



# **COVID-19 vaccine effectiveness updates**

**24 February 2023**

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# Organization of presentation

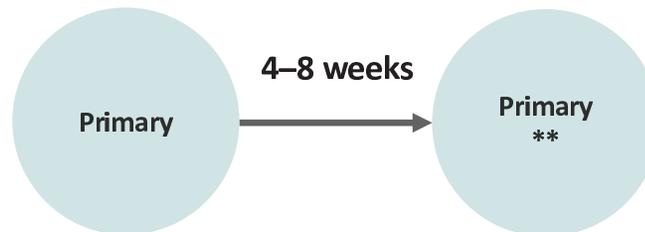
- Preliminary vaccine effectiveness (VE) of **monovalent** vaccines against *symptomatic infection* in children aged 6 months–4 years (Pfizer-BioNTech) and 6 months–5 years (Moderna)
- Update on VE of **bivalent** vaccines against *symptomatic infection* in children aged 5-17 years and adults aged  $\geq 18$  years
- Update on VE of **bivalent** vaccines against *severe disease* in adults with a focus on adults aged  $\geq 65$  years

# Preliminary Estimates of Effectiveness of **Monovalent** mRNA Vaccines in Preventing Symptomatic SARS-CoV-2 Infection Among Children Aged 3–5 Years — Increasing Community Access to Testing Program, United States, July 2022–February 2023

Fleming-Dutra KE, Ciesla AA, Roper, LE et al. Preliminary Estimates of Effectiveness of Monovalent mRNA Vaccines in Preventing Symptomatic SARS-CoV-2 Infection Among Children Aged 3–5 Years — Increasing Community Access to Testing Program, United States, July 2022–February 2023. *MMWR Morb Mortal Wkly Rep* 2023;72:177–182. DOI: <http://dx.doi.org/10.15585/mmwr.mm7207a3>

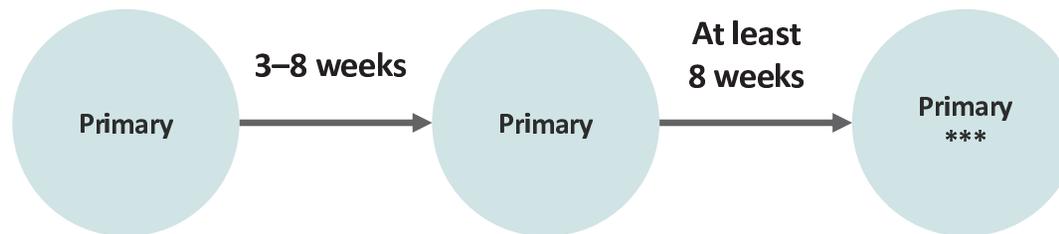
# Pediatric COVID-19 Vaccine Primary Series Schedule\*: Ages 6 months–5 years (Moderna) and 6 months–4 years (Pfizer-BioNTech)

**Ages 6 months–  
5 years**  
(Primary Series:  
**Moderna**)



Earliest date for a child to  
have a “complete series”=  
**August 1, 2022**

**Ages 6 months–  
4 years**  
(Primary Series:  
**Pfizer-BioNTech**)



Earliest date for a child  
to have a “complete  
series”=  
**September 19, 2022**

\*On June 18, 2022, ACIP issued interim recommendations for the use of the Moderna COVID-19 vaccine for children aged 6 months–5 years and for the Pfizer-BioNTech COVID-19 vaccine for children aged 6 months–4 years.

\*\* As of December 9, 2022, children who received 2 doses of monovalent Moderna vaccine are recommended to receive a single bivalent booster dose at least 2 months after their last primary series dose.

\*\*\*As of December 9, 2022, children who received 2 doses of monovalent Pfizer-BioNTech vaccine primary series are recommended to receive a bivalent dose as their third dose.

## Percent of people receiving COVID-19 vaccine by age and date administered – United States, December 14, 2020 – February 15, 2023

	<2 yrs	2-4 yrs	5-11 yrs	12-17 yrs	18-24 yrs	25-49 yrs	50-64 yrs	+65 yrs
At Least One Dose	7.7%	10.3%	39.7%	71.9%	81.9%	85.2%	95.0%	95.0%
Completed Primary Series	3.8%	5.5%	32.6%	61.6%	66.5%	72.0%	83.7%	94.2%
Updated (Bivalent) Booster Dose	0.2%	0.3%	4.1%	7.1%	6.7%	11.3%	20.5%	41.0%

## Increasing Community Access to Testing (ICATT) Program: VE of **monovalent COVID-19 vaccines** against *symptomatic infection* in children aged 3-5 years

