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COVID-19 vaccine effectiveness updates

15 June 2023

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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%

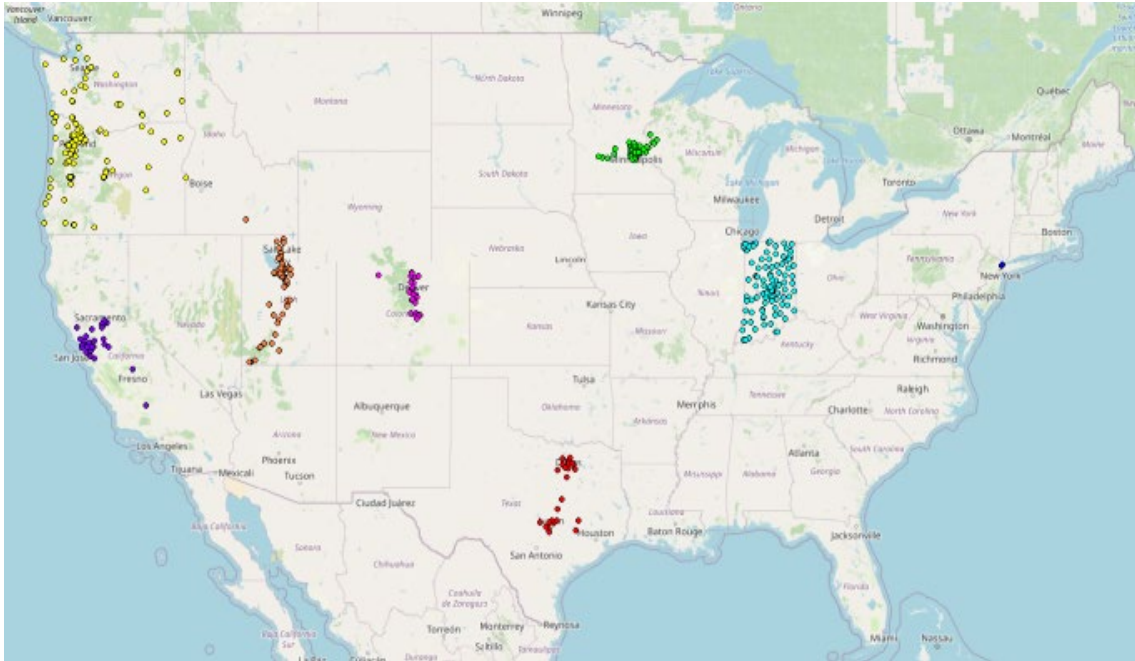
Source: <https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends> Updated June 1, 2023

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

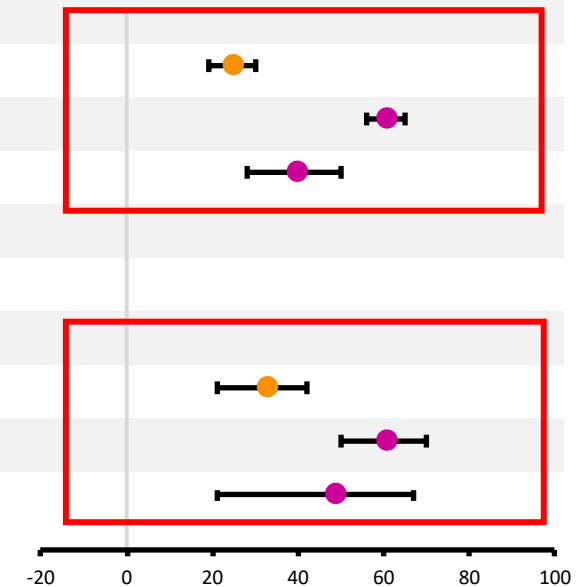
VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical illness* among immunocompetent adults aged ≥ 18 years – September 2022 – May 2023

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)

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.

