

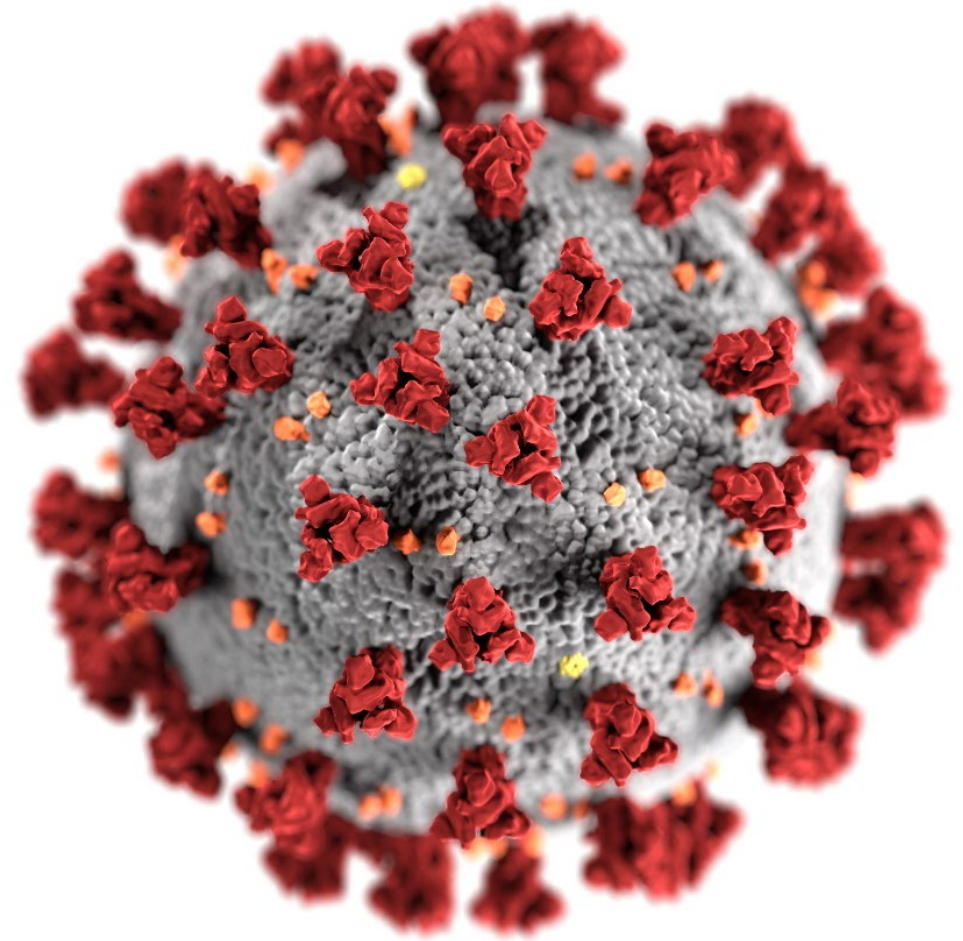
Vaccines and Related Biological Products Advisory Committee Meeting

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COVID-19 Vaccine Effectiveness in Children and Adults

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Epidemiology Task Force, CDC

VRBPAC
April 6, 2022



cdc.gov/coronavirus

Organization of presentation

- Evidence organized by outcome, then by age within outcome
 - Infection
 - Emergency department/urgent care (ED/UC)
 - Hospitalization

Endpoint: infection Population: adults

Vaccine effectiveness (VE) data for infection with Omicron

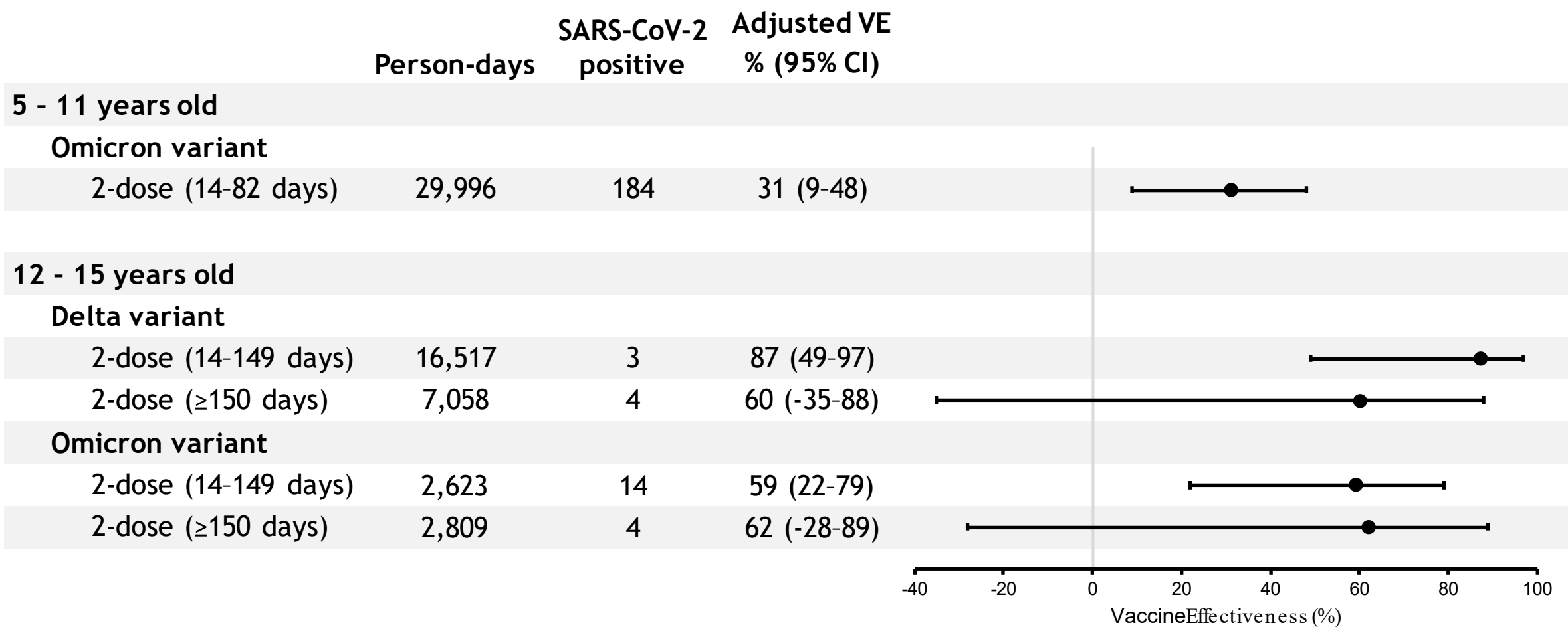
Pediatric Research Observing Trends and Exposures in COVID-19 Timelines (PROTECT)

- **Design:** Prospective cohort study
- **Population:** Children aged 4 months - 17 years
- **Methods:** Weekly surveillance and self-swab
 - SARS-CoV-2 testing by RT-PCR and whole genome sequencing
 - Electronic surveys during and after SARS-CoV-2 infection
 - Multi-method vaccination documentation
- **Analysis:** VE person-time model adjusted by propensity to be vaccinated, site, and SARS-CoV-2 circulation
 - Time period by age for preliminary analysis
 - 5-11 years: 2 weeks after dose 2 to 82 days
 - 12-15 years: 2 weeks after dose 2 to <150 days



Recruitment includes children of adult participants in a similar study (HEROES-RECOVER) of frontline workers and from the local community

PROTECT: VE against SARS-CoV-2 infection by age group during Delta and Omicron variant predominance, Jul 2021-Feb 2022



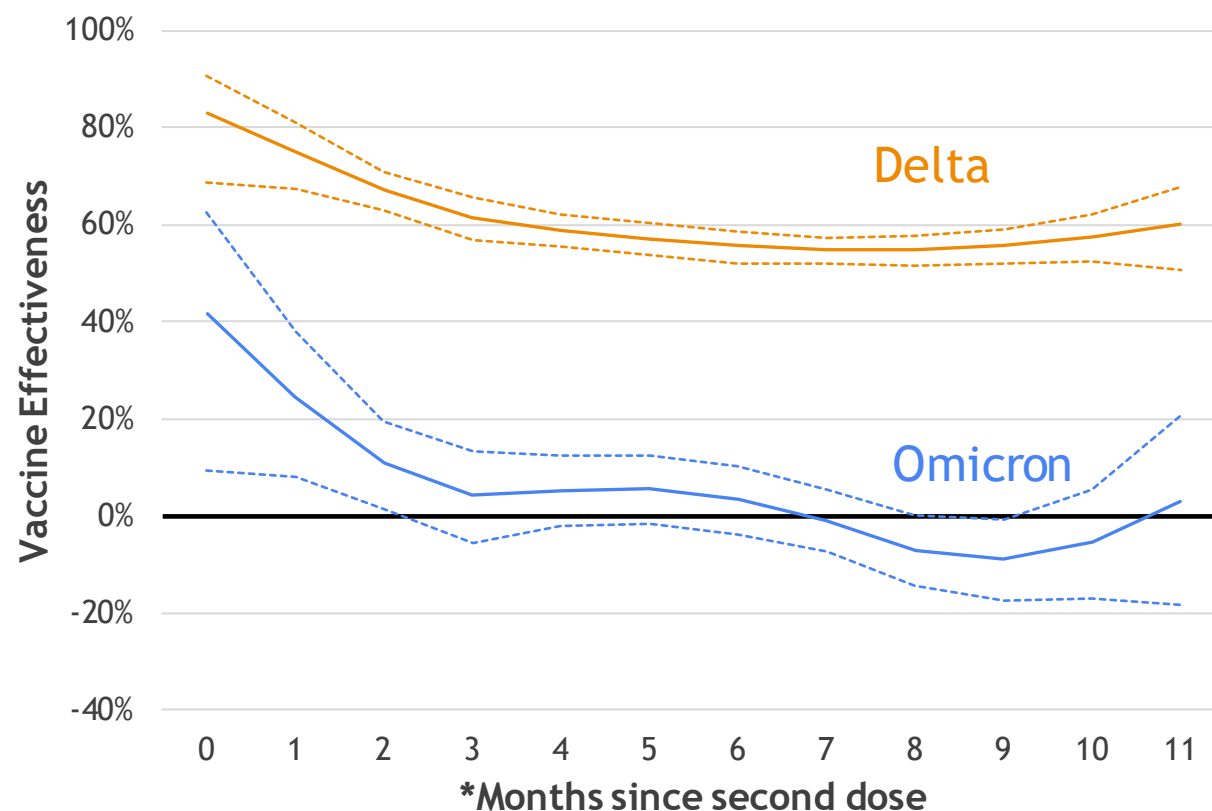
Fowlkes AL, Yoon SK, Lutrick K, et al. Effectiveness of 2-Dose BNT162b2 (Pfizer BioNTech) mRNA Vaccine in Preventing SARS-CoV-2 Infection Among Children Aged 5-11 Years and Adolescents Aged 12-15 Years – PROTECT Cohort, July 2021-February 2022. MMWR Morb Mortal Wkly Rep 2022;71:422-428. DOI: <http://dx.doi.org/10.15585/mmwr.mm7111e1externalicon>