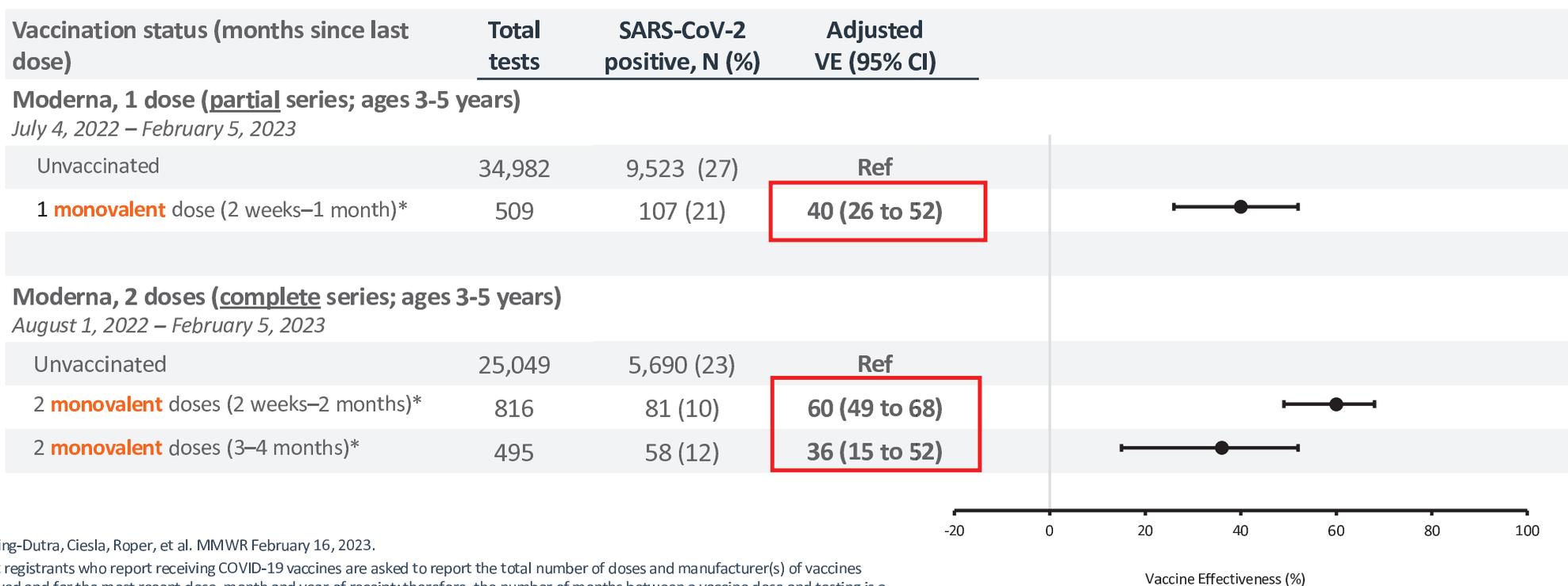
- Nationwide community-based drive-through SARS-CoV-2 testing via pharmacies
- Self-reported vaccine history at time of registration for COVID-19 testing
- **Design:** Test-negative, case-control analysis\*
- **Population:** Immunocompetent children 3 – 4/5\*\* years with  $\geq 1$  COVID-like symptom and nucleic acid amplification testing (NAAT)
- **Period for analysis:**
  - Tested: July 4, 2022\*\*\* – February 5, 2023, BA.4/BA.5 predominant period, but includes XBB

\*Models adjusted for: age, gender, race, ethnicity, social vulnerability index and HHS region of the testing location, underlying conditions (presence versus absence), pharmacy chain conducting the test, local incidence (cases per 100,000 by individual county and state in the 7 days before test date), and date of testing.

\*\* ICATT testing is generally limited to children ages 3 and up.

\*\*\*Analysis start date depended on vaccine/dose number being analyzed: Pfizer and Moderna 1<sup>st</sup> doses started 7/4/2022; Pfizer 2<sup>nd</sup> dose started 7/25/2022; Moderna 2<sup>nd</sup> dose started 8/1/2022; Pfizer 3<sup>rd</sup> dose started 9/19/2022.

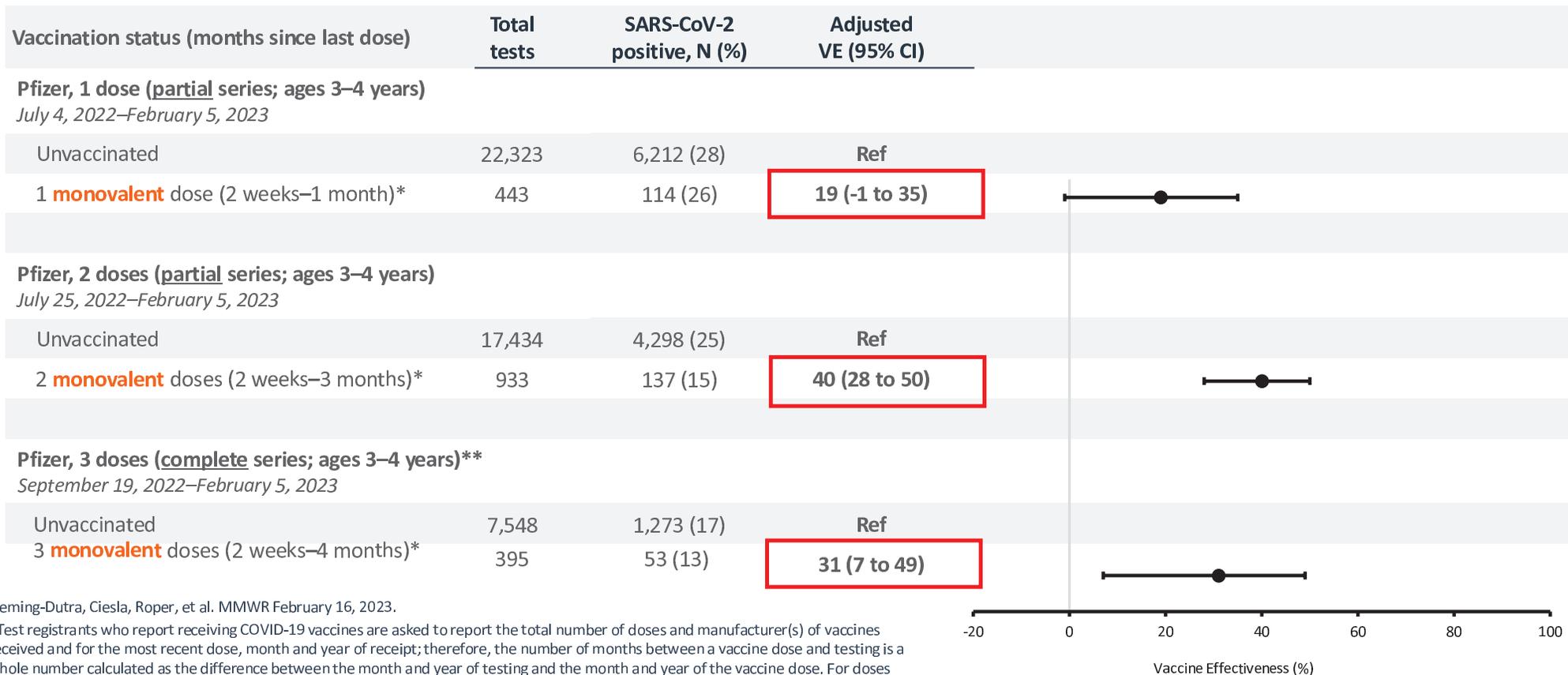
## ICATT: Preliminary estimates of VE for primary series **monovalent** Moderna vaccine (children aged 3–5 years) against *symptomatic infection*, July 4, 2022 – February 5, 2023