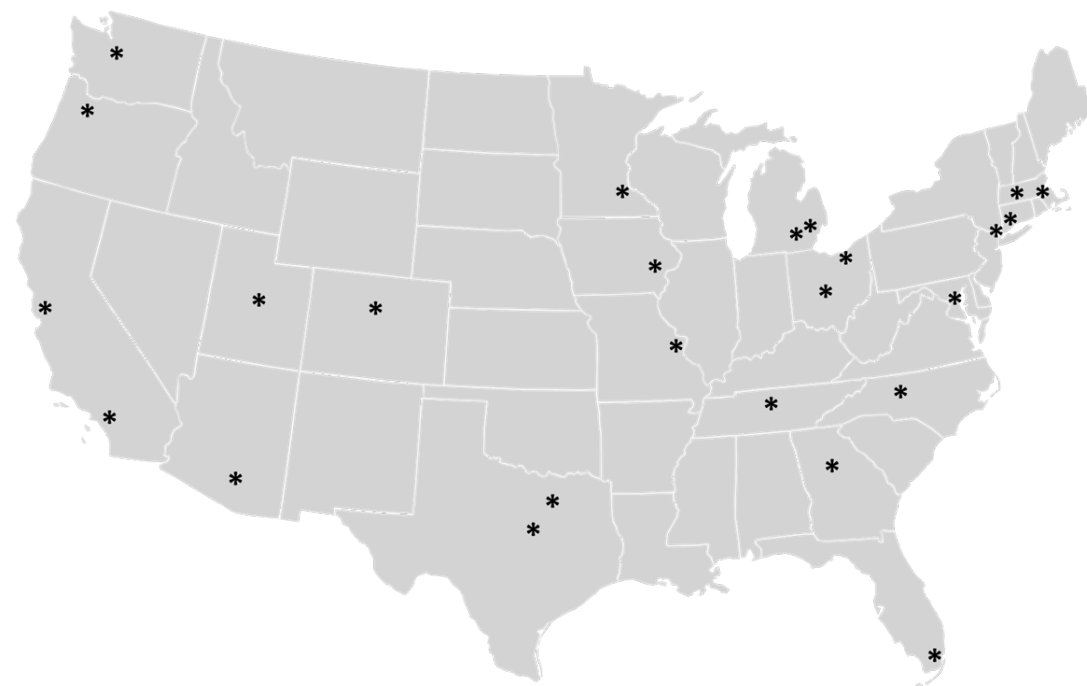
Variant predominance based on regional circulation: <https://covid.cdc.gov/covid-data-tracker/#variant-proportions>

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

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

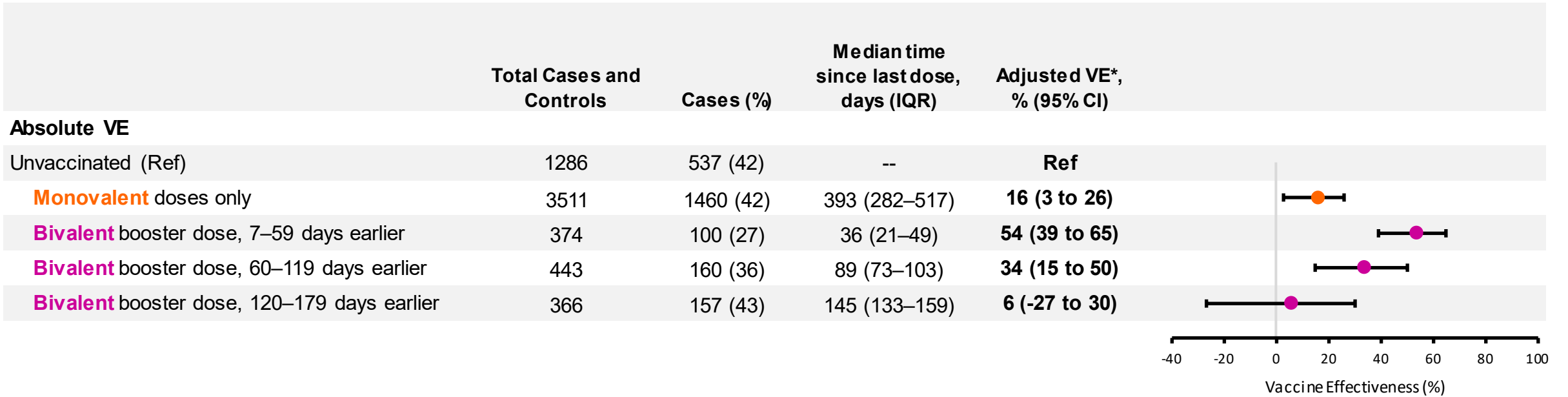
- **Design:** Prospective, case-control
- **Population:** Adults aged ≥ 18 years hospitalized with Acute respiratory illness (ARI)*
 - **Cases:** ARI and test **positive** for SARS-CoV-2 by NAAT or antigen test within 10 days of illness
 - **Controls:** ARI and test **negative** for SARS-CoV-2 and influenza 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



