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COVID-19 Vaccine effectiveness updates

26 January 2023

Ruth Link-Gelles, PhD, MPH
LCDR, US Public Health Service
Program Lead, COVID-19 Vaccine Effectiveness
Centers for Disease Control and Prevention

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Organization of presentation

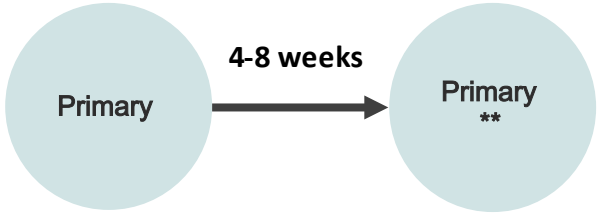
- Vaccine effectiveness (VE) of monovalent vaccines for *symptomatic infection* in children aged 6 months–4 years (Pfizer-BioNTech) and 6 months–5 years (Moderna)
- Early estimates of VE of bivalent vaccines for *symptomatic infection* due to XBB and its sublineages in adults
- Update on VE of bivalent vaccines for *severe disease* in adults

Updates on vaccine effectiveness for children aged 6 months–5 years (Moderna) and aged 6 months–4 years (Pfizer-BioNTech)

Pediatric COVID-19 Vaccine Primary Series Schedule*:

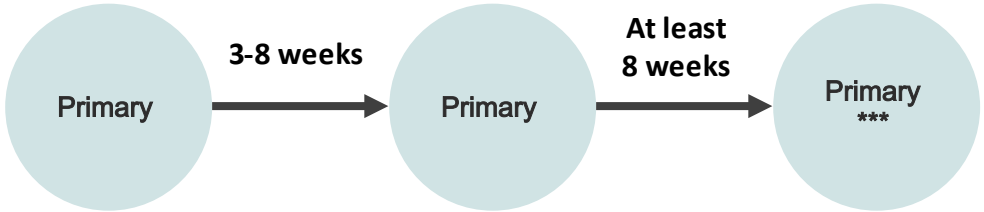
Ages 6 months–4 years (Pfizer-BioNTech) and 6 months–5 years (Moderna)

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



Earliest date that a child could have been considered to have a "complete series"= August 1

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



Earliest date that a child could have been considered to have a "complete series"= September 19

*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.
** Children who received 2 doses of monovalent Moderna vaccine are now authorized for a single bivalent booster at least 2 months after their last dose as of Dec 9, 2023.
*** Children who received 2 doses of monovalent Pfizer vaccine but did not receive the third dose of the primary series should receive a bivalent dose as their third dose as of Dec 9, 2023

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

December 14, 2020 – January 11, 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	7.2%	9.9%	39.5%	71.7%	81.6%	85.0%	95.0%	95.0%
Completed Primary Series	3.3%	5.1%	32.4%	61.5%	66.4%	71.9%	83.6%	94.1%
Updated (Bivalent) Booster Dose			3.6%	6.5%	6.1%	10.5%	19.1%	39.0%