Fleming-Dutra, Ciesla, Roper, et al. MMWR February 16, 2023.

\*Test registrants who report receiving COVID-19 vaccines are asked to report the total number of doses and manufacturer(s) of vaccines received and for the most recent dose, month and year of receipt; therefore, the number of months between a vaccine dose and testing is a whole number calculated as the difference between the month and year of testing and the month and year of the vaccine dose. For doses received in the same month or the month before SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received  $\geq 2$  weeks before testing, and only doses received  $\geq 2$  weeks before testing were included. 17% and 21% of children who received 1 and 2 doses of Moderna, respectively, reported a prior infection  $>90$  days before the current test.

# ICATT: Preliminary estimates of VE for primary series **monovalent** Pfizer-BioNTech vaccine (children aged 3–4 years) against *symptomatic infection*, July 4, 2022 – February 5, 2023



Fleming-Dutra, Ciesla, Roper, et al. MMWR February 16, 2023.

\*Test registrants who report receiving COVID-19 vaccines are asked to report the total number of doses and manufacturer(s) of vaccines received and for the most recent dose, month and year of receipt; therefore, the number of months between a vaccine dose and testing is a whole number calculated as the difference between the month and year of testing and the month and year of the vaccine dose. For doses received in the same month or the month before SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received  $\geq 2$  weeks before testing, and only doses received  $\geq 2$  weeks before testing were included. 18%, 19% and 21% of children who received 1, 2, and 3 doses of Pfizer, respectively, reported a prior infection  $>90$  days before the current test.

\*\*There was insufficient power to stratify Pfizer-BioNTech 3-dose VE estimates by time since vaccination.

## Limitations

- Vaccine coverage is low in children  $\leq 5$  years. VE estimates may be less stable when vaccine coverage is low.
- Prevalence of prior infection in children is high\*; consequently, vaccine effectiveness in this analysis reflects the current situation among young children in the United States.
- Low vaccination coverage in this age group may impact future ability to estimate VE, including against more severe outcomes.

\*<https://covid.cdc.gov/covid-data-tracker/#pediatric-seroprevalence>.

# Conclusions

- Complete **monovalent** primary vaccination series helped provide protection for children aged 3–5 years against *symptomatic* SARS-CoV-2 infection for at least the first 4 months after vaccination.
- Waning of **monovalent** Moderna primary series might occur by 3–4 months after the second dose based on point estimates (although confidence intervals overlapped). This is similar to patterns observed in older children and adults in the first months after vaccination.
  - Waning of monovalent Pfizer-BioNTech VE against symptomatic infection could not be assessed but is also likely based on analyses in older children and adults.
- Children should stay up to date with COVID-19 vaccines, including completing the primary series; those who are eligible should receive a bivalent vaccine dose.
- CDC will continue to monitor VE in this age group, including against severe disease and for bivalent doses.

Updated estimates of **bivalent** VE against symptomatic infection among children aged 5–17 and adults aged  $\geq 18$  years

# Interpreting absolute and relative vaccine effectiveness

- **Absolute VE:** comparing the frequency of health outcomes in vaccinated and unvaccinated people
  - E.g., comparing outcomes in people vaccinated with an updated **bivalent** booster versus no vaccine at all
- **Relative VE:** comparing the frequency of health outcomes in people who received one type of vaccine to people who received a different vaccine or by comparing people who received more vaccine doses to those who received fewer doses
  - E.g., comparing outcomes in people vaccinated with an updated **bivalent** booster versus **monovalent** vaccine only
- In the analyses presented today, relative vaccine effectiveness can be interpreted as the ***additional protection provided by an updated bivalent booster*** among people who already received monovalent COVID-19 vaccines