Increasing Community Access to Testing (ICATT)

Partnership: VE analysis for symptomatic infection

- Nationwide community-based drive-through COVID-19 testing via pharmacies
- Self-reported vaccine history at time of registration for COVID-19 testing; excluded those who did not report vaccination status
- **Design:** Test-negative, case-control analysis
- **Population:** Persons with ≥ 1 COVID-like symptom and nucleic acid amplification testing (NAAT)
- **Adjusted for:**
 - Calendar day, race, ethnicity, gender, site's HHS region, site census tract's social vulnerability index (SVI)
 - Not adjusted for prior infection
- **Period:**
 - **Adults:** Tested December 10, 2021 - January 1, 2022, also adjusted for number of underlying conditions and tests, excluded if prior positive test within 90 days (Omicron defined by s-gene target failure)
 - **Children:** Tested December 26, 2021 - February 21, 2022 (Omicron variant increased from 74 to >99% weekly in nationally sequenced specimens)

ICATT: Pfizer-BioNTech 2-dose VE against symptomatic infection by variant and time since 2nd dose receipt, adults aged ≥18 years, Dec 10, 2021-Jan 1, 2022



■ VE for 2 doses of Pfizer-BioNTech against symptomatic Omicron infection:

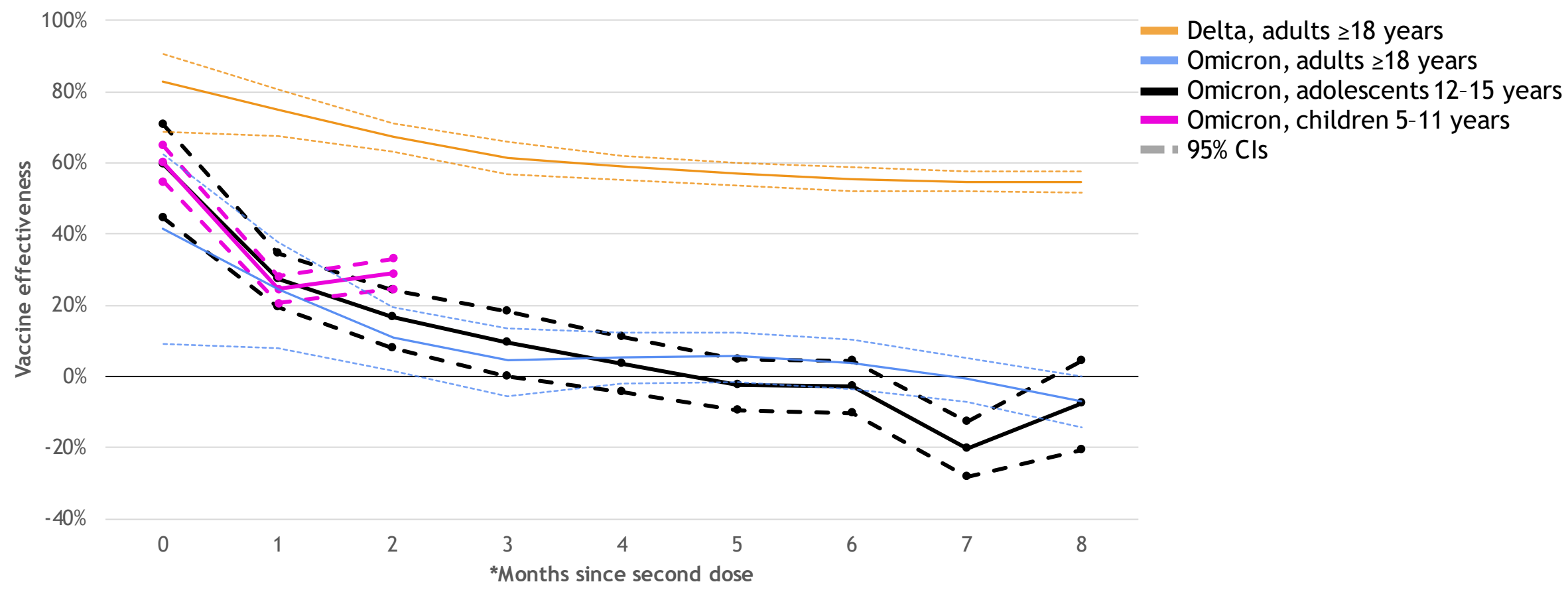
- Starts lower than 2-dose VE against Delta infection
- No longer significant by 3 months after second dose receipt

— VE for Delta
— 95% CI for Delta
— VE for Omicron
— 95% CI for Omicron

*Vaccination dose dates are collected as month and year. Month 0 represents tests in the same month as 2nd dose (at least 2 weeks after 2nd dose). For all months greater than or equal to 1 the value represents the difference between calendar month of test and calendar month of 2nd dose receipt (at least 2 weeks after 2nd dose).

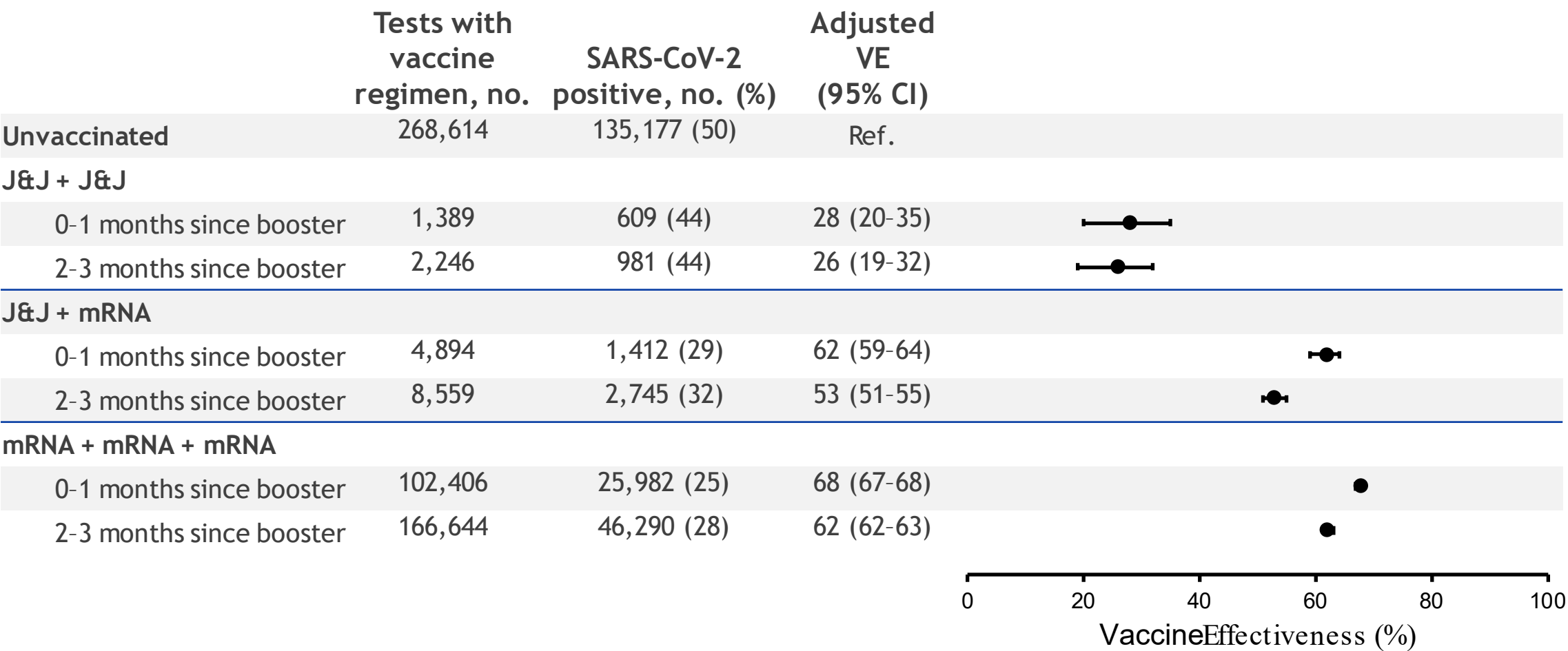
Accorsi EK, Britton A, Fleming-Dutra KE, et al. Association Between 3 Doses of mRNA COVID-19 Vaccine and Symptomatic Infection Caused by the SARS-CoV-2 Omicron and Delta Variants. JAMA. 2022;327(7):639-651. doi:10.1001/jama.2022.0470

