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U.S. Influenza Activity and Preliminary 2022-23 Influenza Vaccine Effectiveness Estimates

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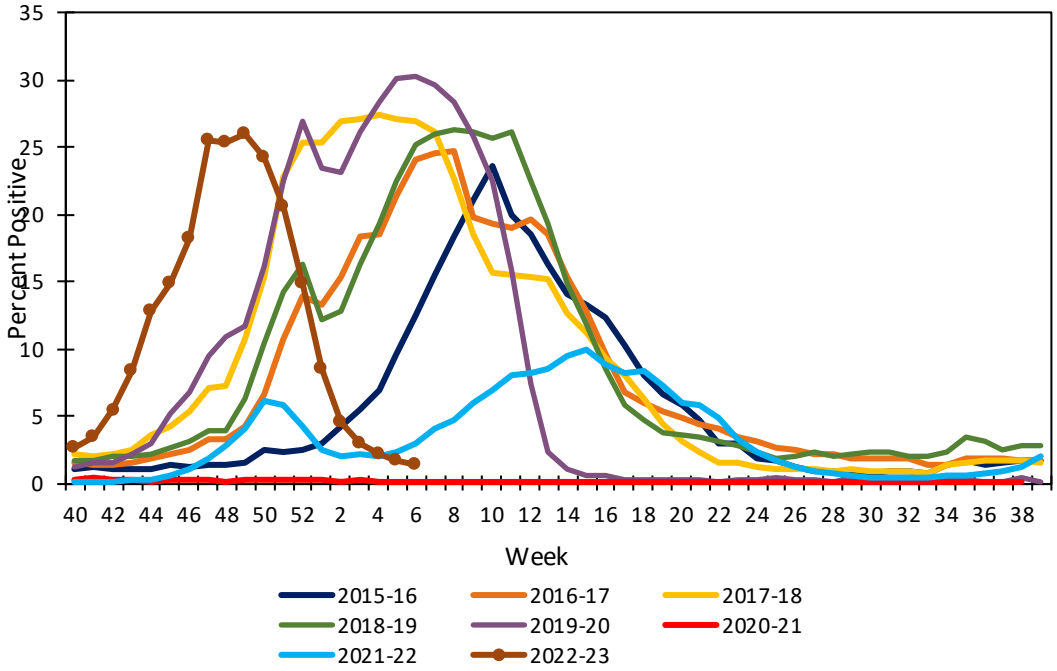
National Center for Immunization and Respiratory Diseases
Centers for Disease Control and Prevention