Location

United States

12/14/2020 1/11/2023

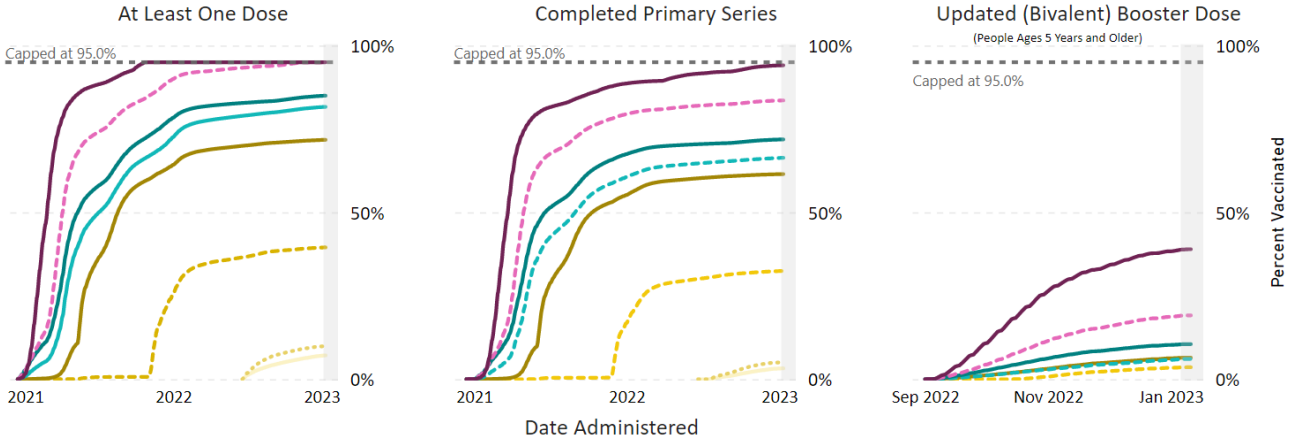
Vaccinations

Sex

Age

Females by Age

Males by Age



People receiving at least one dose: *total count represents the total number of people who received at least one dose of COVID-19 vaccine.* ***People with a completed primary series:*** *total count represents the number of people who have received a dose of a single-shot COVID-19 vaccine, or the second dose in a 2-dose COVID-19 vaccine series.* ***People with an updated (bivalent) booster dose:*** *total count represents the number of people who received an updated (bivalent) booster dose; CDC uses US Census estimates for the total populations within each specified demographic group regardless of prior vaccination status as denominators. Due to the time between vaccine administration and when records are reported to CDC, vaccinations administered during the last week may not yet be reported. This reporting lag is represented by the gray, shaded box.*

Last Updated: Jan 11, 2023

Data source: VTrcks, IIS, Federal Pharmacy Program, Federal Entities Program, U.S. Census Bureau 10-year July 2019 National Population Estimates; Visualization: CDC CPR DEO Situational Awareness Public Health Science Team

https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends

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
- **Design**: Test-negative, case-control analysis
- **Population**: Children 3 – 4/5 years with ≥1 COVID-like symptom and nucleic acid amplification testing (NAAT); children with immunocompromise excluded
- **Period for analysis:**
  - Tested: July 4, 2022* – January 17, 2023, BA.4/BA.5 predominant period, but includes XBB

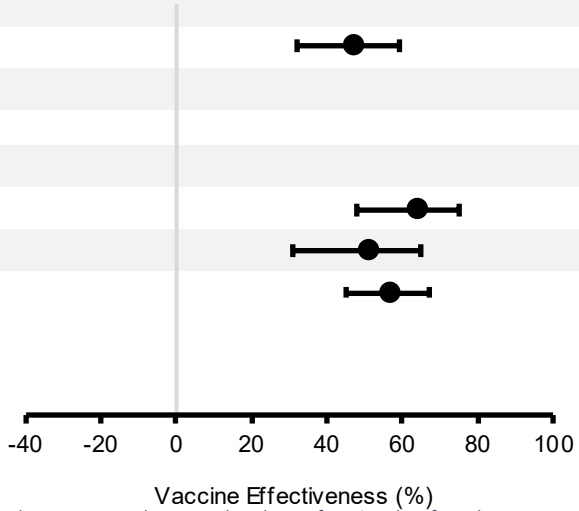
Models adjusted for: age, gender, race, ethnicity, social vulnerability index and HHS region of the testing location, underlying conditions (presence versus absence), pharmacy chain conducting the test, local incidence (cases per 100,000 by individual county and state in the 7 days before test date),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

* Analysis start date depended on vaccine/dose: Pfizer and Moderna 1st doses started 7/4/2022; Pfizer 2nd dose started 7/25/2022; Moderna 2nd dose started 8/1/2022; Pfizer 3rd dose started 9/19/2022;

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

ICATT: Preliminary estimates of VE for monovalent Moderna (3 – 5 years) COVID-19 vaccines against *symptomatic infection*, July 4, 2022 – January 17, 2023