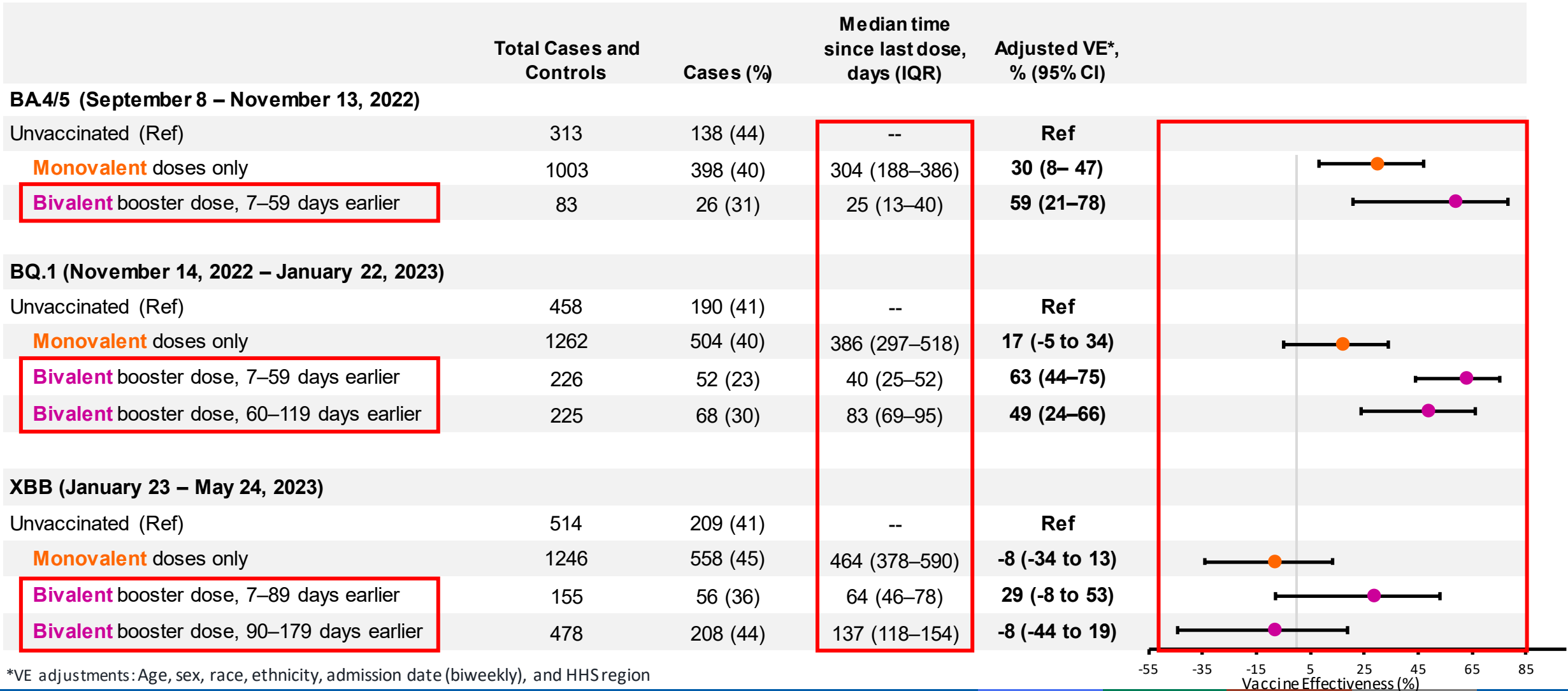
*ARI is defined as presence of any one of the following: fever, cough, shortness of breath, chest imaging consistent with pneumonia, hypoxemia