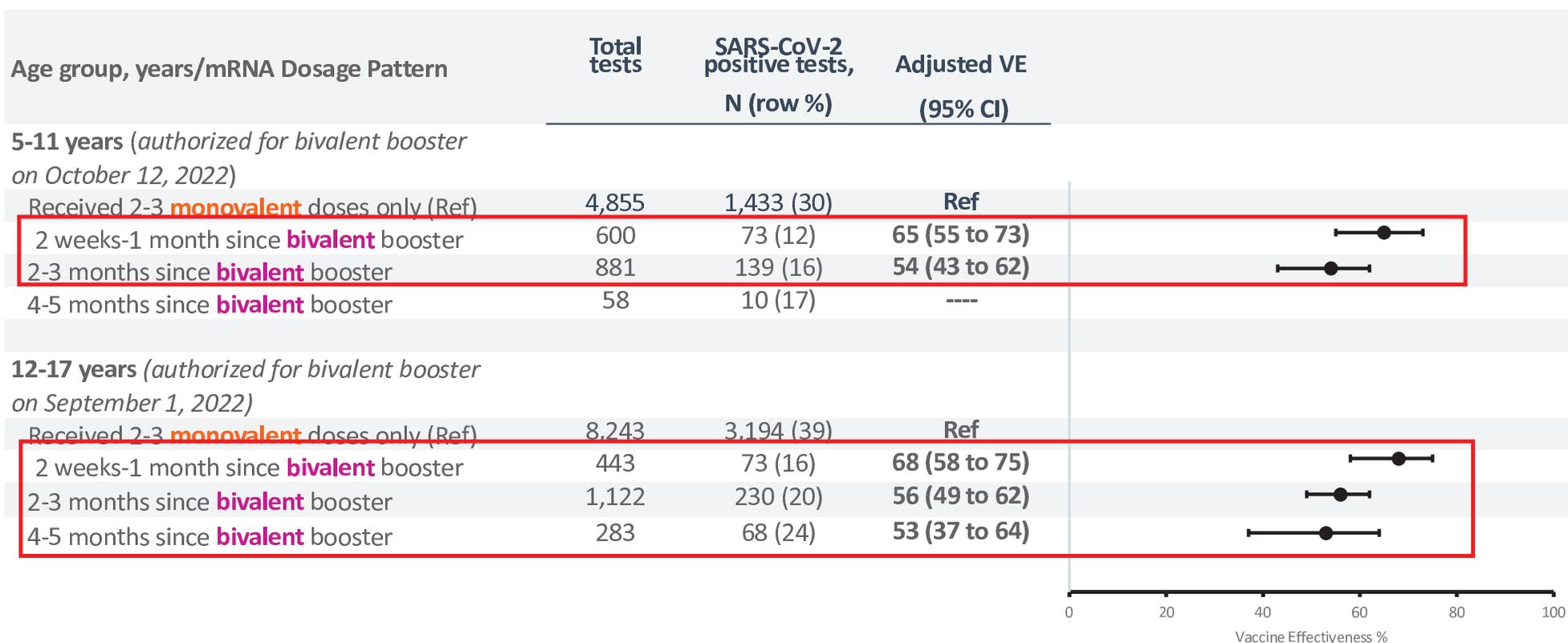
## ICATT: *Relative VE of bivalent booster against symptomatic infection in children aged 5–17 years and adults aged ≥18 years*

- Nationwide community-based drive-through SARS-CoV-2 testing via pharmacies
- Self-reported vaccine history at time of registration for COVID-19 testing
- **Design:** Test-negative, case-control analysis\*
- **Population:** Children aged 5–17 years and adults aged ≥18 years with ≥1 COVID-like symptom and nucleic acid amplification testing (NAAT)
- **Exclusion criteria:** Excluded individuals <4 months from last monovalent dose and individuals with immunocompromising conditions
- **Periods for analysis:**
  - Tested: December 1, 2022 – February 13, 2023\*\*
  - Includes periods of both BA.5-related sublineage and XBB/XBB.1.5 sublineage predominance

\*Models adjusted for: age, gender, race, ethnicity, social vulnerability index and HHS region of the testing location, underlying conditions (presence versus absence), local incidence (cases per 100,000 by individual county and state in the 7 days before test date), and date of testing

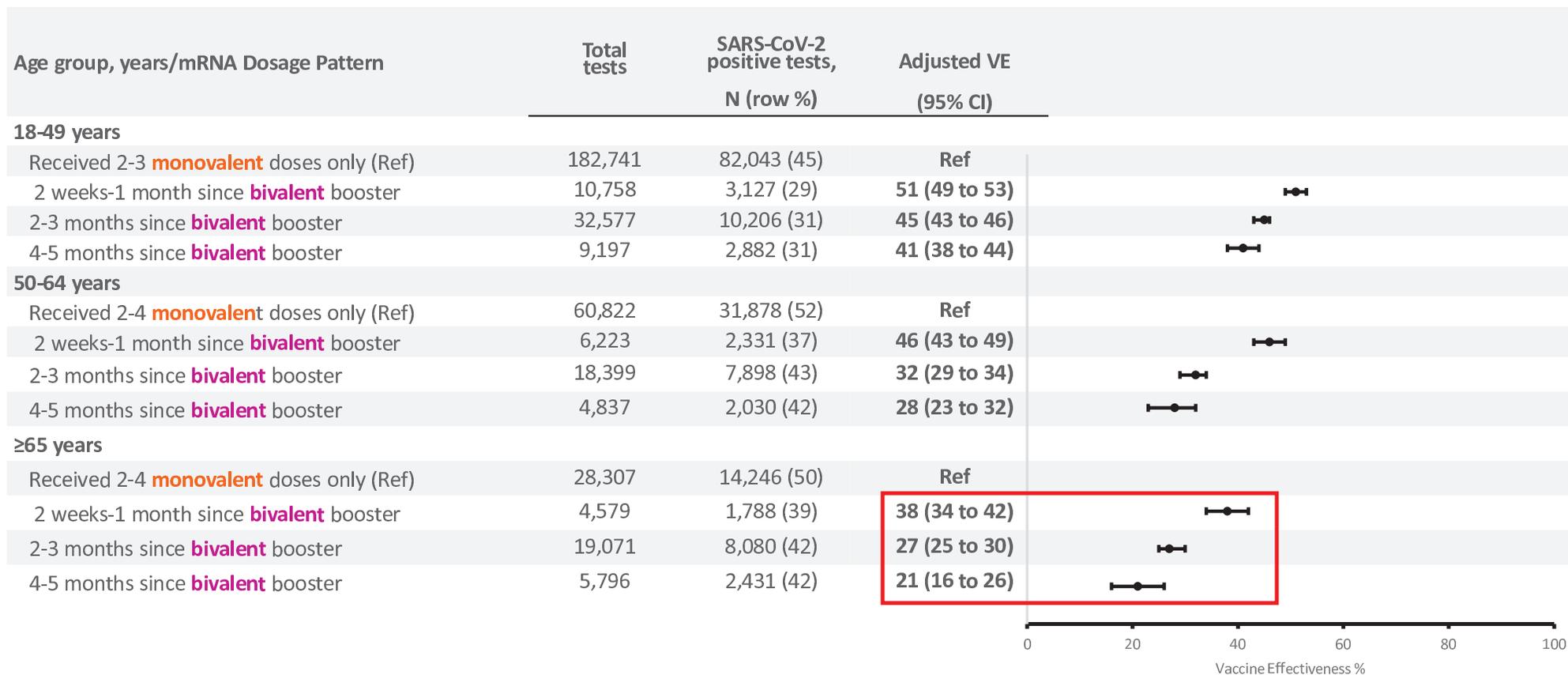
\*\*Analysis is an update of data published in Link-Gelles R, Ciesla AA, Roper LE, et al. Early estimates of bivalent mRNA booster dose vaccine effectiveness in preventing symptomatic SARS-CoV-2 infection attributable to SARS-CoV-2 Omicron BA.5-related and XBB/XBB.1.5-related sublineages among immunocompetent adults—Increasing Community Access to Testing Program, United States, December 2022–January 2023. MMWR Morb Mortal Wkly Rep 2023;72. <https://www.cdc.gov/mmwr/volumes/72/wr/mm7205e2.htm>