Vaccination status (months since last dose)	Total tests	SARS-CoV-2 positive, N	Adjusted VE (95% CI)
Moderna, 1 dose (partial series; ages 3-5 years), July 4, 2022 – January 17, 2023			
Unvaccinated	29,012	7,948 (27)	Ref
1 dose (≥2 weeks-1 month)	391	77 (20)	47 (32 to 59)
Moderna, 2 doses (complete series; ages 3-5 years), August 1, 2022 – January 17, 2023			
Unvaccinated	20,471	4,655 (23)	Ref
2 doses (2 weeks–1 month)	312	31 (10)	64 (48 to 75)
2 doses (2–3 months)	398	40 (10)	51 (31 to 65)
Overall (2 weeks-2 months)	**710**	**71 (10)**	**57 (45 to 67)**

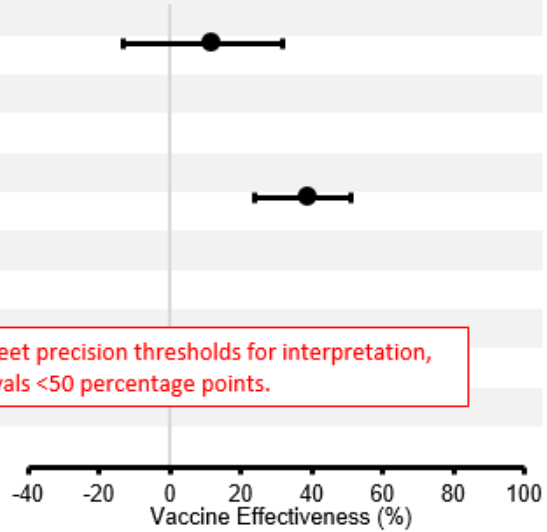


Test registrants who report receiving COVID-19 vaccines are asked to report the total number of doses and manufacturer(s) of vaccines received and for the most recent dose, month and year of receipt; therefore, the number of months between a vaccine dose and testing is a whole number calculated as the 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 ≥2 weeks before testing, and only doses received ≥2 weeks before testing were included. 17% and 21% of children who received 1 and 2 doses of Moderna, respectively, reported a prior infection reported >90 days before the current test.

CDC, preliminary unpublished data

ICATT: Preliminary estimates of VE for monovalent Pfizer (3 – 4 years) and COVID-19 vaccines against *symptomatic infection*, July 4, 2022 – January 17, 2023

Vaccination status (months since last dose)	Total tests	SARS-CoV-2 positive, N	Adjusted VE (95% CI)
Pfizer, 1 dose (partial series; ages 3-4 years), July 4, 2022–January 17, 2023			
Unvaccinated	18,442	5,154 (28)	Ref
1 dose (≥2 weeks-1 month)	325	89 (27)	12 (-13 to 32)
Pfizer, 2 doses (partial series; ages 3-4 years), July 25, 2022–January 17, 2023			
Unvaccinated	14,301	3,528 (25)	Ref
2 doses (≥2 weeks-3 months)	642	96 (15)	39 (24 to 51)
Pfizer, 3 doses (complete series; ages 3-4 years), September 19, 2022– January 17, 2023**			
Unvaccinated	5,901		
3 doses (2 weeks–1 month)	129		
3 doses (2–3 months)	139		
Overall	268		



CDC, preliminary unpublished data

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 ≥2 weeks before testing, and only doses received ≥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 reported >90 days before the current test.