ICATT: Pfizer-BioNTech 2-dose VE against symptomatic infection, by age group and variant



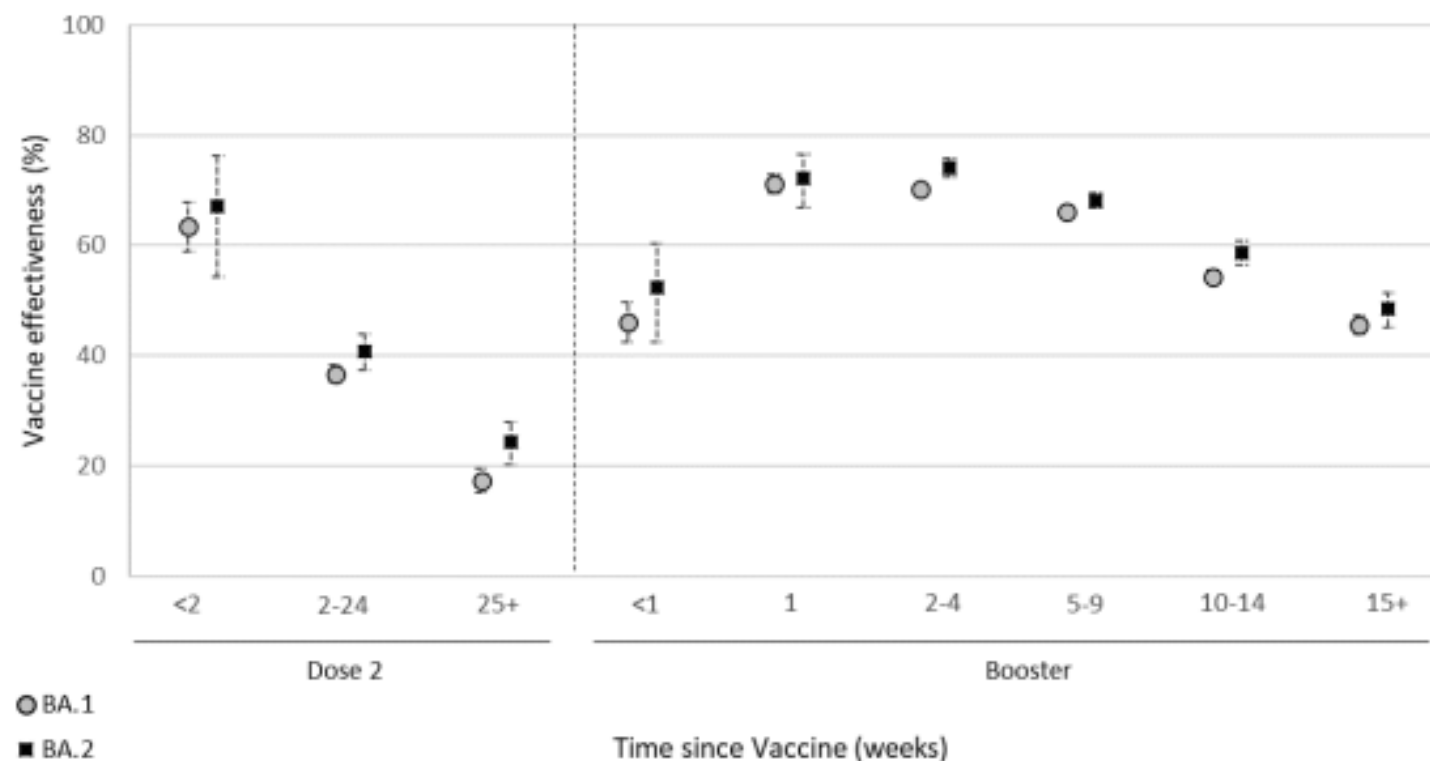
*Vaccination dose dates are collected as month and year. Month 0 represents tests in the same month as 2nd dose (at least 2 weeks after 2nd dose). For all months greater than or equal to 1 the value represents the difference between calendar month of test and calendar month of 2nd dose receipt (at least 2 weeks after 2nd dose).

Increasing Community Access to Testing (ICATT) Partnership, VE against [symptomatic infection](#) in adults ≥18 years during Omicron, Dec 26, 2021-Feb 22, 2022



Data from the UK: VE vs. symptomatic infection comparing Omicron sublineages (BA.1 vs BA.2) by time since booster

- Pfizer-BioNTech, Moderna, or ChAdOx1-S primary series, Pfizer-BioNTech or Moderna booster
- VE was generally comparable by Omicron sublineage

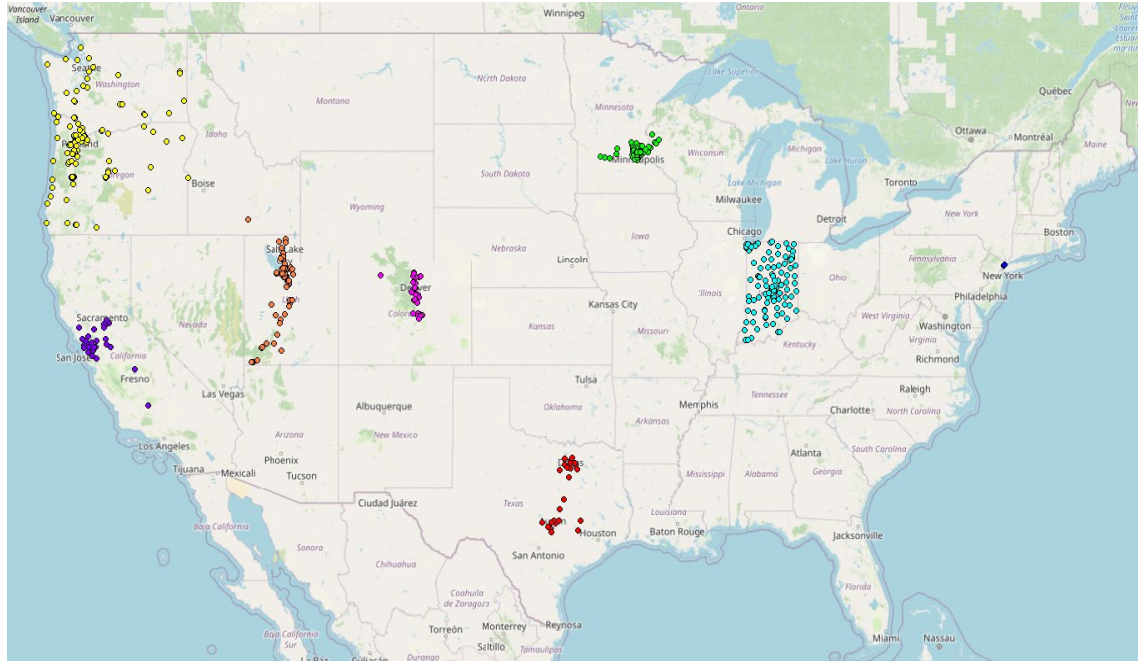


Overall summary of VE against infection

- mRNA VE against infection during Omicron starts lower than during Delta and wanes faster.
- Patterns of mRNA VE and waning by time since last dose look similar across age groups.
- Waning looks different for recipients of J&J vaccine; lower overall
- Early VE data from the UK show similar VE for BA.1 and BA.2 sublineages of Omicron variant

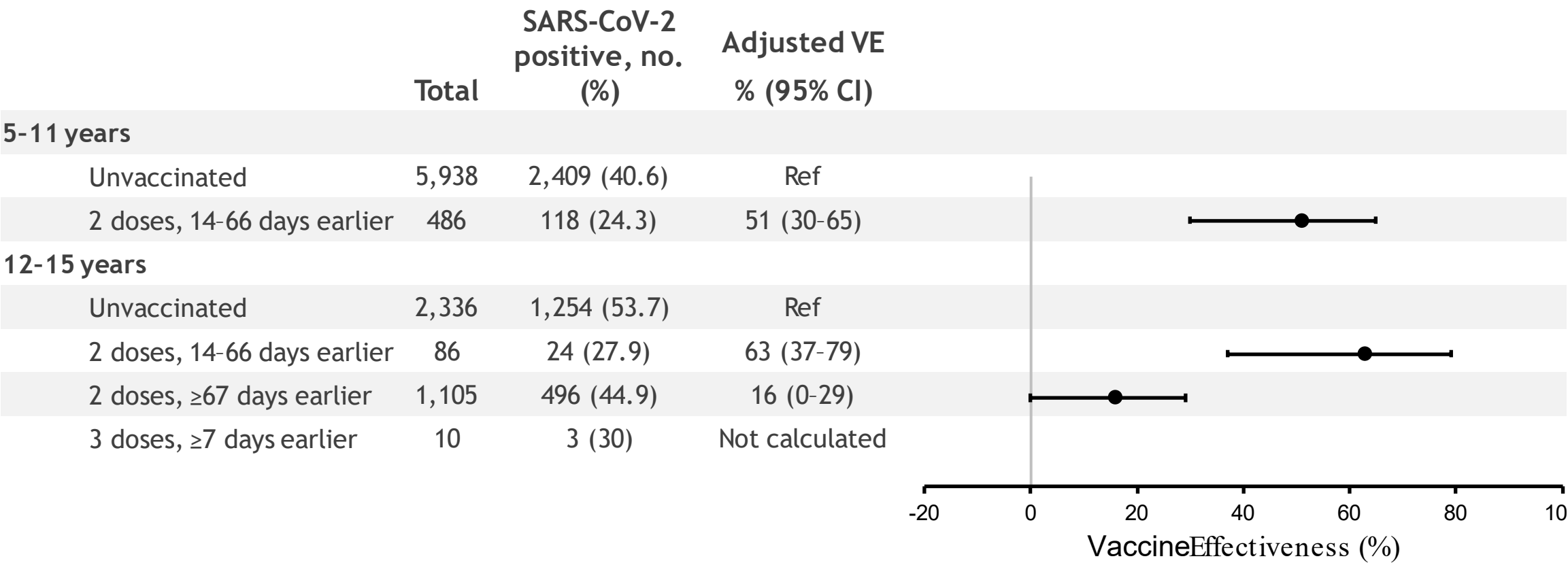
Vaccine effectiveness data for emergency department/urgent care (ED/UC) due to Omicron in the US

