed or presumed COVID-19 during pregnancy. Confirmed cases only are included for California, Maryland, Ohio, North Dakota, and Tennessee.

² Gestational age in completed weeks; based on the obstetric estimate of gestation.

³ Less than 2,500 grams

⁴ Less than 1,500 grams

NOTES: Reporting area includes Alabama, Alaska, Arkansas, California, District of Columbia, Idaho, Maine, Maryland, New Hampshire, North Dakota, Ohio, Oklahoma, Oregon, Tennessee, and West Virginia. District of Columbia did not report for October-December 2022.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Natality.

Summary

- Incidence of COVID-19 among pregnant people mirrors that of the general population
- Pregnancy remains a risk factor for severe maternal disease and adverse pregnancy outcomes, even with new variants
- Some maternal, fetal, and infant risks were lower with Omicron; cannot disentangle the impact of prior infection/vaccination

Conclusion

COVID-19 vaccination improves outcomes for pregnant people, their pregnancies and their infants; therefore vaccination should continue to be recommended for maternal and fetal benefit



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TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.





COVID-19 vaccine effectiveness updates

23 June 2023

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COVID-19 Vaccine Effectiveness Program Lead
Centers for Disease Control and Prevention

U.S. COVID-19 Vaccination Coverage (%) of Total Population by Age Group — May 10, 2023

Coverage / Age (years)	<2	2-4	5-11	12-17	18-24	24-49	50-64	≥65
At least one dose†	8.9	10.9	40.0	72.2	82.3	85.5	95.0	95.0
At least one bivalent dose	0.6	0.6	4.8	7.8	7.4	12.1	21.7	43.3
Unvaccinated	91.1	89.1	60.0	27.8	17.7	14.5	—†	—†

†Note: Coverage is capped at 95%

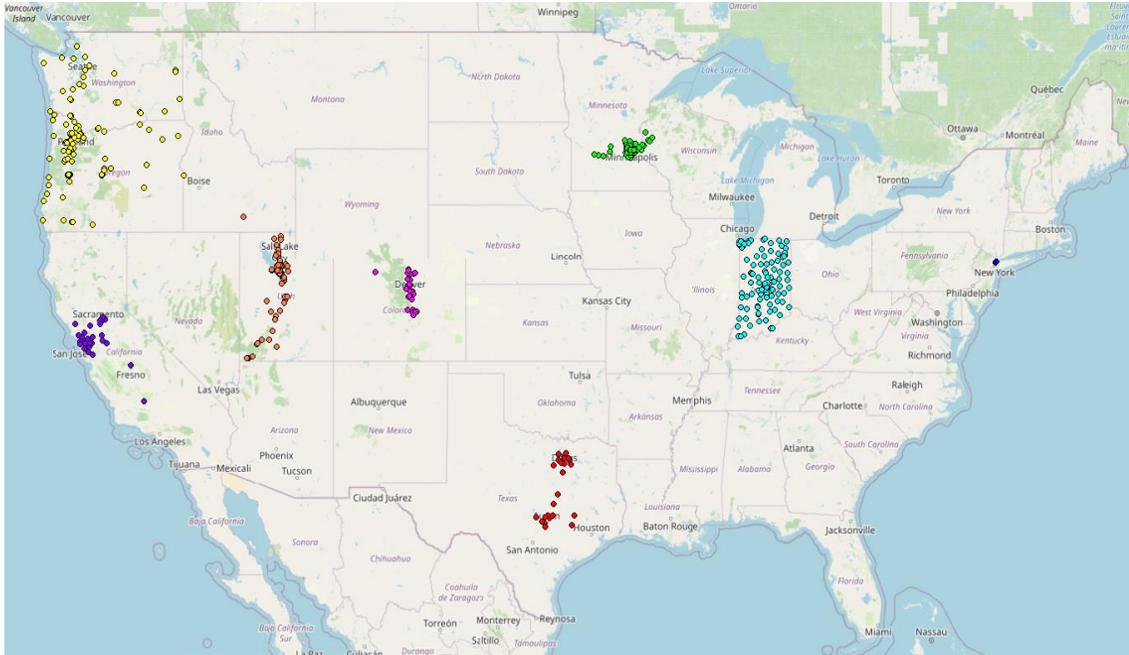
Source: <https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends> Updated June 1, 2023