Early look: Bivalent VE against symptomatic infection with XBB and its sublineages

Increasing Community Access to Testing (ICATT) Partnership: VE analysis for *symptomatic infection*

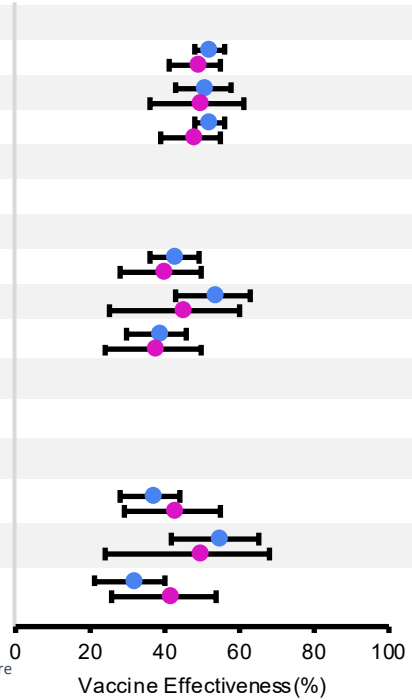
- Nationwide community-based drive-through COVID-19 testing via pharmacies
- Self-reported vaccine history at time of registration for COVID-19 testing
- **Design**: Test-negative, case-control analysis
- **Population**: Adults with ≥1 COVID-like symptom and nucleic acid amplification testing (NAAT) completed from 1 laboratory partner; adults with immunocompromise excluded
- **Variants:** S-gene target reduction or failure (SGTF) used as proxy for infection with likely BA.5-related sublineages and S-gene target presence (SGTP) for likely XBB/XBB.1.5-related sublineages
- **Period for analysis:**
  - Tested: December 1, 2022 – January 13, 2023

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

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

ICATT: Relative effectiveness of COVID-19 bivalent boosters against *symptomatic infection* among adults aged ≥18 years who received 2–4 monovalent doses, by S-gene target amplification status – December 1, 2022-January 13, 2023

Age group, yrs/mRNA Dosage Pattern	Total tests	SARS-CoV-2 Negative	SARS-CoV-2 positive			
			SGTF (likely BA.5-related)		SGTP (likely XBB/XBB.1.5-related)	
		No (row %)	No (row %)	VE (95% CI)	No (row %)	VE (95% CI)
18-49 years						
Received 2-3 monovalent doses only (Ref)*	13,921	7,043 (51)	5,326 (38)	—	1,552 (11)	—
Overall (≥2 weeks since bivalent booster dose)	4,199	2,864 (68)	1,027 (24)	**52 (48-56)**	308 (7)	**49 (41-55)**
0-1 month since bivalent booster	1,056	716 (68)	262 (25)	**51 (43-58)**	78 (7)	**50 (36-61)**
2-3 months since bivalent booster	3,143	2,148 (68)	765 (24)	**52 (48-56)**	230 (7)	**48 (39-55)**
50-64 years						
Received 2-4 monovalent doses only (Ref)	4,603	2,036 (44)	1,983 (43)	—	584 (13)	—
Overall (≥2 weeks since bivalent booster dose)	2,038	1,182 (58)	656 (32)	**43 (36-49)**	200 (10)	**40 (28-50)**
0-1 month since bivalent booster	538	336 (62)	149 (28)	**54 (43-63)**	53 (10)	**45 (25-60)**
2-3 months since bivalent booster	1,500	846 (56)	507 (34)	**39 (30-46)**	147 (10)	**38 (24-50)**
≥65 years						
Received 2-4 monovalent doses only (Ref)	2,393	1,159 (48)	972 (41)	—	262 (11)	—
Overall (≥2 weeks since bivalent booster dose)	2,021	1,243 (62)	632 (31)	**37 (28-44)**	146 (7)	**43 (29-55)**
0-1 month since bivalent booster	381	260 (68)	94 (25)	**55 (42-65)**	27 (7)	**50 (24-68)**
2-3 months since bivalent booster	1,640	983 (60)	538 (33)	**32 (21-40)**	119 (7)	**42 (26-54)**



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 Median months from most recent monovalent dose to test was 13 for those without a bivalent dose. * Persons aged <50 years without moderate or severe immunocompromise were not eligible for a fourth monovalent (second booster) dose so the reference group for this age strata includes only those who received 2–3 monovalent doses.