Vaccines and Related Biological Products Advisory Committee

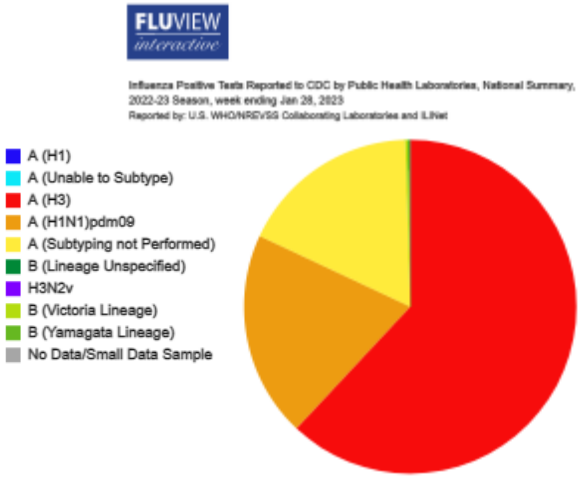
March 7, 2023

Virologic Surveillance

Clinical Laboratories: Percent Positive for Influenza

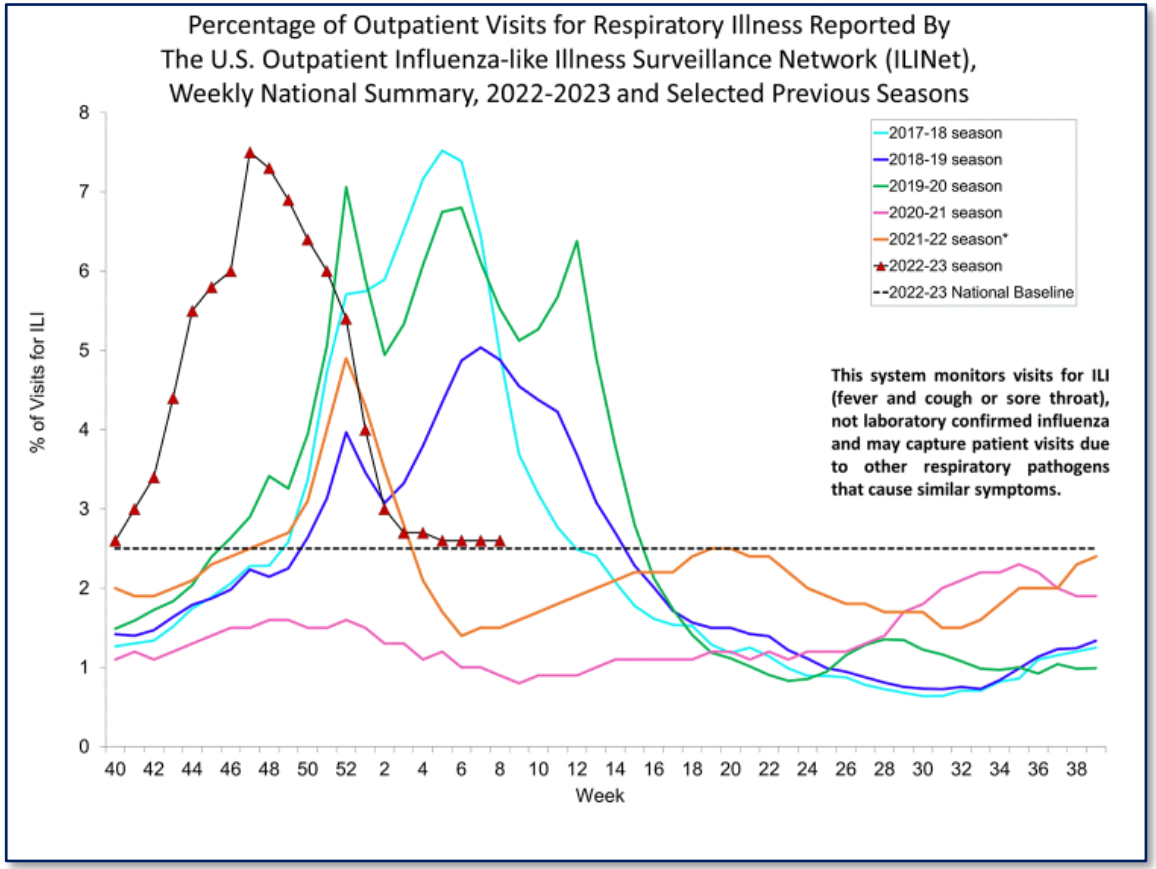


Public Health Laboratories: Influenza Virus Subtyping/Lineage Testing



- 99.5% influenza A
  - 76% H3
  - 24% H1
- 0.5% influenza B
  - 100% Victoria lineage