VISION Multi-State Network of Electronic Health Records



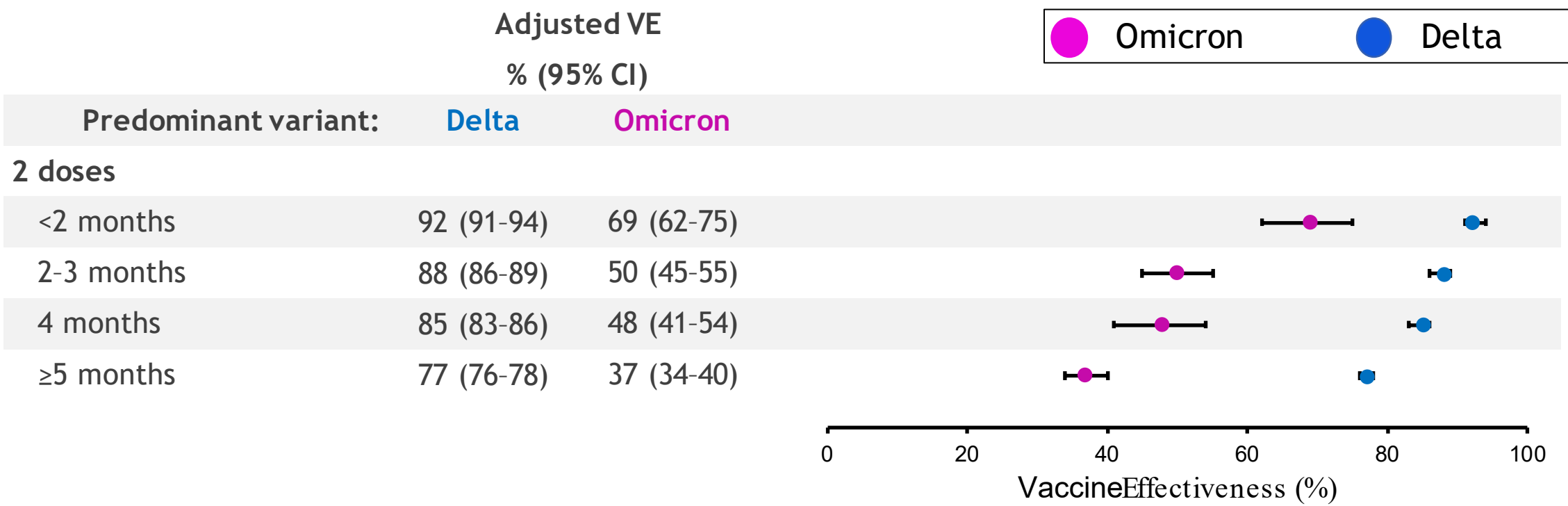
- **Cases:** COVID-like illness (CLI) with positive PCR for SARS-CoV-2 within 14 days before or 72 hours after the admission or encounter
- **Controls:** CLI with negative PCR for SARS-CoV-2
- Delta vs. Omicron determined by time when Omicron predominated in study site
- VE adjusted using inverse propensity to be vaccinated weights and by calendar time, region, local virus circulation, and age
- Vaccination documented by electronic health records and state and city registries

VISION: mRNA VE for ED/UC by age during Omicron predominance, mid-Dec, 2021-Jan 29, 2022

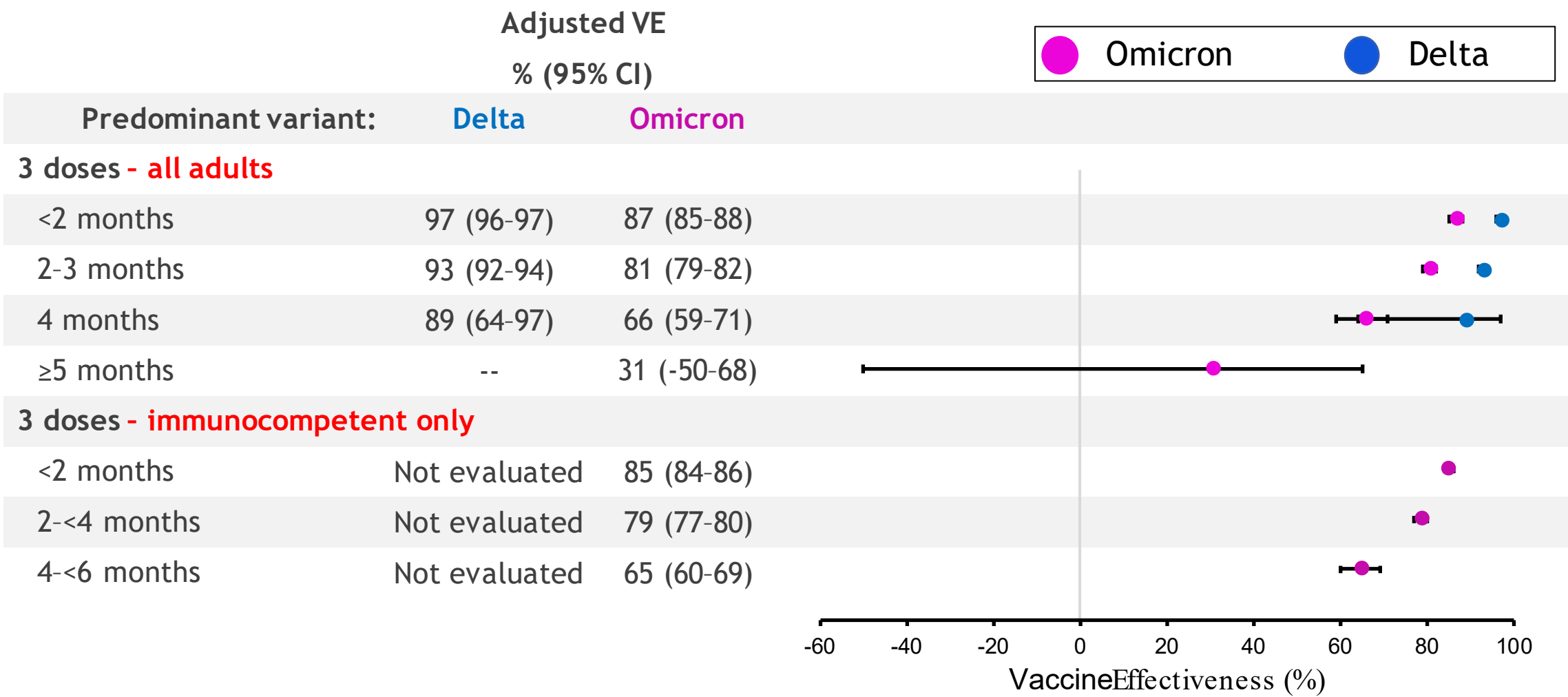


CDC preliminary unpublished data, 2022

VISION: mRNA VE for ED/UC visits by number of doses and time since last dose receipt for adults ≥18 years, Aug 2021-Jan 2022



VISION: mRNA VE for ED/UC visits by number of doses and time since last dose receipt for adults ≥18 years, Aug 2021-Jan 2022