Updates (+1 month of data) to:

Effectiveness of Bivalent mRNA Vaccines in Preventing COVID-19-Associated Hospitalizations among Immunocompetent Adults Aged ≥65 Years — IVY Network, 18 States, September 8–November 30, 2022

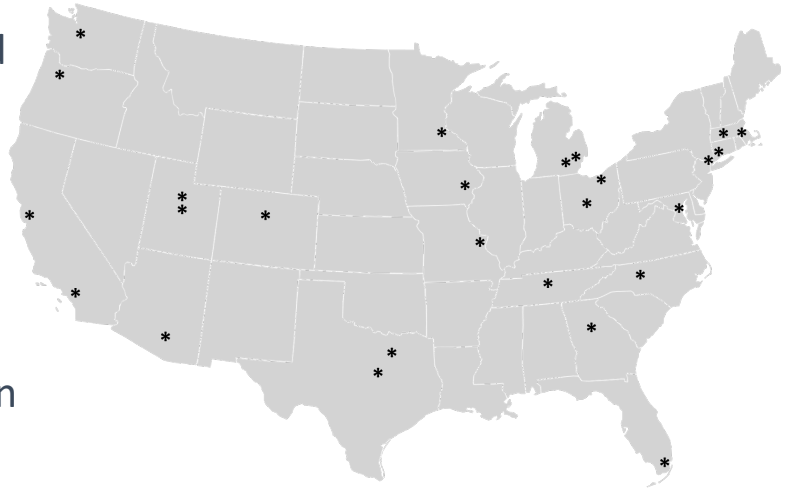
Surie D, DeCuir J, Zhu Y, et al. Early Estimates of Bivalent mRNA Vaccine Effectiveness in Preventing COVID-19–Associated Hospitalization Among Immunocompetent Adults Aged ≥65 Years — IVY Network, 18 States, September 8–November 30, 2022. MMWR Morb Mortal Wkly Rep 2022;71:1625–1630.

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

- Design: Prospective test-negative, case-control
- Period: September 8–December 29, 2022
- Population: Immunocompetent adults hospitalized with COVID-like illness (CLI)
- Participants have CLI and 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

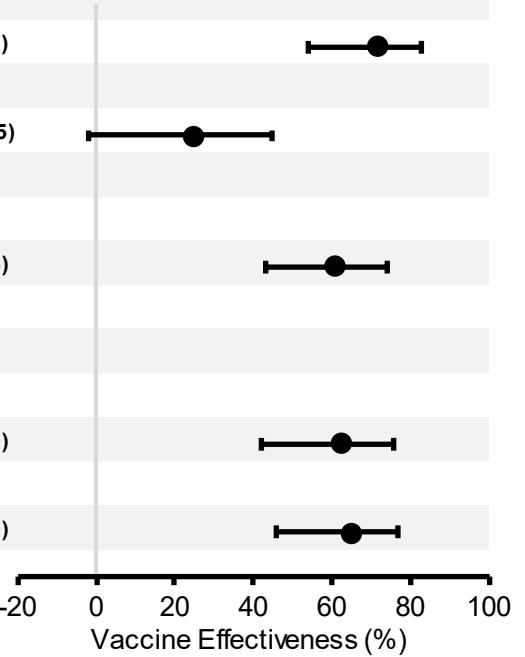
IVY

INVESTIGATING RESPIRATORY VIRUSES IN THE ACUTELY ILL



IVY: Bivalent booster VE against COVID-19 *hospitalizations* among immunocompetent adults aged *≥65 years* — IVY Network, September 8–December 29, 2022