Organization of vaccine effectiveness (VE) data

- *Bivalent* VE, by outcome and Omicron subvariant in adults
- VE in special populations:
 - *Monovalent* and *bivalent* VE in pregnant people
 - *Bivalent* people with immunocompromising conditions

Monovalent and *bivalent* VE, against
hospitalization and *critical illness* by Omicron
subvariant in adults ≥ 18 years, VISION Network

VISION Multi-State Network of Electronic Health Records



- **Cases:** COVID-like illness (CLI) with positive PCR for SARS-CoV-2 within 14 days before or 72 hours after the admission or encounter
- **Controls:** CLI with negative PCR for SARS-CoV-2

- Variant periods designated for analysis based on time when novel sublineage became predominant (>50%) at study site
- VE adjusted for age, sex, race and ethnicity, geographic region, and calendar time
- Vaccination documented by electronic health records and state and city registries

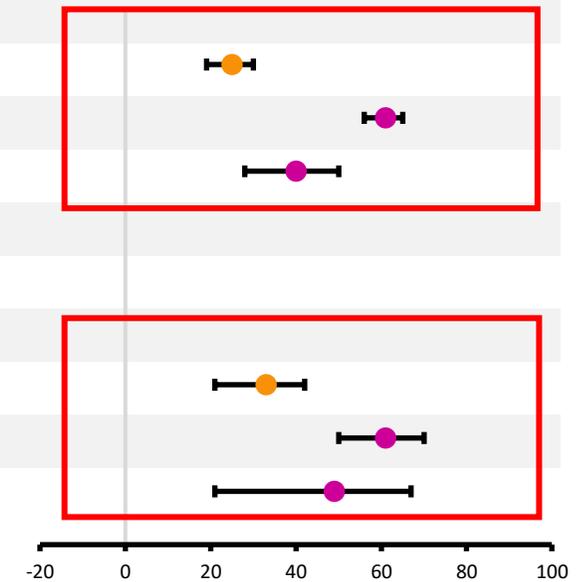
VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical illness* among immunocompetent adults aged ≥18 years – September 2022 – May 2023

mRNA Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
Hospitalization				
Unvaccinated (ref)	16,219	1,835 (11)	--	Ref
Monovalent doses only	38,843	4,086 (11)	381 (275-513)	21 (16-26)
Bivalent booster, 7-59 days earlier	4,894	329 (7)	35 (21-47)	62 (57-67)
Bivalent booster, 60-119 days earlier	5,283	491 (9)	87 (73-103)	47 (41-53)
Bivalent booster, 120-179 days earlier	3,756	346 (9)	146 (132-161)	24 (12-33)
Critical illness				
Unvaccinated (ref)	14,762	378 (3)	--	Ref
Monovalent doses only	35,415	658 (2)	380 (275-514)	31 (21-40)
Bivalent booster, 7-59 days earlier	4,614	49 (1)	34 (21-47)	69 (58-77)
Bivalent booster, 60-119 days earlier	4,880	88 (2)	87 (73-103)	45 (29-58)
Bivalent booster, 120-179 days earlier	3,445	35 (1)	146 (132-161)	52 (30-67)

Critical illness defined as admission to intensive care unit or death; case-patients were persons admitted to ICU or who experienced death associated with COVID-19, and control patients were persons hospitalized without COVID-19. VE estimates adjusted for age, sex, race and ethnicity, geographic region, and calendar time. Updated from: Link-Gelles et al., MMWR, <https://www.cdc.gov/mmwr/volumes/72/wr/mm7221a3.htm>

VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical illness* among immunocompetent adults aged ≥ 18 years, during BA.4/5 predominance – September 2022 – January 2023

mRNA Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
Hospitalization				
Unvaccinated (ref)	11,240	1,426 (13)	--	Ref
Monovalent doses only	27,564	3,106 (11)	349 (238-460)	25 (19-30)
Bivalent booster, 7-89 days earlier	6,723	524 (8)	47 (28-67)	61 (56-65)
Bivalent booster, ≥ 90 days earlier	1,511	163 (11)	105 (96-115)	40 (28-50)
Critical illness				
Unvaccinated (ref)	10,110	296 (3)	--	Ref
Monovalent doses only	24,976	518 (2)	347 (236-460)	33 (21-42)
Bivalent booster, 7-89 days earlier	6,199	91 (1)	47 (28-66)	61 (50-70)
Bivalent booster, ≥ 90 days earlier	1,348	25 (2)	105 (96-115)	49 (21-67)



CDC unpublished data. VE estimates adjusted for age, sex, race and ethnicity, geographic region, and calendar time. Variant predominance based on regional circulation: <https://covid.cdc.gov/covid-data-tracker/#variant-proportions>

VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical illness* among immunocompetent adults aged ≥ 18 years, during *XBB* predominance – January – May 2023

mRNA Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
Hospitalization				
Unvaccinated (ref)	4,979	409 (8)	--	Ref
Monovalent doses only	11,279	980 (9)	469 (375-605)	9 (-4 to 20)
Bivalent booster, 7-89 days earlier	1,045	60 (6)	65 (43-79)	51 (35 to 63)
Bivalent booster, 90-179 days earlier	4,654	419 (9)	139 (119-157)	20 (7 to 32)
Critical illness				
Unvaccinated (ref)	4,652	82 (2)	--	Ref
Monovalent doses only	10,439	140 (1)	469 (375-602)	28 (3 to 46)
Bivalent booster, 7-89 days earlier	994	9 (1)	65 (43-78)	58 (15 to 79)*
Bivalent booster, 90-179 days earlier	4282	47 (1)	139 (119-157)	48 (23 to 65)

The forest plot displays Vaccine Effectiveness (%) for Hospitalization and Critical Illness. The x-axis ranges from -20 to 100. The y-axis lists dosage patterns. Points represent adjusted VE estimates, and horizontal lines represent 95% confidence intervals. A vertical line is at 0%.

Outcome	Dosage Pattern	Adjusted VE (%)	95% CI (%)
Hospitalization	Unvaccinated (ref)	Ref	-
	Monovalent doses only	9	(-4 to 20)
	Bivalent booster, 7-89 days earlier	51	(35 to 63)
	Bivalent booster, 90-179 days earlier	20	(7 to 32)
Critical Illness	Unvaccinated (ref)	Ref	-
	Monovalent doses only	28	(3 to 46)
	Bivalent booster, 7-89 days earlier	58	(15 to 79)*
	Bivalent booster, 90-179 days earlier	48	(23 to 65)

CDC unpublished data. VE estimates adjusted for age, sex, race and ethnicity, geographic region, and calendar time.

* These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation.