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



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

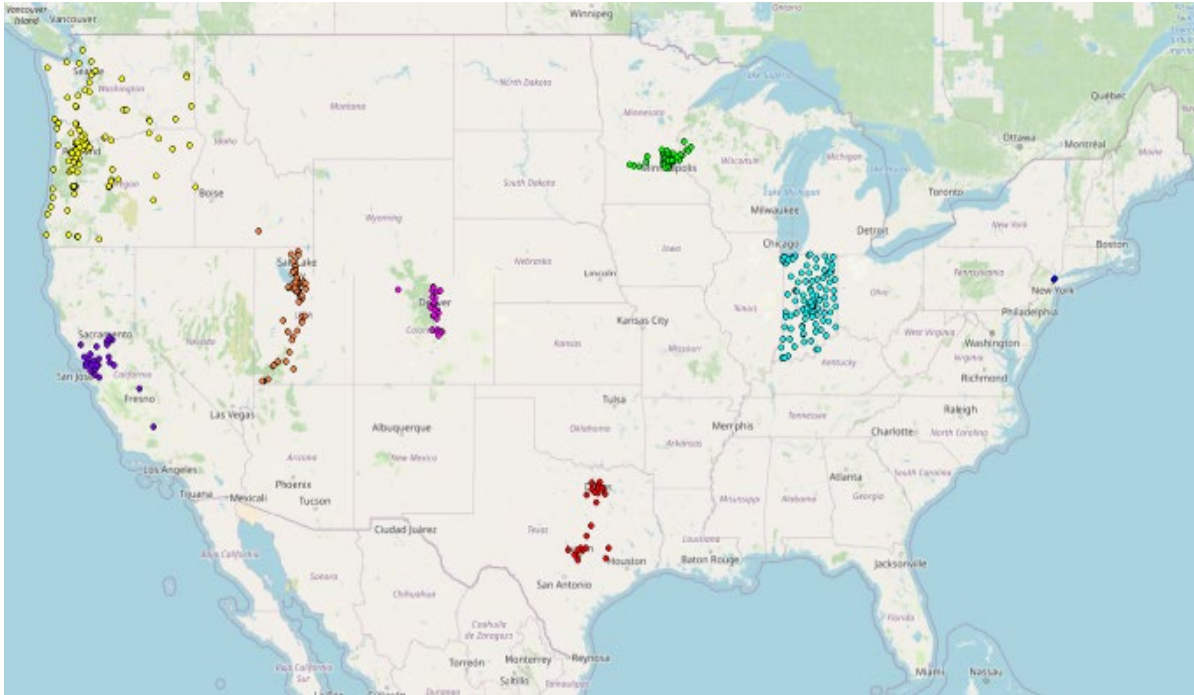
IVY Network: *Absolute VE against COVID-19 hospitalization* among immunocompetent adults aged ≥ 18 years by lineage period — September 8, 2022 – May 24, 2023