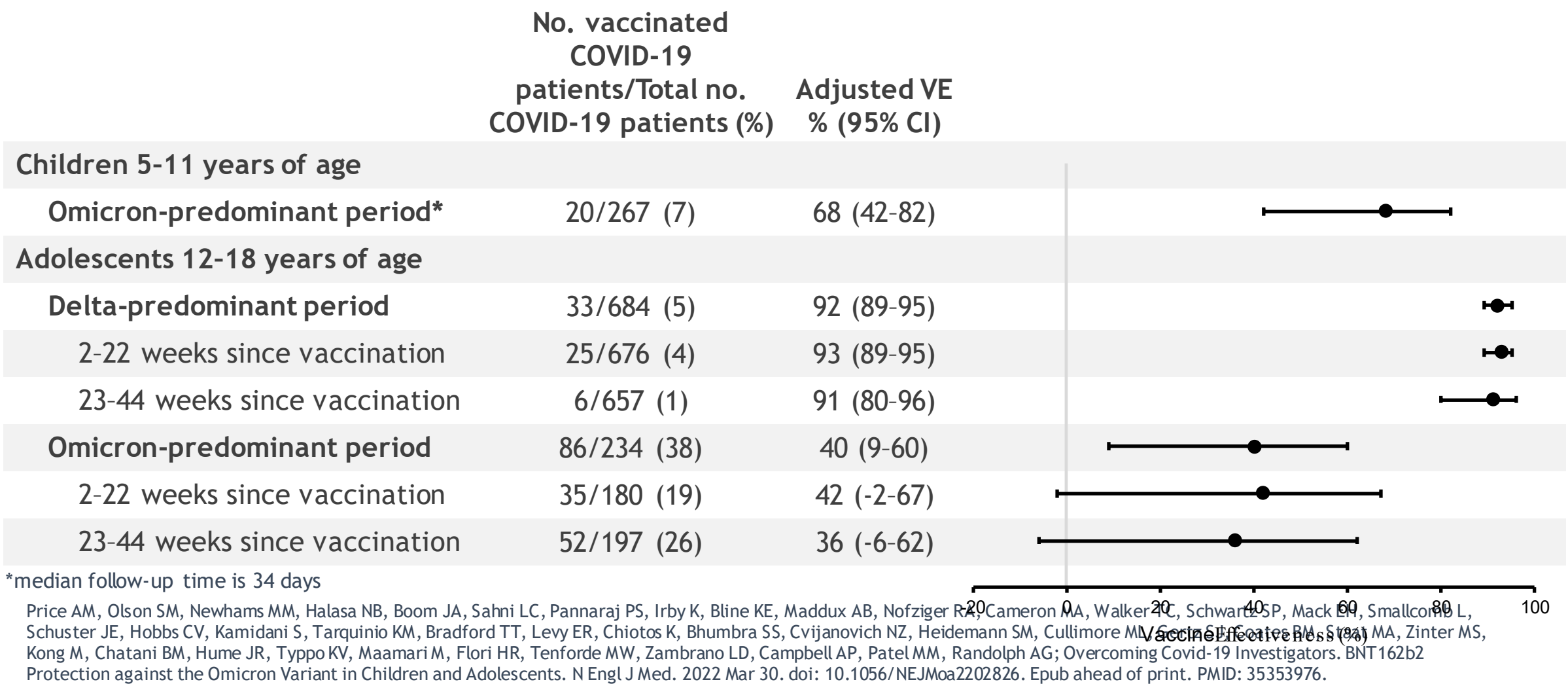


Vaccine effectiveness data for hospitalization due to Omicron in the US

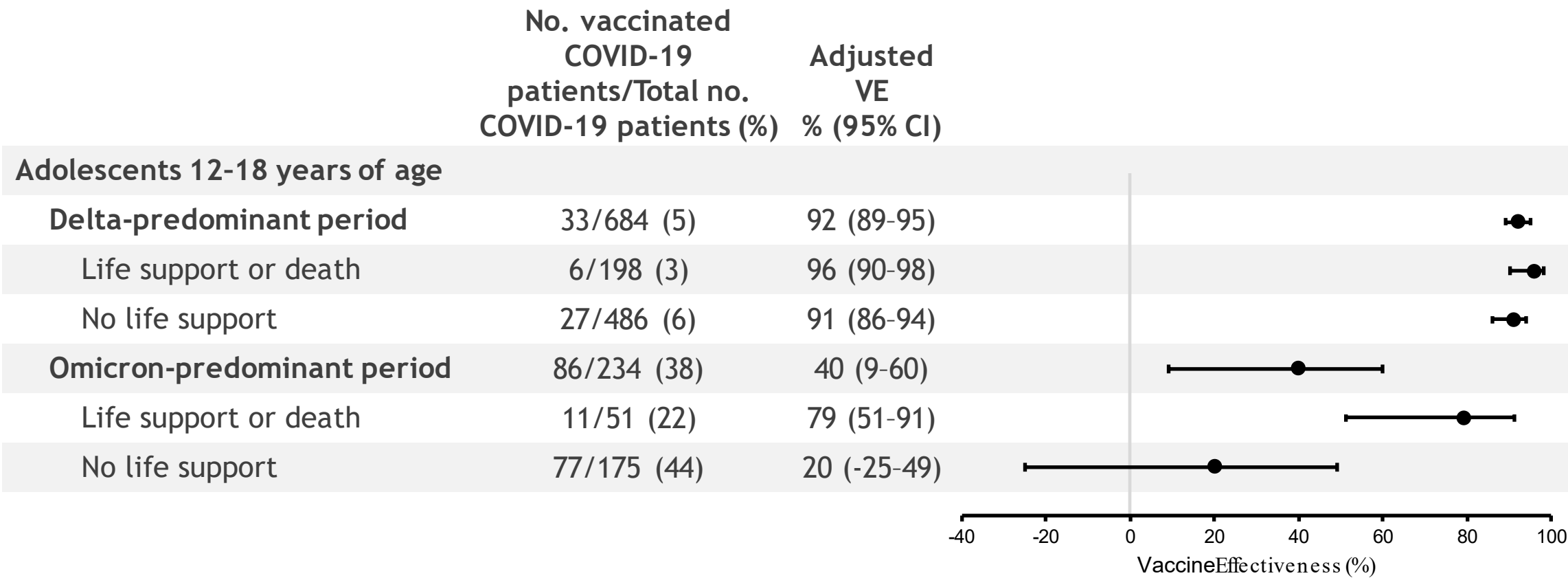
Overcoming COVID-19 Methods

- **Design:** Case-control test-negative design
- **Population:** Children and adolescents hospitalized at 31 pediatric medical centers in 23 U.S. states
- **Case status (RT-PCR or antigen)**
 - Cases tested SARS-CoV-2 positive
 - Controls tested SARS-CoV-2 negative
- **Vaccination status (documented or plausible self-report)**
 - Fully vaccinated with Pfizer-BioNTech vaccine (dose 2 is ≥ 14 days prior to illness onset)
 - Or unvaccinated by illness onset
- **Logistic regression to estimate VE against hospitalization (VE_s)**
 - Comparing odds of being fully vaccinated vs unvaccinated in COVID-19 cases and controls
 - $VE_s = 100 \times (1 - \text{adjusted odds ratio})$
 - Adjusting for admission date, hospital region, age, sex, race/ethnicity

Overcoming COVID-19 platform: VE for 2 doses of Pfizer-BioNTech vaccine against hospitalization, July 1, 2021-February 17, 2022



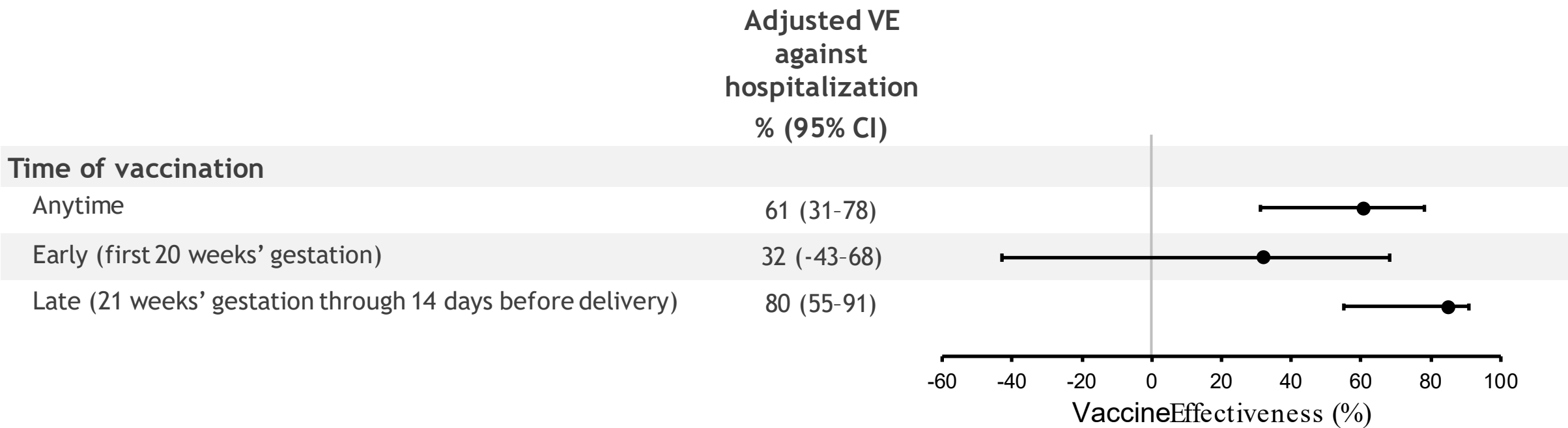
Overcoming COVID-19 platform: VE for 2 doses of Pfizer-BioNTech vaccine against hospitalization with and without life support/death, Jul 1, 2021-Feb 17, 2022



Price AM, Olson SM, Newhams MM, Halasa NB, Boom JA, Sahni LC, Pannaraj PS, Irby K, Bline KE, Maddux AB, Nofziger RA, Cameron MA, Walker TC, Schwartz SP, Mack EH, Smallcomb L, Schuster JE, Hobbs CV, Kamidani S, Tarquinio KM, Bradford TT, Levy ER, Chiotos K, Bhumbra SS, Cvijanovich NZ, Heidemann SM, Cullimore ML, Gertz SJ, Coates BM, Staat MA, Zinter MS, Kong M, Chatani BM, Hume JR, Typpo KV, Maamari M, Flori HR, Tenforde MW, Zambrano LD, Campbell AP, Patel MM, Randolph AG; Overcoming Covid-19 Investigators. BNT162b2 Protection against the Omicron Variant in Children and Adolescents. N Engl J Med. 2022 Mar 30. doi: 10.1056/NEJMoa2202826. Epub ahead of print. PMID: 35353976.