mRNA Dosage Pattern	Vaccinated cases, no./total no. (%)	Vaccinated controls, no./total no. (%)	Median interval since last dose, days (IQR)	Adjusted VE, % (95% CI)
Absolute VE				
Unvaccinated (Ref)			--	
Bivalent booster dose, ≥7 days earlier	50/166 (30)	135/238 (57)	40 (22–56)	**72 (54–83)**
Unvaccinated (Ref)			--	
≥ 2 Monovalent doses, last dose ≥ 2 months earlier	416/532 (78)	452/555 (81)	327 (196–407)	**25 (-2 to 45)**
Relative VE				
≥ 2 Monovalent doses, last dose ≥ 2 months earlier (Ref)			327 (196–407)	
Bivalent booster dose, ≥7 days earlier	50/466 (11)	135/587 (23)	40 (22–56)	**61 (43–74)**
≥ 2 Monovalent doses, last dose 2–5 months earlier (Ref)			138 (114–156)	
Bivalent booster dose, ≥7 days earlier	50/128 (39)	135/245 (55)	40 (22–56)	--*
≥ 2 Monovalent doses, last dose 6–11 months earlier (Ref)			300 (247–336)	
Bivalent booster dose, ≥7 days earlier	50/230 (22)	135/316 (43)	40 (22–56)	**63 (42–76)**
≥ 2 Monovalent doses, last dose ≥12 months earlier (Ref)			485 (390–587)	
Bivalent booster dose, ≥7 days earlier	50/208 (24)	135/296 (46)	40 (22–56)	**65 (46–77)**



CDC unpublished data.

*Estimate not reported due to imprecision (CI >50 percentage points).

IVY: Bivalent booster VE against COVID-19 *hospitalizations* among immunocompetent adults aged *≥65 years*, by analytic period — IVY Network

mRNA Dosage Pattern	September 8 - November 30, 2022 Published Data*			September 8 - December 29, 2022 Updated Analysis**		
	Bivalent Vaccinated cases, no./total no. (%)	Bivalent Vaccinated controls, no./total no. (%)	Adjusted VE, % (95% CI)	Bivalent Vaccinated cases, no./total no. (%)	Bivalent Vaccinated controls, no./total no. (%)	Adjusted VE, % (95% CI)
Absolute VE						
Unvaccinated (Ref)						
Bivalent booster dose, ≥ 7 days earlier	20/101 (20)	59/121 (49)	**84 (64–93)**	50/166 (30)	135/238 (57)	**72 (54–83)**
Relative VE						
≥ 2 Monovalent doses, last dose ≥ 2 months earlier (Ref)						
Bivalent booster dose, ≥ 7 days earlier	20/300 (7)	59/355 (17)	**73 (52–85)**	50/466 (11)	135/587 (23)	**61 (43–74)**
≥ 2 Monovalent doses, last dose 2–5 months earlier (Ref)						
Bivalent booster dose, ≥ 7 days earlier	20/82 (24)	59/155 (38)	**--*** **	50/128 (39)	135/245 (55)	**--*** **
≥ 2 Monovalent doses, last dose 6–11 months earlier (Ref)						
Bivalent booster dose, ≥ 7 days earlier	20/155 (13)	59/176 (34)	**78 (57–89)**	50/230 (22)	135/316 (43)	**63 (42–76)**
≥ 2 Monovalent doses, last dose ≥12 months earlier (Ref)						
Bivalent booster dose, ≥ 7 days earlier	20/103 (19)	59/142 (42)	**83 (63–92)**	50/208 (24)	135/296 (46)	**65 (46–77)**

* Surie, DeCuir, et al. MMWR published December 16, 2022. ** CDC unpublished data. *** Estimate not reported due to imprecision (CI >50 percentage points).

Conclusions

Conclusions

- **VE of monovalent COVID-19 primary series against symptomatic infection among children aged 6 months through 4/5 years**
  - Moderna
    - 2 dose provides moderate protection (57%), but may wane
  - Pfizer
    - 2 doses of Pfizer provide modest protection (39%) during the interval between dose 2 and 3
    - Pfizer: Not yet powered for 3 dose estimates
- **Early VE of bivalent COVID-19 booster for symptomatic infection due to XBB/XBB.1.5 among adults ≥18 years**
  - Bivalent booster provided added protection
- **Updates to VE of bivalent COVID-19 booster hospitalization among adults ≥18 years**
  - With additional month of data, confirmed that bivalent is providing protection against hospitalization
  - Those who have only received monovalent doses may have limited remaining protection (though at a much longer time since last dose)

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- Mark Tenforde

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

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