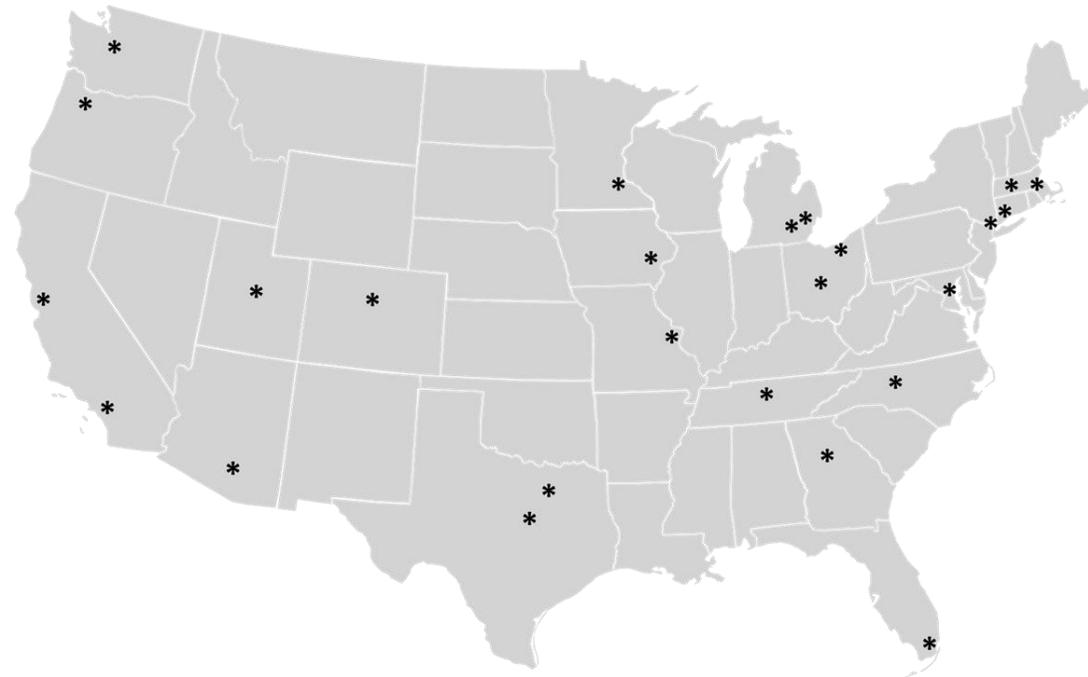
Variant predominance based on regional circulation: <https://covid.cdc.gov/covid-data-tracker/#variant-proportions>

Monovalent and ***bivalent*** VE against
hospitalization among adults aged ***≥18 years***,
IVY Network

IVY Network — 25 hospitals, 20 U.S. States

- **Design:** Prospective, case-control
- **Population:** Adults aged ≥ 18 years hospitalized with Acute respiratory illness (ARI)*
 - **Cases:** ARI and test *positive* for SARS-CoV-2 by NAAT or antigen test within 10 days of illness
 - **Controls:** ARI and test *negative* for SARS-CoV-2 and influenza by NAAT within 10 days of illness
- **Vaccination data:** Electronic medical records (EMR), state and city registries, and self-report
- **Specimens:** Upper respiratory specimens obtained for central RT-qPCR testing and sequencing

IVY
INVESTIGATING RESPIRATORY VIRUSES IN THE ACUTE ILL



*ARI is defined as presence of any one of the following: fever, cough, shortness of breath, chest imaging consistent with pneumonia, hypoxemia