## ICATT: Relative VE of **bivalent** booster against *symptomatic infection* in children aged 5–17 years, December 1, 2022 – February 13, 2023\*



\*Unpublished CDC data.

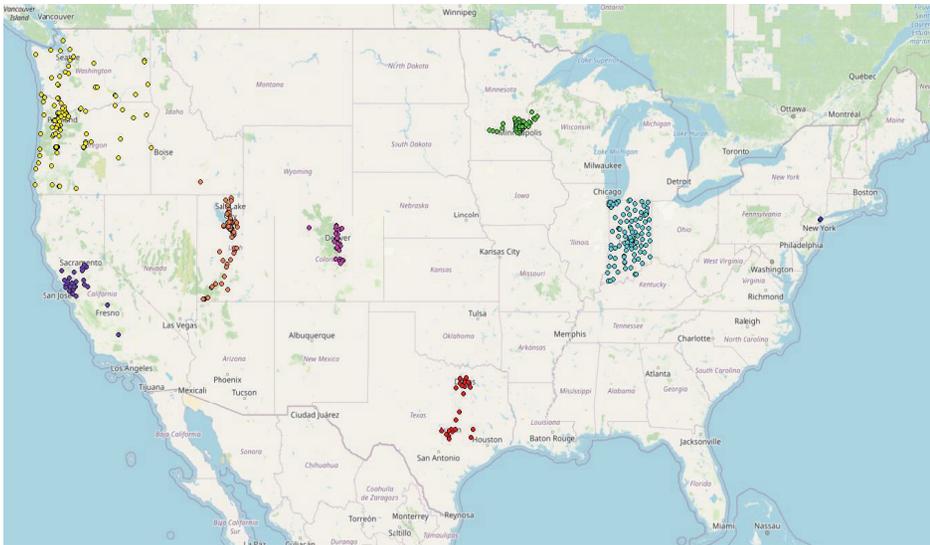
## ICATT: Relative VE of **bivalent** booster against *symptomatic infection* in adults aged ≥18 years, December 1, 2022 – February 13, 2023\*



\*Unpublished CDC data.

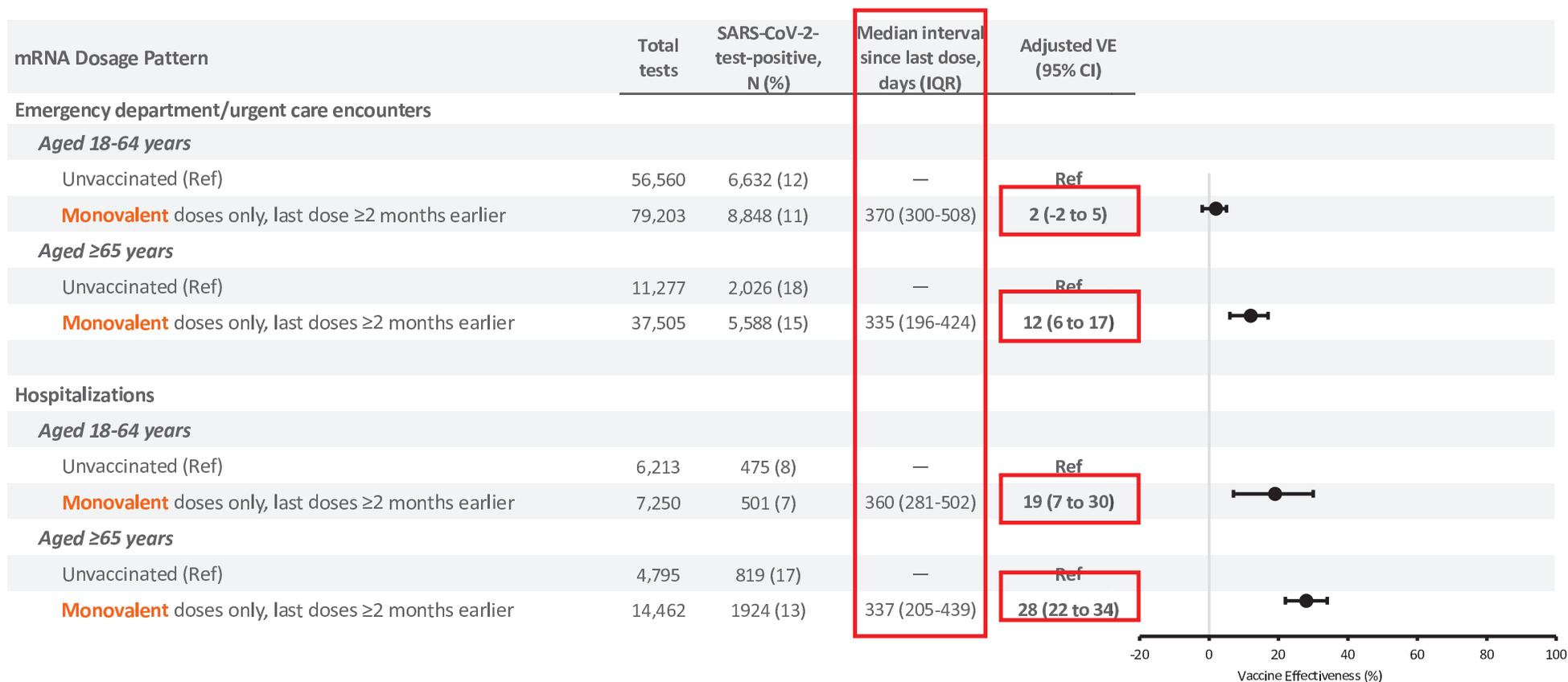
Updated estimates of **bivalent** VE against emergency department/urgent care encounters and hospitalizations among adults aged  $\geq 18$  years, VISION Network