VE against infant hospitalization by timing of vaccination during pregnancy, Jul 2021-Jan 2022

- Among 379 hospitalized infants:
 - 16% of case-infant mothers were fully vaccinated during pregnancy
 - 32% of control-infant mothers were fully vaccinated during pregnancy



Overcoming COVID-19 platform: VE for 2 doses of Pfizer-BioNTech vaccine against MIS-C among persons aged 12-18 years hospitalized between Jul 1-Dec 13, 2021

Critical care support among MIS-C patients, by vaccination status

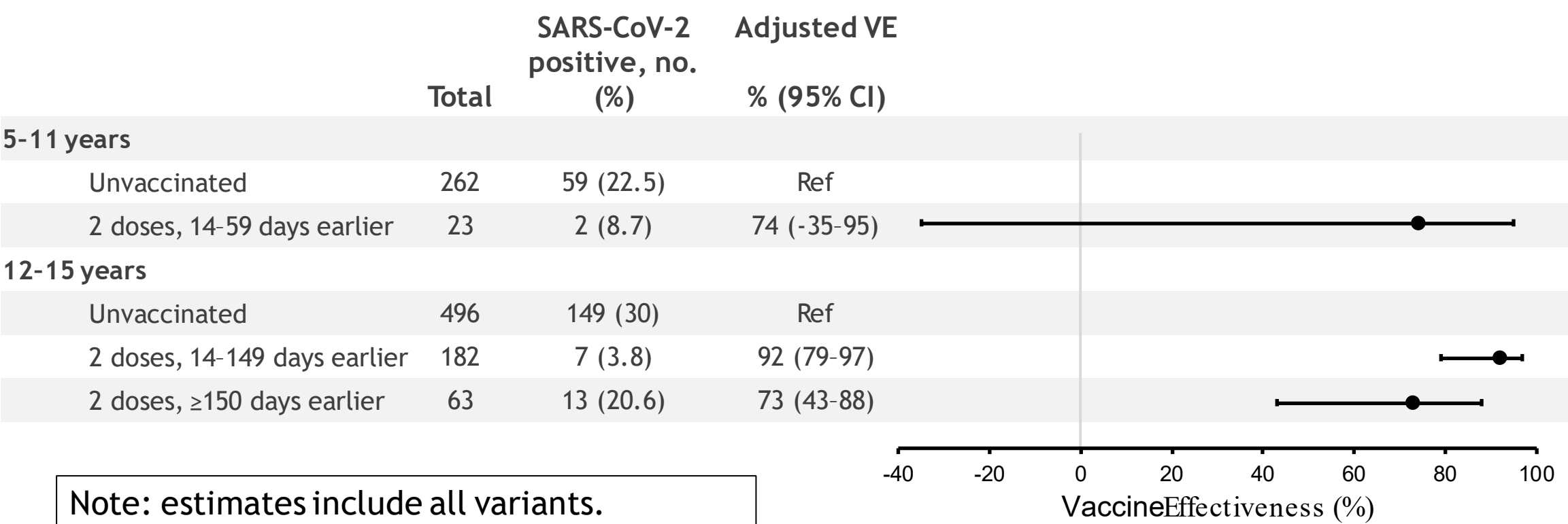
Characteristic	Total (n=102)	Unvaccinated (n=97)	Fully vaccinated (n=5)
Critically ill patients on life support	38 (37.3)	38 (39.2)	0 (0)
Invasive mechanical ventilation	9 (8.8)	9 (9.3)	0 (0)
Vasoactive infusions	35 (34.3)	35 (36.1)	0 (0)
ECMO	1 (1.0)	1 (1.0)	0 (0)

VE against MIS-C

Control groups	MIS-C case-patients	Control patients	Adjusted VE, (95% CI)
All controls	5/102 (4.9)	65/181 (35.9)	91 (78 - 97)
Test-neg	5/102 (4.9)	34/90 (37.8)	92 (77 - 97)
Syndrome-neg	5/102 (4.9)	31/91 (34.1)	89 (70 - 96)
Case-patients with serologic evidence	5/88 (5.7)	61/161 (37.9)	90 (75 - 96)

- Fully vaccinated: Defined as 2nd dose received ≥28 days prior to hospitalization.
- 95% of MIS-C patients were unvaccinated.
- No vaccinated MIS-C patients required life support.
- Overall VE against MIS-C = 91% (95% CI: 78 - 97%)

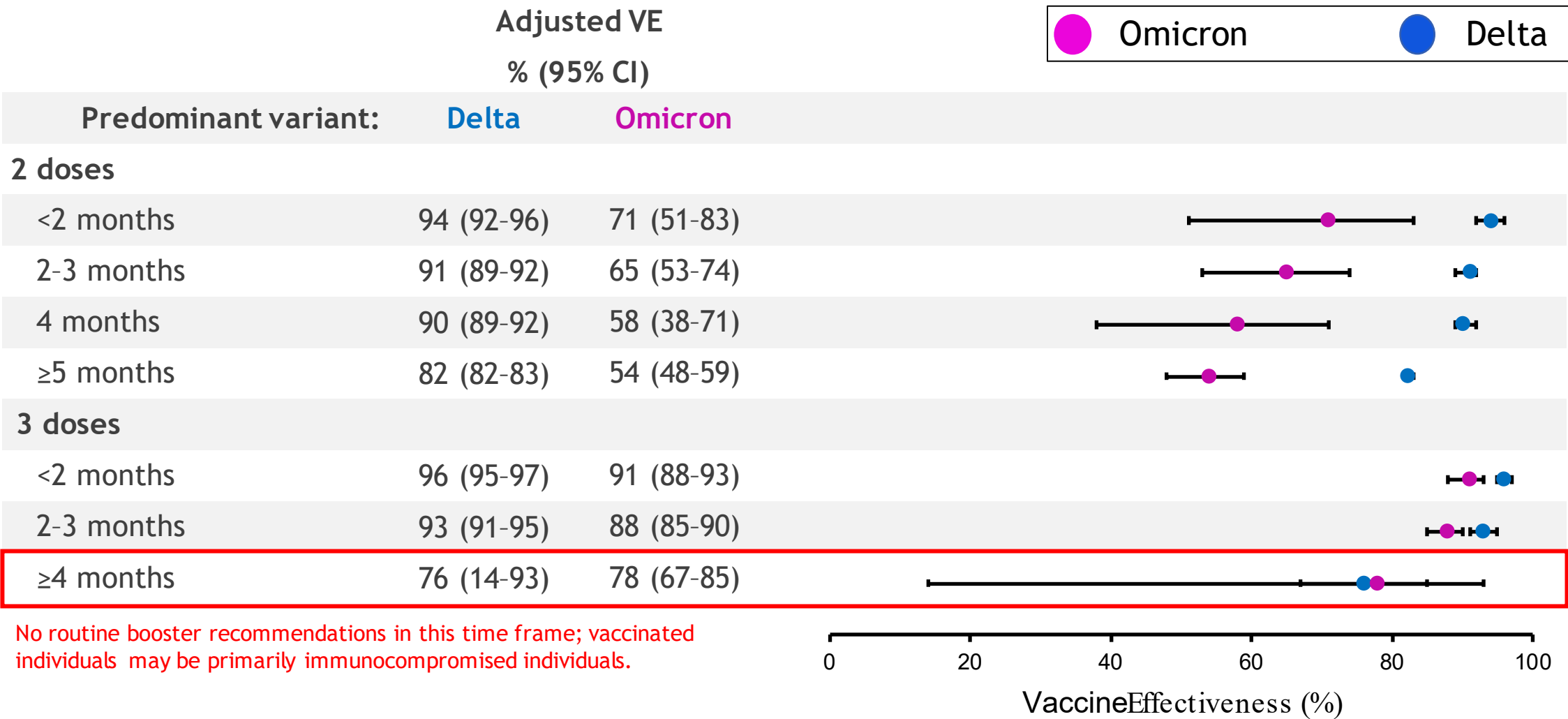
VISION: mRNA VE against hospitalization, all variants, ages 5-15 years, Apr 9, 2021-Jan 29, 2022