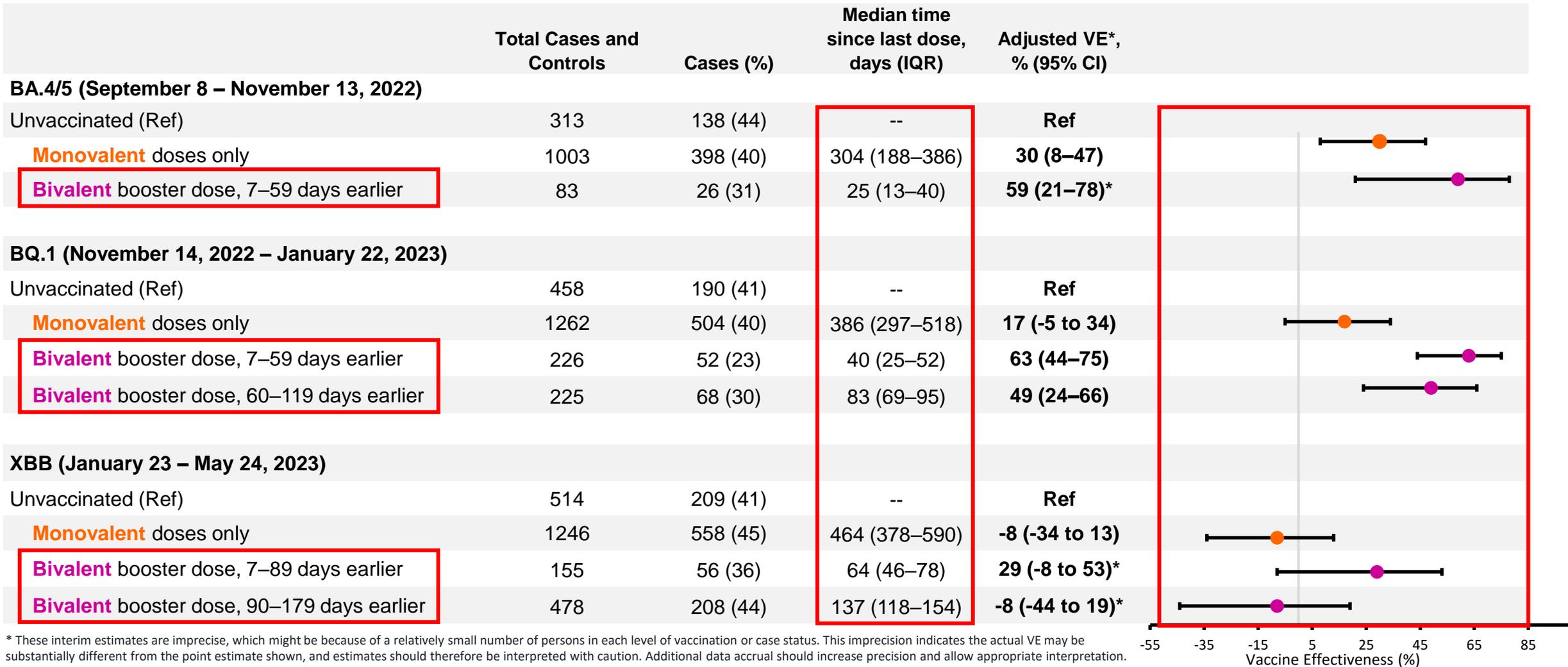
IVY Network: *Absolute VE against COVID-19 hospitalization* among immunocompetent adults aged ≥ 18 years —September 8, 2022 – May 29, 2023

	Total Cases and Controls	Cases (%)	Median time since last dose, days (IQR)	Adjusted VE*, % (95% CI)
Absolute VE				
Unvaccinated (Ref)	1286	537 (42)	--	Ref
Monovalent doses only	3511	1460 (42)	393 (282–517)	16 (3 to 26)
Bivalent booster dose, 7–59 days earlier	374	100 (27)	36 (21–49)	54 (39 to 65)
Bivalent booster dose, 60–119 days earlier	443	160 (36)	89 (73–103)	34 (15 to 50)
Bivalent booster dose, 120–179 days earlier	366	157 (43)	145 (133–159)	6 (-27 to 30)*

* These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation.

VE adjustments: Age, sex, race, ethnicity, admission date (biweekly), and HHS region