# VISION Multi-State Network of Electronic Health Records



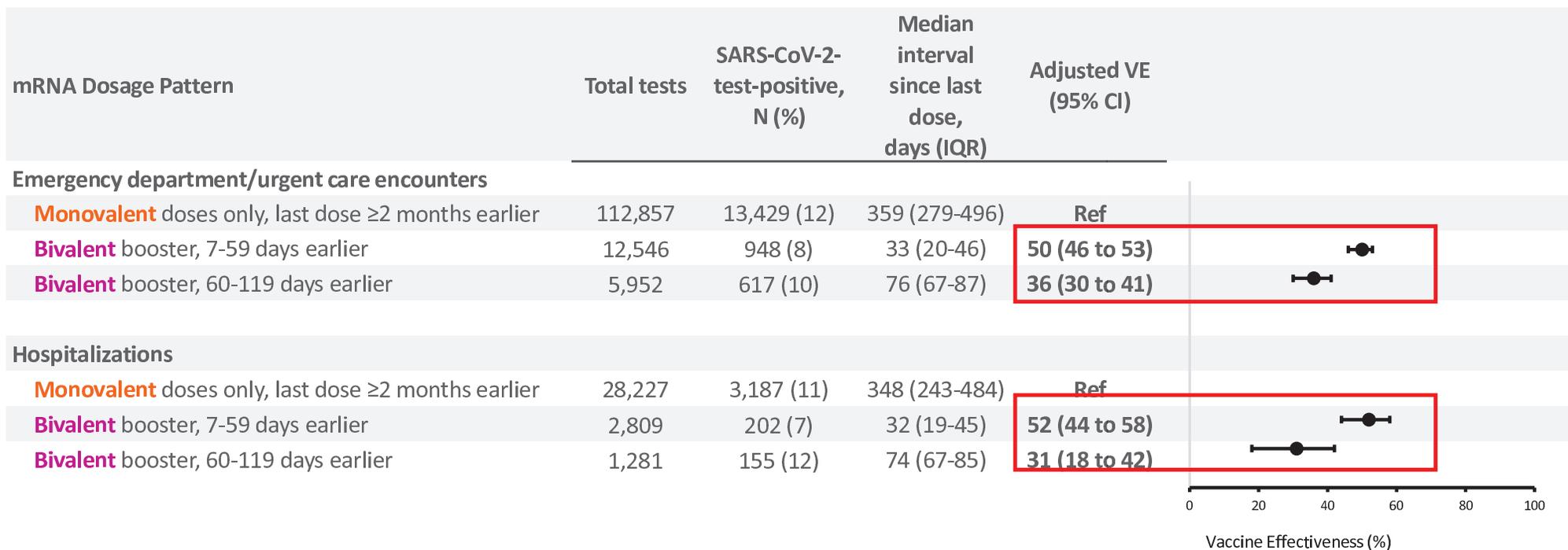
- **Cases:** COVID-like illness (CLI) with positive PCR for SARS-CoV-2 within 14 days before or 72 hours after the admission or encounter
- **Controls:** CLI with negative PCR for SARS-CoV-2
- Variant periods designated for analysis based on time when novel sublineage became predominant at study site
- VE adjusted for age, sex, race, ethnicity, geographic region, calendar time, and local rates of SARS-CoV-2 circulation
- Vaccination documented by electronic health records and state and city registries

# VISION: Absolute VE of $\geq 2$ monovalent doses against ED/UC encounters and hospitalizations among adults aged $\geq 18$ years– September 2022 – January 2023\*



\*Unpublished CDC data.

## VISION: Relative VE of **bivalent** booster against *ED/UC encounters* and *hospitalizations* among adults aged $\geq 18$ years –September 2022 – January 2023\*