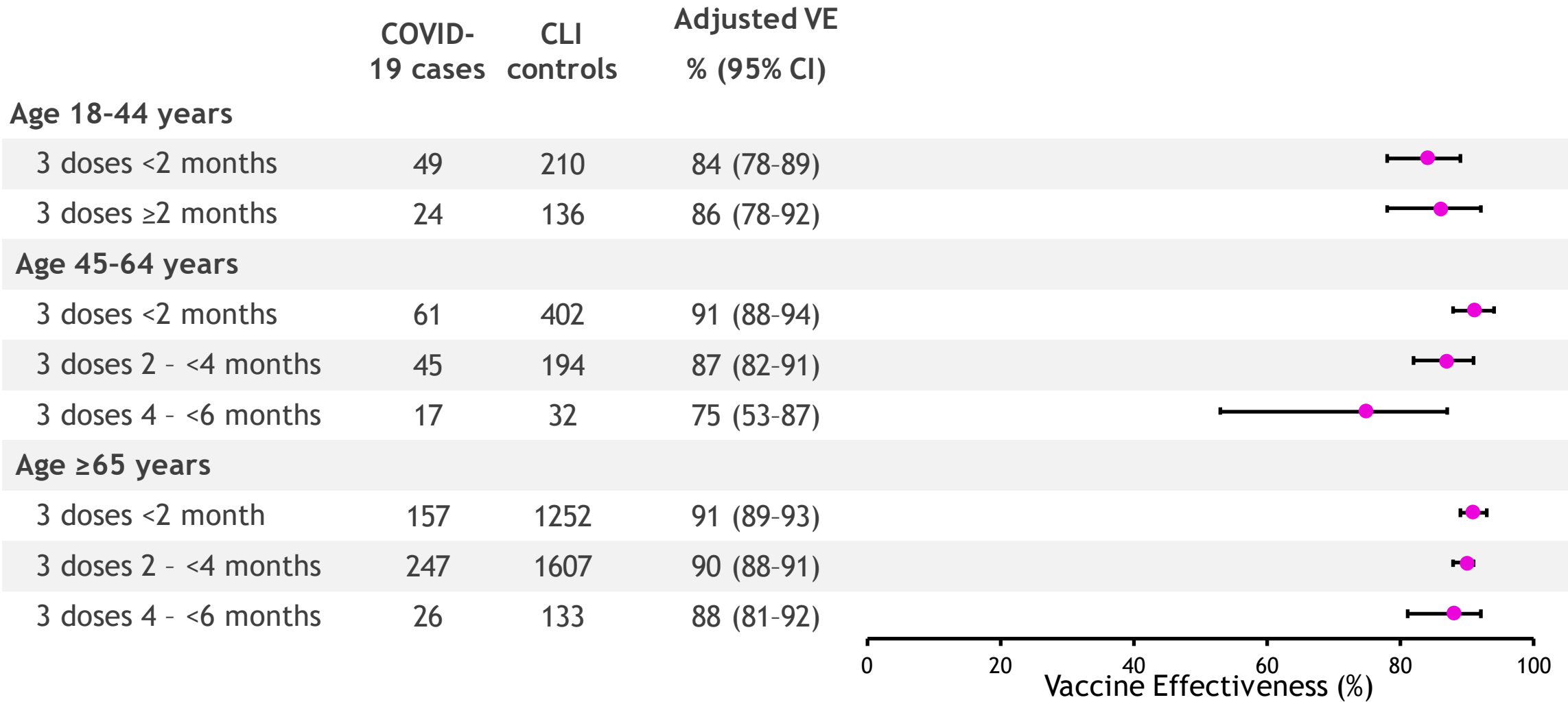
Note: estimates include all variants.

- 5-11-year-olds: 190 (67%) due to Omicron
- 12-15-year-olds: 111 (15%) due to Omicron

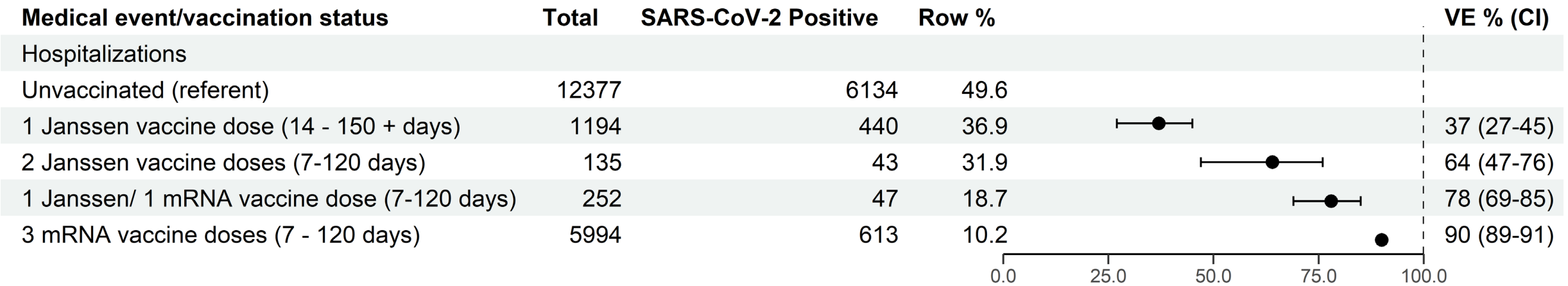
VISION: mRNA VE against hospitalization by number of doses and time since last dose receipt for adults ≥18 years, Aug 2021-Jan 2022



VISION: mRNA VE against [hospitalization](#) by time since 3rd dose receipt for [immunocompetent](#) adults ≥18 years during Omicron predominance, mid-Dec 2021-Feb 4, 2022



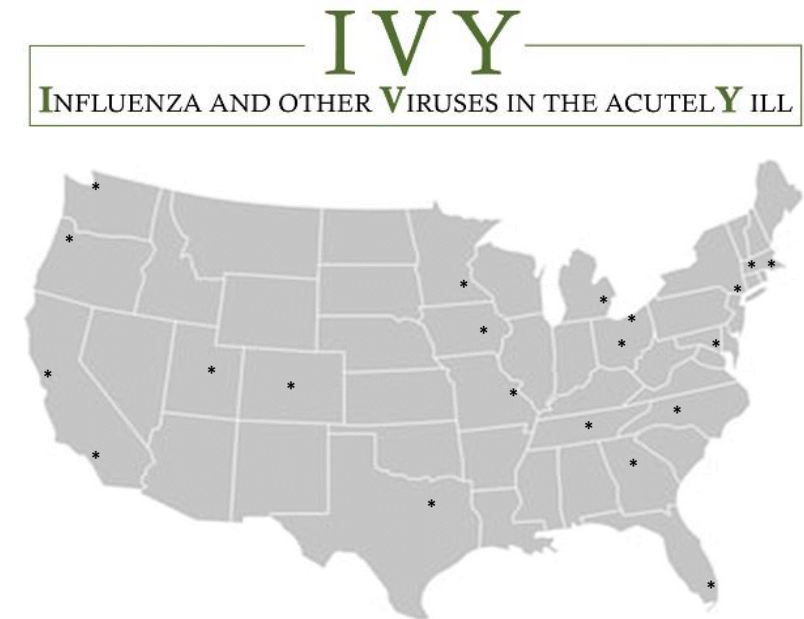
VE against COVID-19-associated hospitalizations during Omicron, Dec 16, 2021-Mar 7, 2022



- VE of any booster dose is significantly higher than VE for 1 Janssen dose only
- VE of 3 mRNA doses is significantly higher than Janssen plus booster

Effectiveness of mRNA vaccines for preventing COVID-19 hospitalization, IVY Network

- **Population:** Adults (≥ 18 years) hospitalized at 21 medical centers in 18 states
- **Case status:**
 - Cases with COVID-like illness and SARS-CoV-2 antigen / RT-PCR (+)
 - Controls: SARS-CoV-2 RT-PCR (-)
- **Testing:** SARS-CoV-2 testing within 10 days of illness onset, and admission within 14 days of illness onset

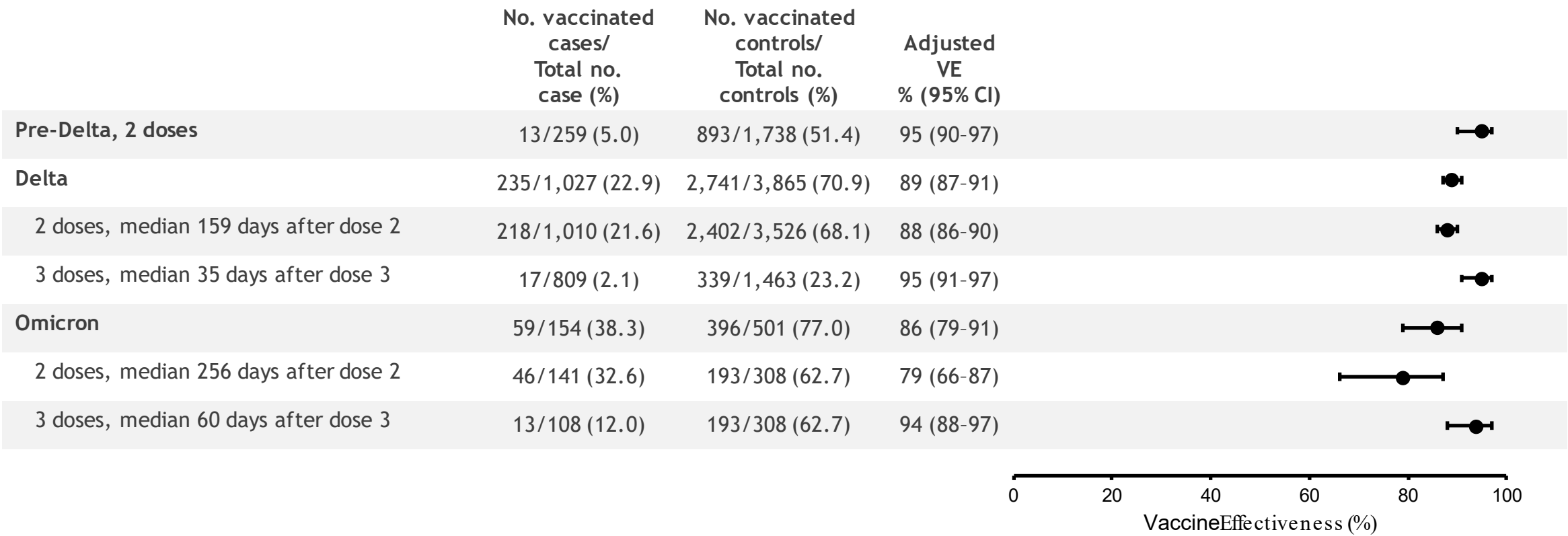


IVY: VE against hospitalization among immunocompetent adults during Omicron, by time since 3rd dose, Jan 1-Mar 15, 2022