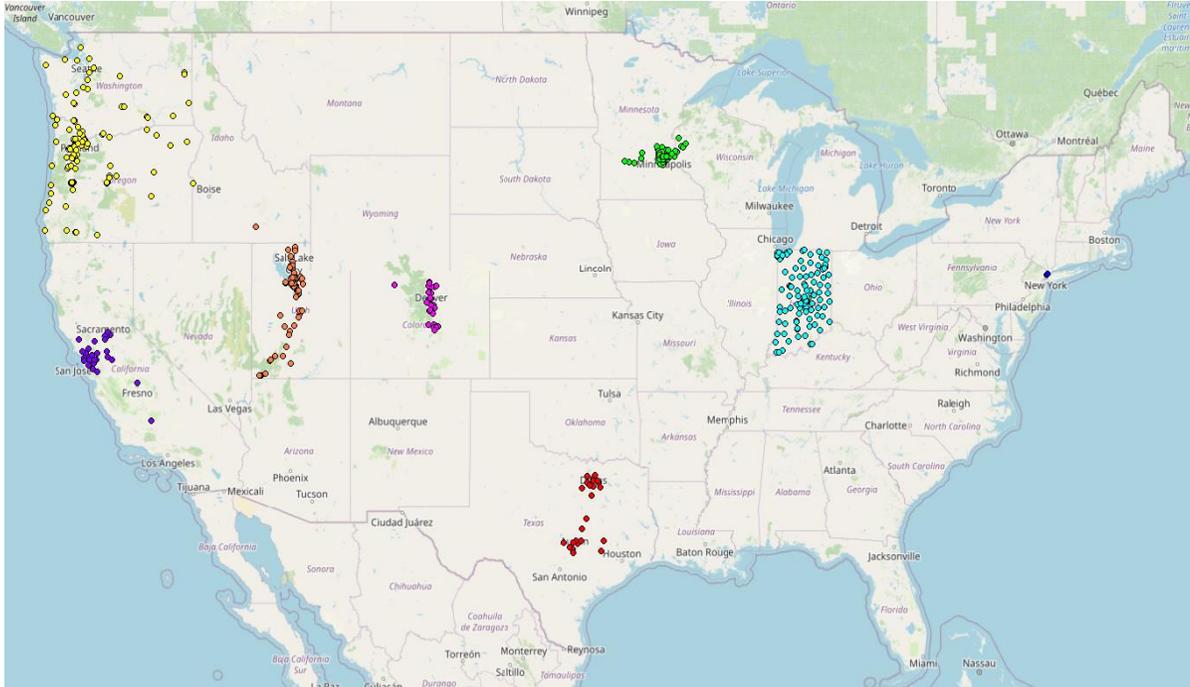
IVY Network: *Absolute VE against COVID-19 hospitalization* among immunocompetent adults aged ≥ 18 years by lineage period — September 8, 2022 – May 24, 2023



* These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation. VE adjustments: Age, sex, race, ethnicity, admission date (biweekly), and HHS region

VE in special populations: pregnant people

VISION Multi-State Network of Electronic Health Records



- Among pregnant people 18-45 years at time of emergency department/urgent care encounter
- VE adjusted for age, ethnicity, race, underlying medical conditions, gestational age at encounter, site, Medicaid status, day of encounter, site facility urbanicity
- Vaccination documented by electronic health records and state and city registries
- Separate results for COVID-19 vaccine monovalent doses received prior to pregnancy and bivalent doses received during pregnancy due to timing of bivalent authorization/analysis (Sept 2022-May 2023)

- **Cases:** COVID-like illness (CLI) with positive PCR for SARS-CoV-2 within 14 days before or 72 hours after the encounter
- **Controls:** CLI with negative PCR for SARS-CoV-2

VISION: Absolute VE of COVID-19 *monovalent* doses received prior to pregnancy against *ED/UC encounters* among immunocompetent pregnant persons aged 18-45 years – June 2022 – May 2023*

Vaccine Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
<i>Absolute VE</i>				
Unvaccinated (ref)	2238	317 (14)	--	<i>Ref</i>
Monovalent received:				
<6 months before pregnancy	833	108 (13)	270 (216, 326)	27 (6, 44)
≥6 months before pregnancy	1986	264 (13)	454 (375, 544)	5 (-15, 22)

Adjusted for: Age, ethnicity, race, underlying medical conditions, gestational age at encounter, site, Medicaid status, day of encounter, site facility urbanicity

*Unpublished CDC data.