Influenza-Like Illness (ILI) Activity—ILINet

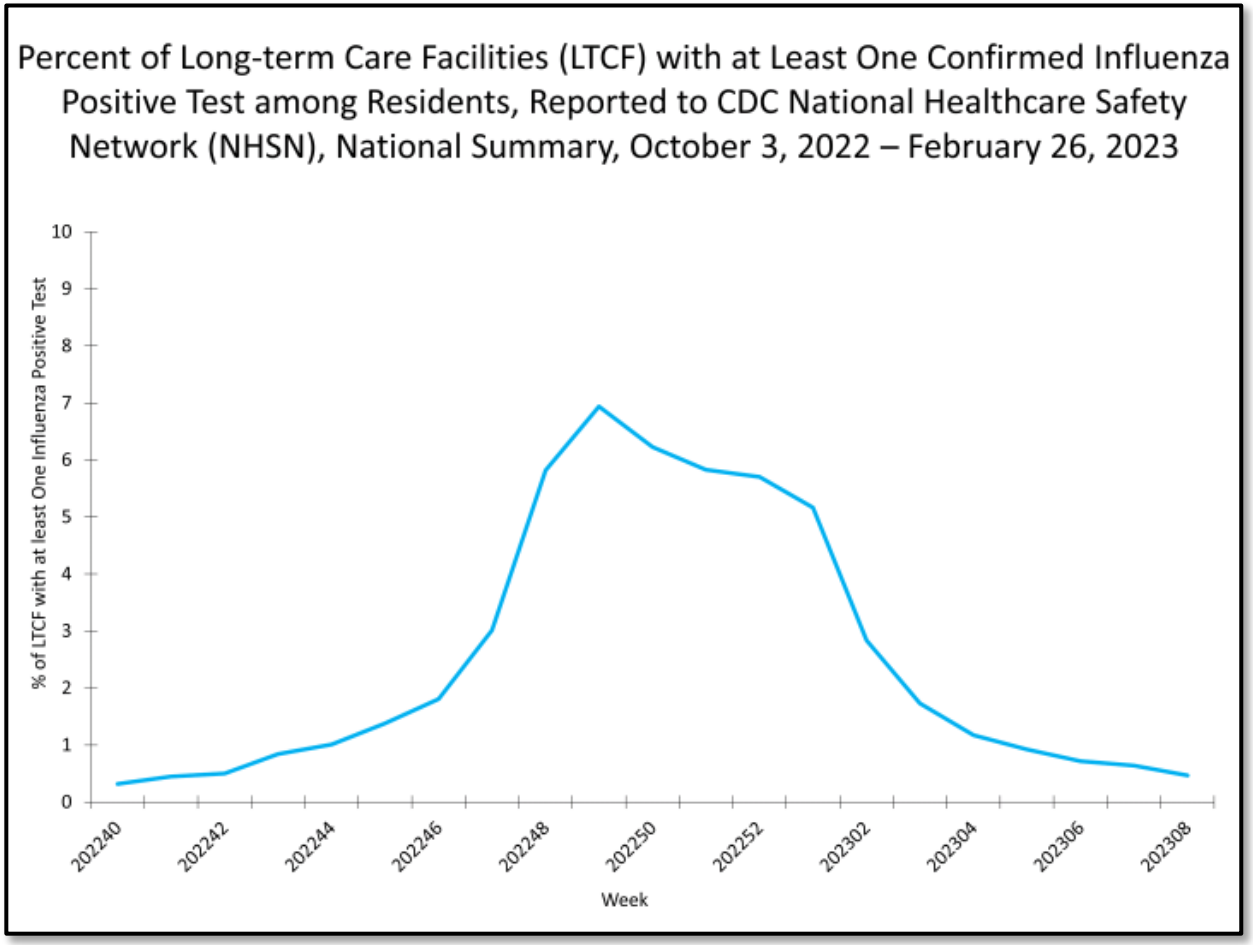


CDC FluView—ILINet, week ending February 25, 2023