Group	No. of vaccinated case-patients/ Total no. of case-patients (%)	No. of vaccinated control-patients/ Total no. of control- patients (%)	Adjusted VE, % (95% CI)
Overall			
3 mRNA vaccine doses, 7–120 days	111/572 (19)	257/466 (55)	85 (79–89)
3 mRNA vaccine doses, >120 days	16/477 (3)	44/253 (17)	80 (60–90)
≥65 years only			
3 mRNA vaccine doses, 7–120 days	67/247 (27)	142/199 (71)	87 (80–92)
3 mRNA vaccine doses, >120 days	11/191 (6)	37/94 (39)	88 (69–95)

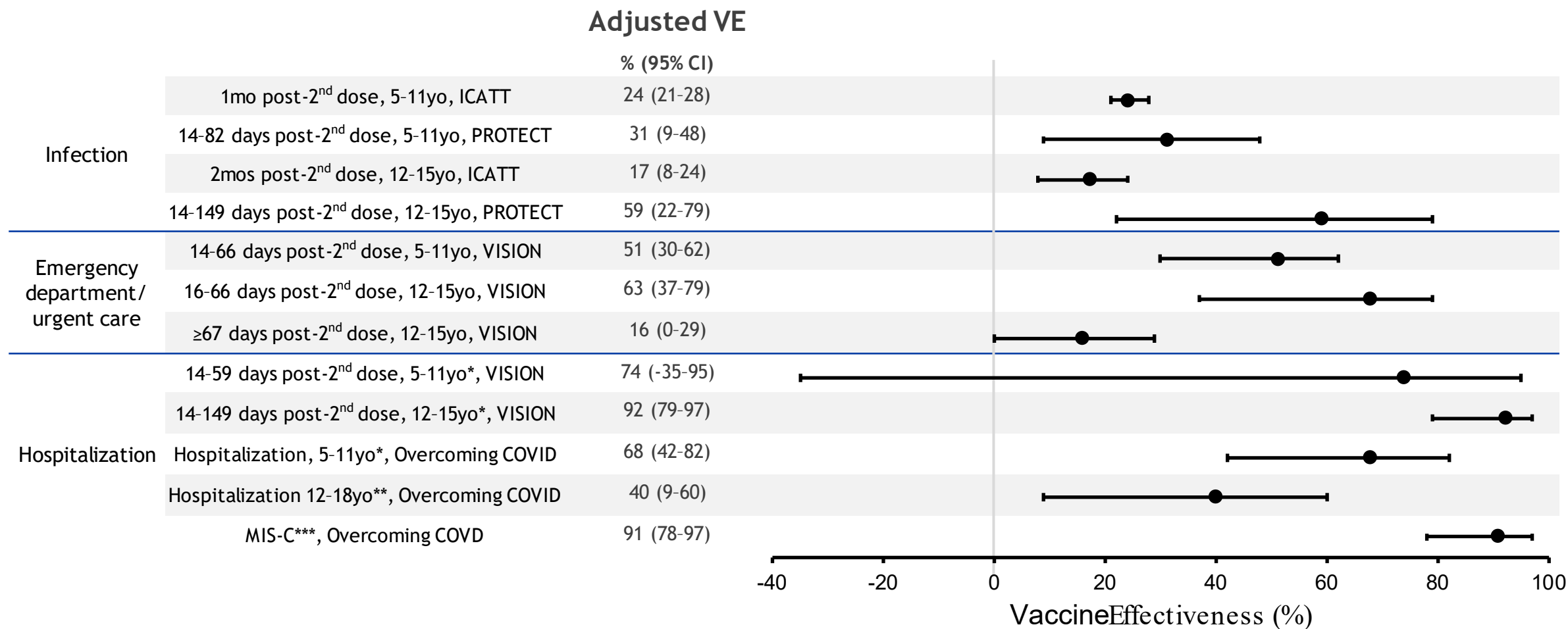
Group	Adjusted VE, % (95% CI)
Overall	85 (79–89)
3 mRNA vaccine doses, 7–120 days	85 (79–89)
3 mRNA vaccine doses, >120 days	80 (60–90)
≥65 years only	
3 mRNA vaccine doses, 7–120 days	87 (80–92)
3 mRNA vaccine doses, >120 days	88 (69–95)

IVY: VE against critical illness or in-hospital death, by variant, Jul 4, 2021-Jan 24, 2022



Summary

Summary: VE of 2 doses of mRNA vaccine during Omicron increases with increasing severity of outcome in children 5-18 years

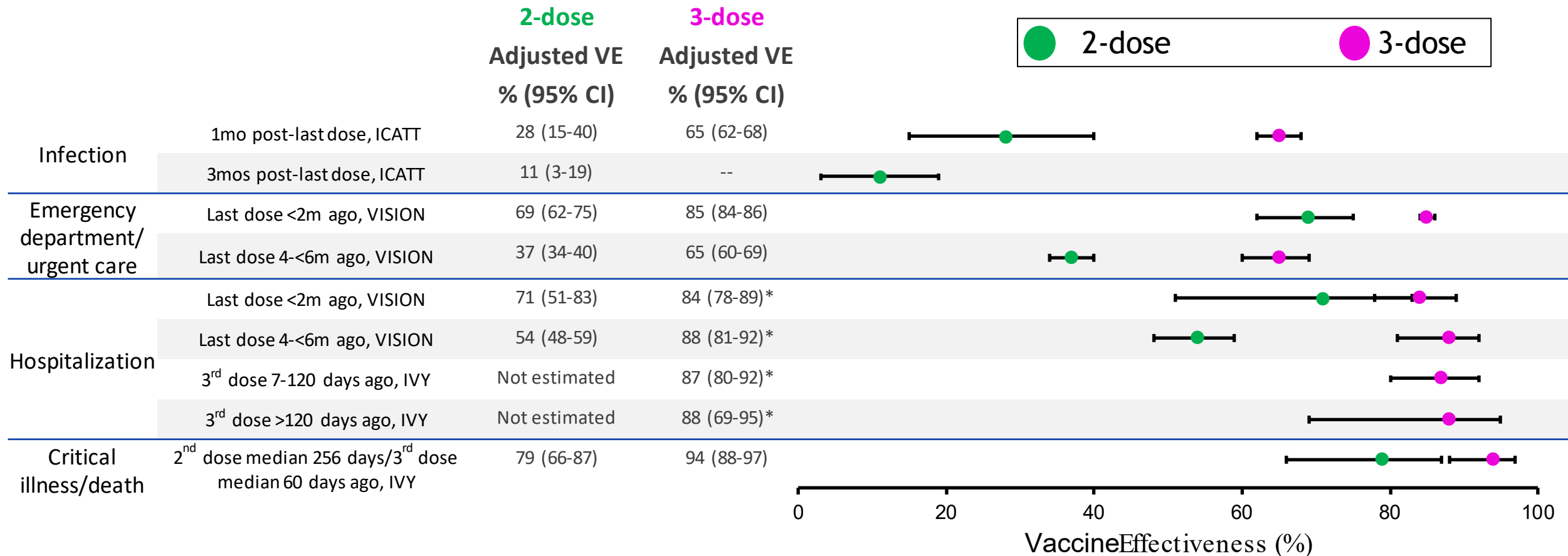


*Median follow-up time was 34 days.

**Median follow-up time was 6 months.

***MIS-C VE estimates are from pre-Omicron.

Summary: VE of 2 doses of mRNA vaccine increases with increasing severity of outcome during Omicron in adults ≥18 years; 3rd dose increases VE



**Booster receipt increases protection across all outcomes.
Booster dose VE remains high among immunocompetent individuals 4-6 months after dose.**

*Among immunocompetent individuals ≥65 years of age.

Summary: VE during Omicron

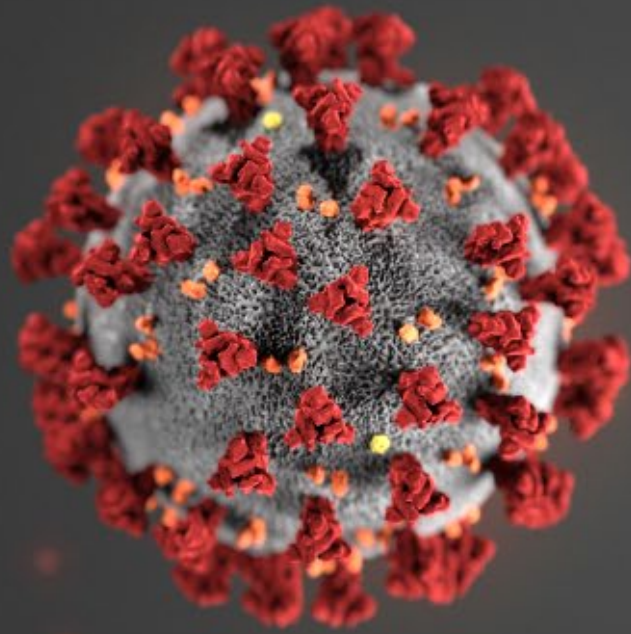
	Children 5-11 years	Adolescents, 12-17 years	Adults ≥18 years
2-dose VE against:			
Infection (+/- symptoms)	Limited protection	Limited protection	Limited protection
ED/UC	Higher protection	Higher protection	Higher protection, some waning
Hospitalization	Highest protection, not enough cases to estimate waning	Highest protection, some waning	Highest protection, some waning
3-dose VE against:			
Infection (+/- symptoms)	N/A	Too early to assess	Substantial additional protection for all outcomes; limited waning for hospitalization, especially among immunocompetent
ED/UC			
Hospitalization			

Protection from death: Small numbers of deaths make estimation difficult, but consistently lower rates among vaccinated compared to unvaccinated during Omicron suggest that vaccines protect against deaths in all age groups

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For more information, contact CDC
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