VISION: Absolute VE of COVID-19 *bivalent* doses received *during* pregnancy against *ED/UC encounters* among immunocompetent pregnant persons aged 18-45 years – September 2022 – May 2023*

Vaccine Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
<i>Absolute VE</i>				
Unvaccinated (ref)	1701	196 (12)	--	<i>Ref</i>
Bivalent dose**	191	10 (5)	56 (29, 97)	61 (22, 81)***

Adjusted for: Age, ethnicity, race, underlying medical conditions, gestational age at encounter, site, Medicaid status, day of encounter, site facility urbanicity

*Unpublished CDC data

Doses received **during pregnancy for bivalent group

***These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation.

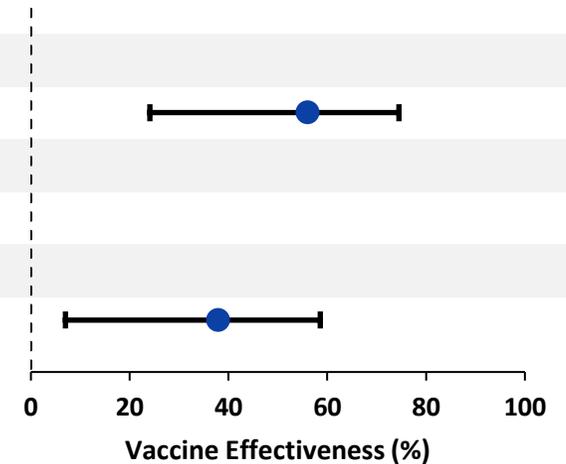
Overcoming COVID-19 network



- **Cases infants:** hospitalized with COVID-19 as the primary reason for admission and with a positive SARS-CoV-2 RT-PCR or antigen test result
- **Control infants:** hospitalized with or without COVID-19 symptoms and negative SARS-CoV-2 RT-PCR or antigen test result
 - Matched to case-infants by site; hospitalized within 4 weeks of case-infant admission
- Case-control study to assess effectiveness of maternal vaccination for COVID-19 in infants < 6 months of age
- 25 pediatric hospitals across 20 states
- Infants admitted between March 9, 2022, and May 9, 2023
- Baseline demographic and clinical characteristics obtained via parent interview
- Maternal vaccination status verified using state vaccination registries, electronic medical records, or other sources

Overcoming COVID-19: Effectiveness of maternal vaccination in prevention of hospitalization among infants – March 9, 2022 – May 9, 2023

Vaccination during pregnancy*	Total	Case infants, N (%)	Median interval since last maternal dose, days (IQR)	Infant median age at hospitalization, days (IQR)	Adjusted VE (95% CI)	Effectiveness of Maternal Vaccination against Infant Covid-19 Hospitalization % (95% CI)†
Infants <3 months of age at hospitalization						
Unvaccinated (ref)	310	174 (56)	NA	44 (27 to 63)	Ref	
Vaccinated	101	43 (43)	222 (152 to 271)	41 (23 to 66)	56 (24 to 75)*	
Infants <6 months of age at hospitalization						
Unvaccinated (ref)	498	281 (56)	NA	68 (37 to 125)	Ref	
Vaccinated	163	78 (48)	236 (190 to 302)	74 (33 to 132)	38 (7 to 59)*	



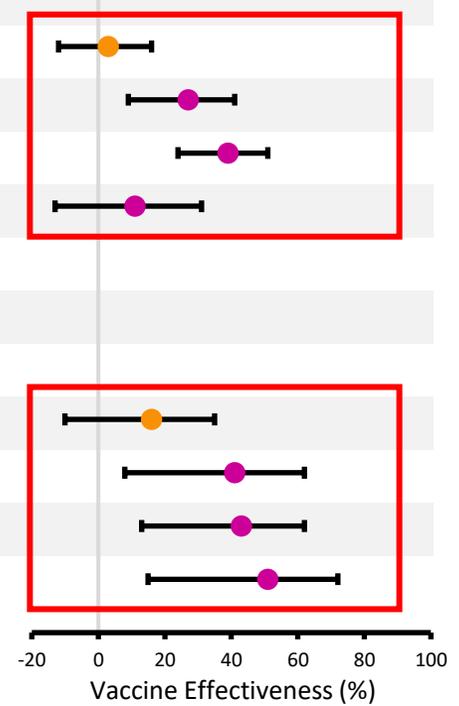
*Last mRNA or viral vector vaccine dose received between the beginning of pregnancy and 14 days before delivery. 14 people received a bivalent mRNA vaccine.