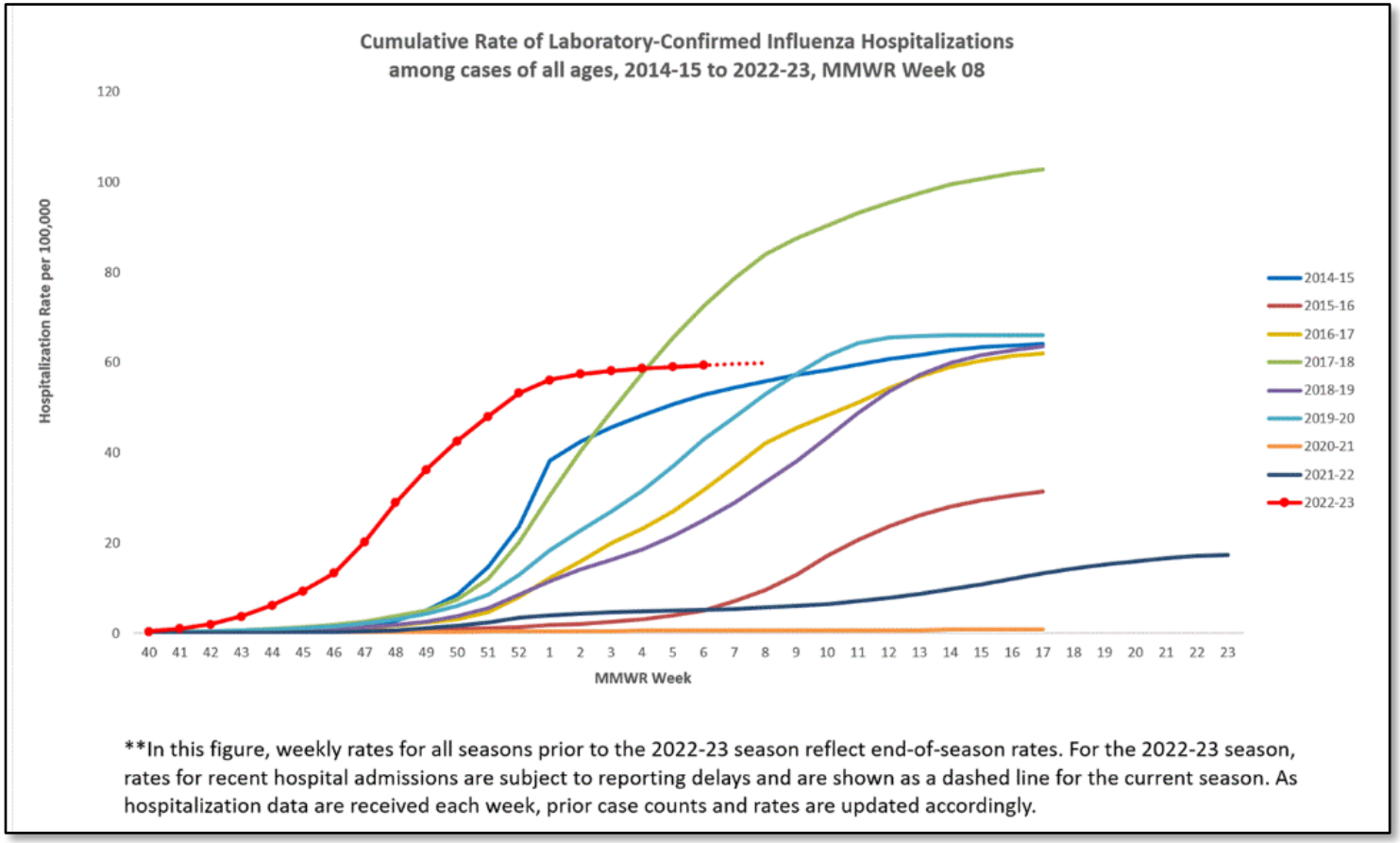
Long-Term Care Facilities—

National Healthcare Safety Network (NHSN)