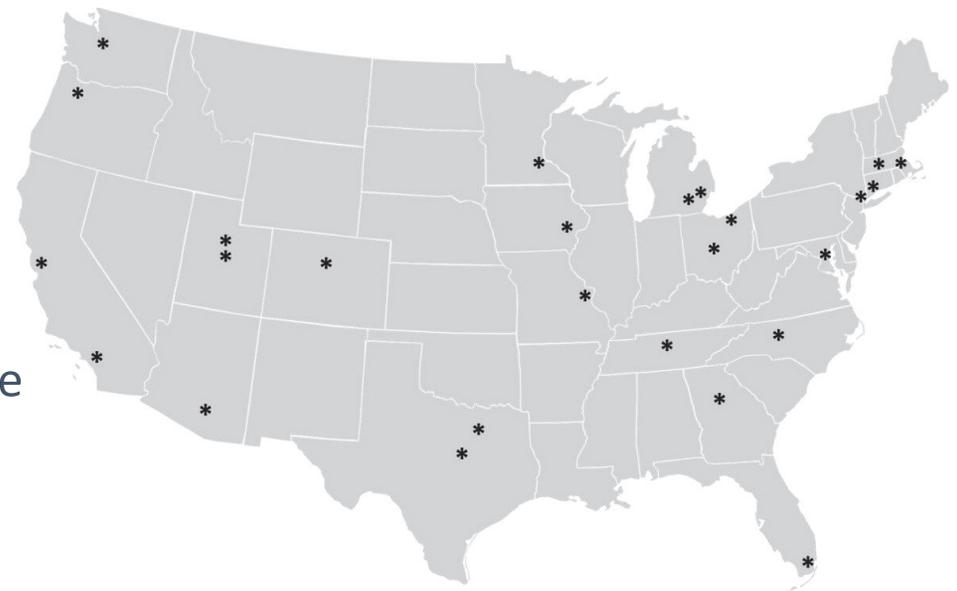
\*Unpublished CDC data.

Preliminary estimates of **bivalent** VE against hospitalizations among adults aged  $\geq 65$  years, IVY Network

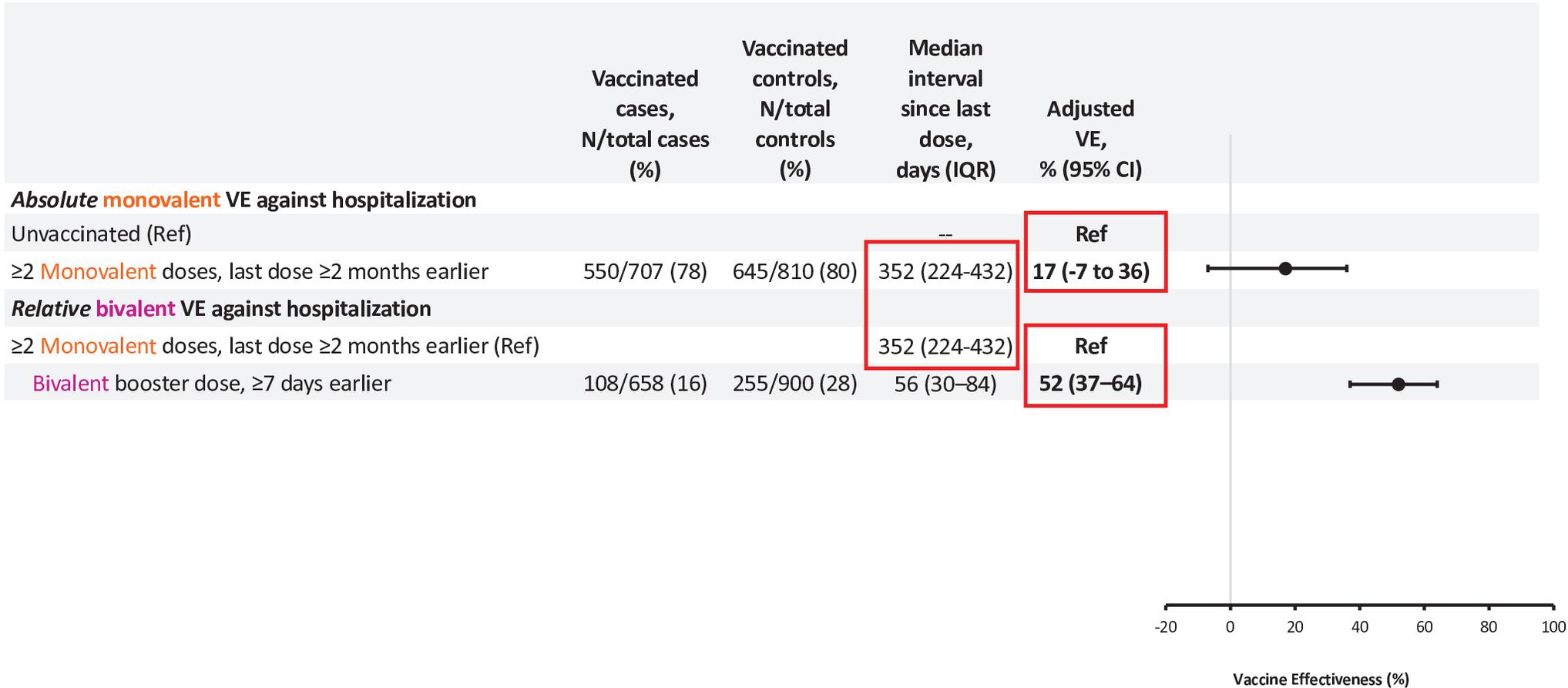
# IVY Network — 24 hospitals, 19 U.S. States

- **Design:** Prospective test-negative, case-control
- **Period:** September 8, 2022–January 30, 2023
- **Population:** Immunocompetent adults hospitalized with COVID-like illness (CLI)
- **Participants have CLI and SARS-CoV-2 test:**
  - **Cases:** SARS-CoV-2-positive by RT-PCR or antigen
  - **Controls:** SARS-CoV-2- and influenza-negative by RT-PCR
- **VE adjustments:** Age, sex, race/ethnicity, admission date (biweekly), and HHS region