*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

- **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*

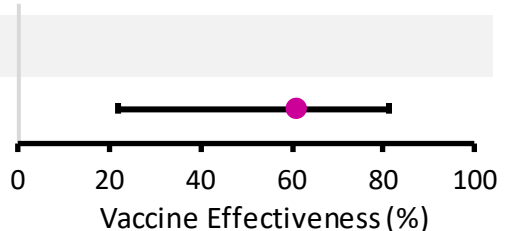
Vaccine Dosage Pattern	Total tests	SARS-CoV-2-test-positive, N (%)	Median interval since last dose, days (IQR)	Adjusted VE (95% CI)
<i>Absolute VE</i>				
Unvaccinated (ref)	2238	317 (14)	--	<i>Ref</i>
Monovalent received:				
<6 months before pregnancy	833	108 (13)	270 (216, 326)	27 (6, 44)
≥6 months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



The forest plot displays the adjusted vaccine effectiveness (VE) for the bivalent dose group. The x-axis represents Vaccine Effectiveness (%) from 0 to 100. A horizontal line indicates the 95% confidence interval (CI) from 22% to 81%. A pink dot represents the point estimate of 61%.

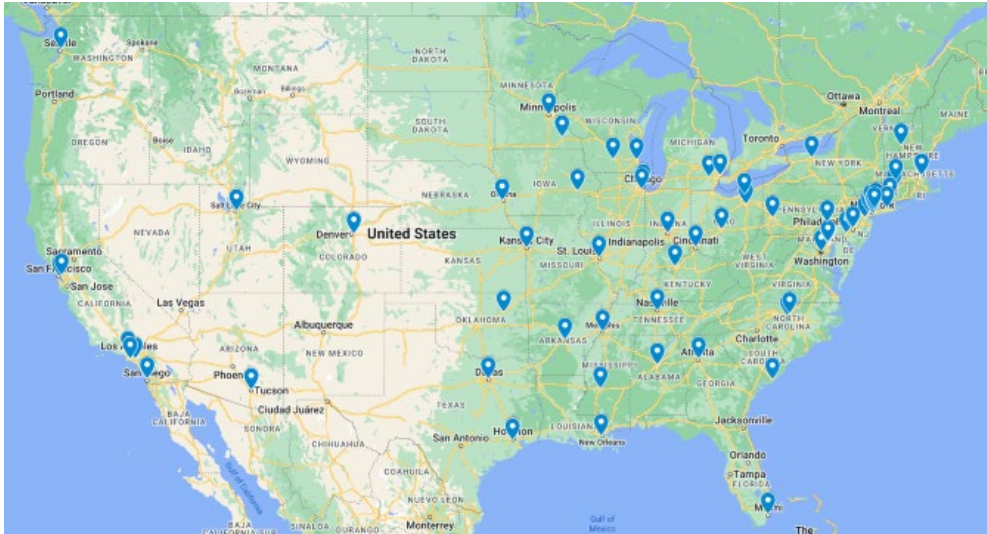
Adjusted for: Age, ethnicity, race, underlying medical conditions, gestational age at encounter, site, Medicaid status, day of encounter, site facility urbanicity

*Unpublished CDC data

Doses received **during pregnancy for bivalent group


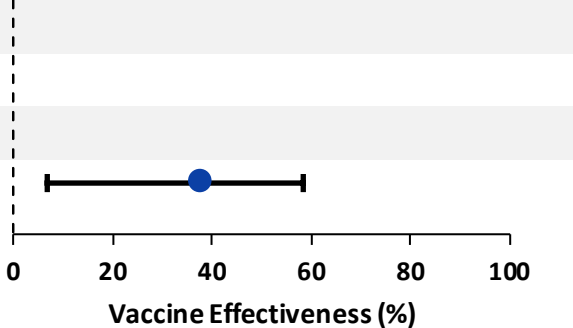
***These interim estimates are imprecise, which might be because of a relatively small number of persons in each level of vaccination or case status. This imprecision indicates the actual VE may be substantially different from the point estimate shown, and estimates should therefore be interpreted with 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 19 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 a appropriate interpretation.

Bivalent VE in special populations:
people with immunocompromising conditions

VISION: Absolute VE of *monovalent* and *bivalent* booster doses against *hospitalization* and *critical outcomes* 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.

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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