†These estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation.

Bivalent VE in special populations:
people with immunocompromising conditions

VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical illness* among immunocompromised adults aged ≥ 18 years – September 2022 – May 2023

mRNA Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
Hospitalization				
Unvaccinated (ref)	3,240	322 (10)	--	Ref
Monovalent doses only	11,623	1,169 (10)	359 (242-481)	3 (-12-16)
Bivalent booster, 7-59 days earlier	1,627	144 (9)	33 (19-46)	27 (9-41)
Bivalent booster, 60-119 days earlier	1,862	144 (8)	88 (74-104)	39 (24-51)
Bivalent booster, 120-179 days earlier	1,448	118 (8)	146 (133-161)	11 (-13-31)
Critical illness				
Unvaccinated (ref)	3,006	88 (3)	--	Ref
Monovalent doses only	10,725	271 (3)	358 (241-481)	16 (-10-35)
Bivalent booster, 7-59 days earlier	1,515	32 (2)	33 (19-46)	41 (8-62)*
Bivalent booster, 60-119 days earlier	1,755	37 (2)	88 (74-104)	43 (13-62)
Bivalent booster, 120-179 days earlier	1,348	18 (1)	146 (133-162)	51 (15-72)*



* These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual should increase precision and allow appropriate interpretation.

Critical illness defined as admission to intensive care unit or death; case-patients were persons admitted to an ICU or who experienced death associated with COVID-19, and control patients were persons hospitalized without COVID-19. VE estimates adjusted for age, sex, race and ethnicity, geographic region, and calendar time. Updated from: Link-Gelles et al., MMWR, <https://www.cdc.gov/mmwr/volumes/72/wr/mm7221a3.htm>

Summary and conclusions

Limitations of VE against severe disease

- For estimates of **absolute** vaccine effectiveness, if unvaccinated are meaningfully different from vaccinated individuals (e.g., by COVID-19 risk factors), estimates may be biased.
 - For estimates of **relative** vaccine effectiveness, residual protection from prior doses is an important consideration for interpretation.
- Information on prior infection is limited, although we know rates of prior infection in the U.S. population are high and vary by age.
- VE against COVID-19-associated hospitalization may underestimate protection against more severe COVID-19 disease.
- Lack of statistical power to estimate VE for maternal vaccination by timing of doses during pregnancy; could not separate monovalent and bivalent doses for protection against infant hospitalization

Conclusions: updates to VE of *bivalent* COVID-19 boosters

- *Bivalent* boosters are helping provide additional protection against hospitalization, though evidence of waning
- For most people who received *monovalent* doses and are eligible for a *bivalent* booster, more than a year has elapsed since their last monovalent dose. Because of waning, they may have limited remaining protection against hospitalization.
- Effectiveness against the most critical illness (ICU admission and death) more sustained compared to less severe illness
- VE during XBB predominance may wane more quickly against hospitalization compared to early variant predominant periods
- Vaccination during pregnancy provides protection against hospitalization for infants <6 months; protection may be highest in the first 3 months
- CDC will continue ongoing monitoring of VE, including for all outcomes of interest and for all authorized COVID-19 vaccines in the U.S. with a focus on assessing new policy recommendations and VE in populations at higher risk of severe COVID-19

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And many more!!!

Questions?

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TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