IVY  
INVESTIGATING RESPIRATORY VIRUSES IN THE ACUTE ILL

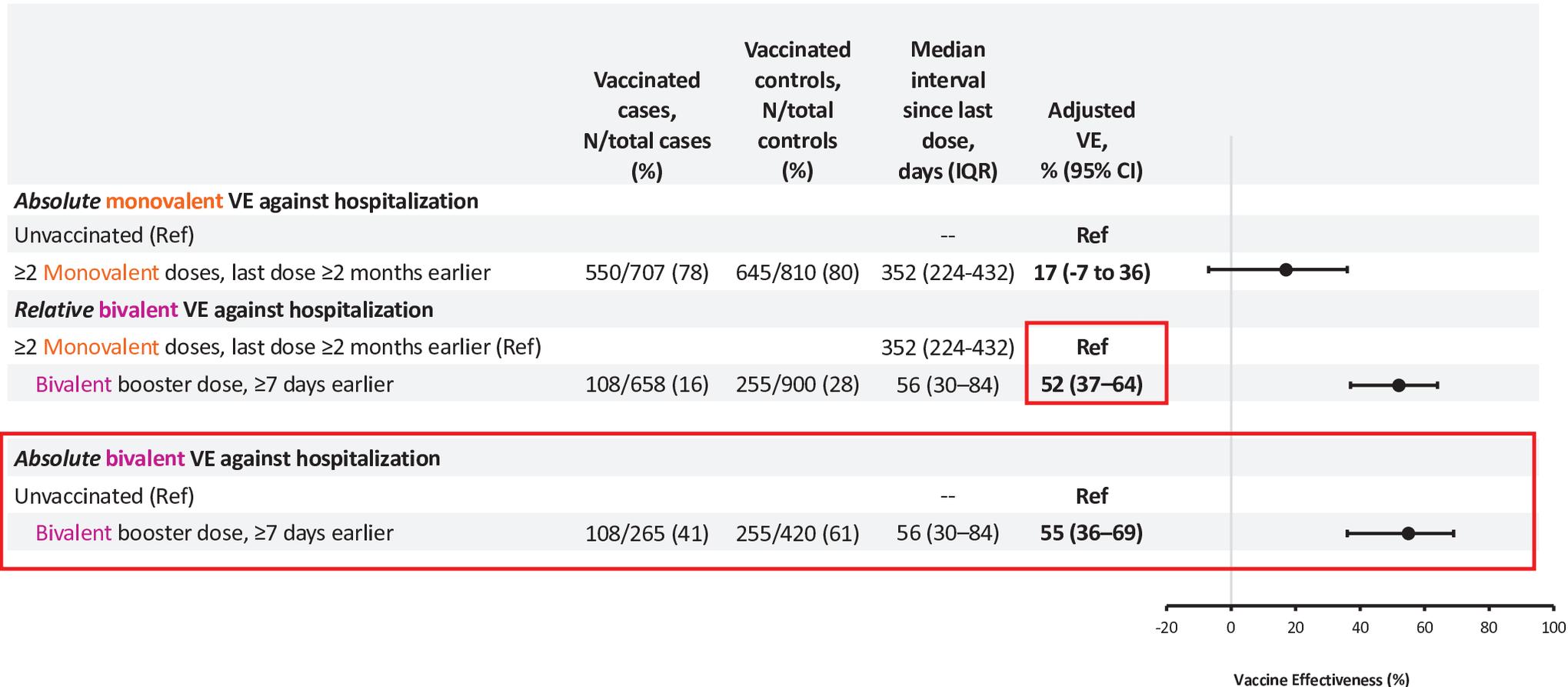


**IVY: Absolute VE of  $\geq 2$  monovalent doses and relative VE of bivalent booster against COVID-19 hospitalizations among adults aged  $\geq 65$  years — IVY Network, September 8, 2022–January 30, 2023\***



\*Unpublished CDC data.

## IVY: Absolute VE of $\geq 2$ monovalent doses and relative VE of bivalent booster against COVID-19 hospitalizations among adults aged $\geq 65$ years — IVY Network, September 8, 2022–January 30, 2023\*



\*Unpublished CDC data.

**IVY: severity of COVID-19 associated hospitalizations in bivalent booster VE analysis—  
IVY Network, September 8, 2022–January 30, 2023\***

Characteristic	Case-patients, N (%) N = 719**
Hypoxemia	427 (59)
High flow nasal cannula (HFNC)	78 (11)
Non-invasive positive pressure ventilation (NIPV)	51 (7)
Invasive mechanical ventilation (IMV)	47 (7)
HFNC, NIPPV, or IMV	138 (19)
ICU admission	116 (16)
In-hospital death on or before Day 28	38 (5)

- Of all hospitalized cases, 59% had documented hypoxemia
- Approximately 16% of hospitalized cases required an ICU admission
- Some hospitalizations included in the analysis may not represent severe COVID-19 disease

\*Unpublished CDC data

\*\*Data missing for 12% (96/815) of cases due to reporting lag

# Conclusions



# Limitations

- For estimates of **absolute** vaccine effectiveness, if unvaccinated or vaccinated individuals are significantly different than the rest of the population, estimates may be biased.
- For estimates of **relative** vaccine effectiveness, residual protection from prior doses is an important consideration.
  - Particularly important for severe disease, for which residual protection from prior doses may be higher
  - Can be challenging to interpret waning of relative VE
- Limited information on prior infection, although we know rates of prior infection in the U.S. population are high.
- VE against COVID-19 associated hospitalization may underestimate protection against severe COVID-19 disease.

# Conclusions

- Updates to VE of **bivalent** COVID-19 booster against *symptomatic infection* among children aged 5-17 years and adults aged  $\geq 18$  years
  - Bivalent booster provided added protection, though early evidence of waning of relative effectiveness
- Updates to VE of **bivalent** COVID-19 booster against *ED/UC encounters* and *hospitalizations* among adults  $\geq 18$  years
  - Bivalent boosters are helping provide additional protection against emergency department/urgent care encounters and hospitalization
  - 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.

# Acknowledgements

## CDC COVID-19 Vaccine Effectiveness and Policy Team

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