CDC FluView—NHSN, week ending February 25, 2023



Influenza-Associated Hospitalizations—FluSurv-NET

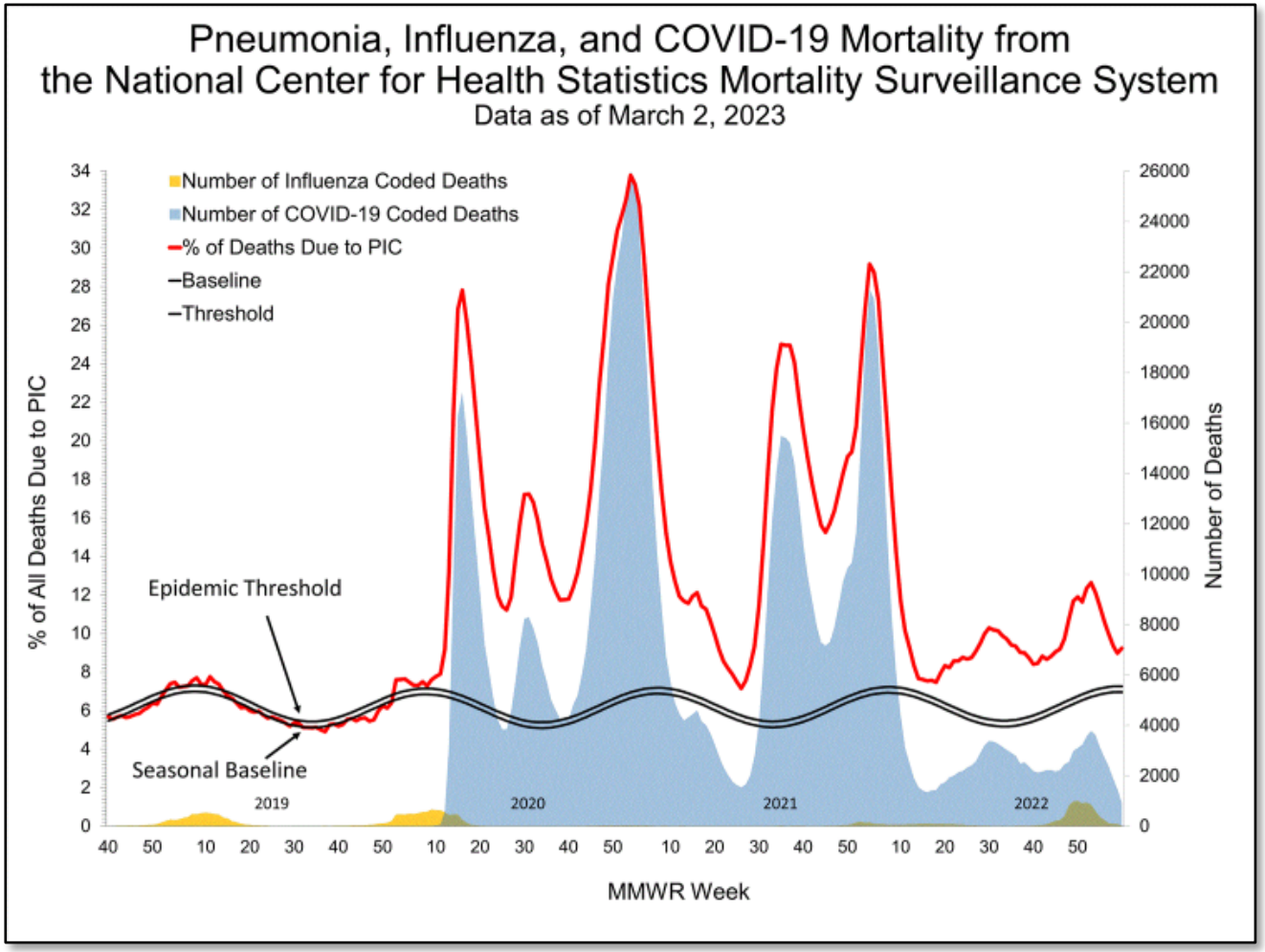


CDC FluView—FluSurv-NET, week ending February 25, 2023

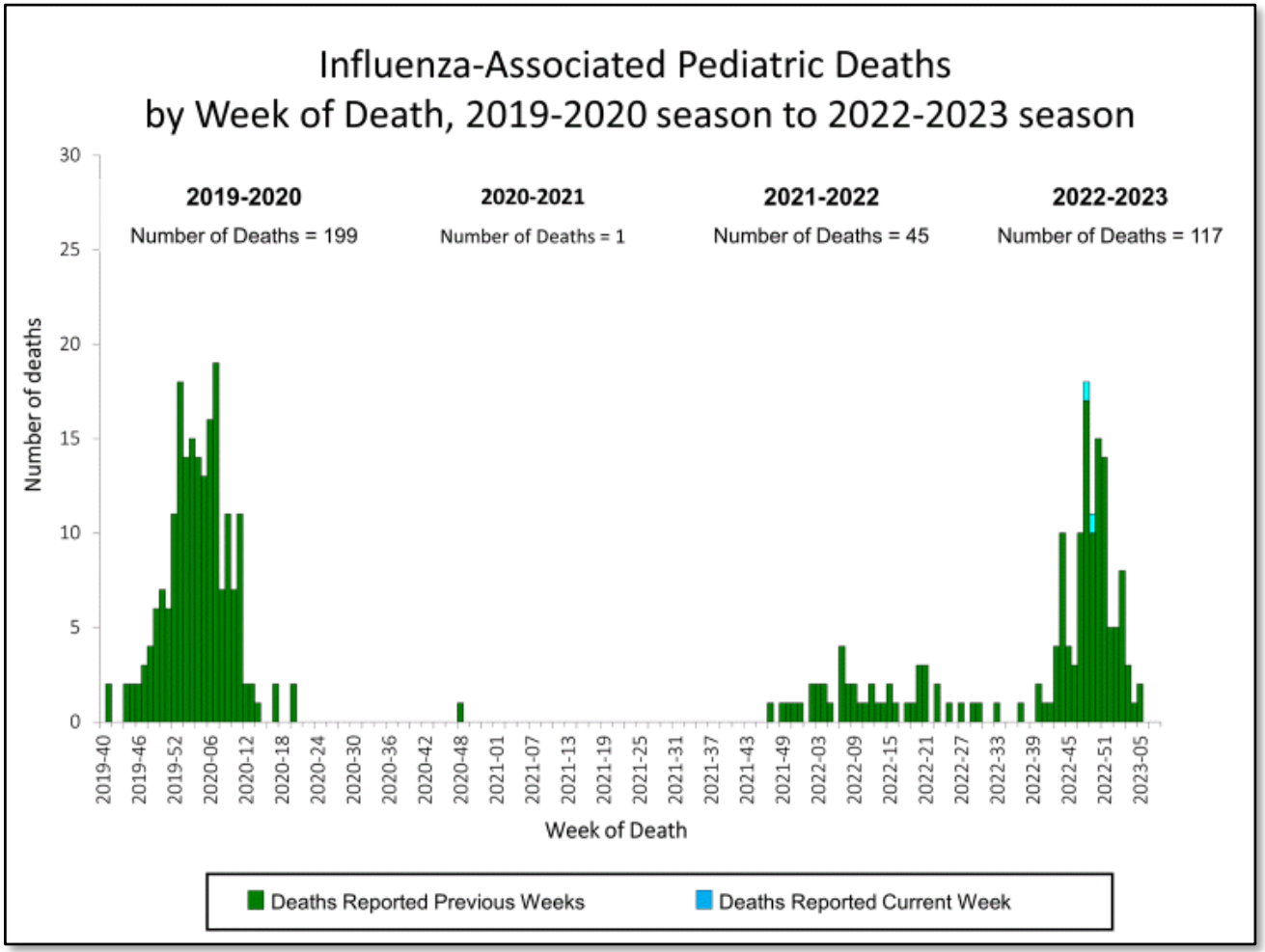
Pneumonia, Influenza, and COVID-19 Mortality—

National Center for Health Statistics Mortality Surveillance System

CDC FluView—week ending February 25, 2023



Pediatric Mortality



CDC FluView— week ending February 25, 2023

Summary as of the Week Ending February 25, 2023

- U.S. influenza activity rose early, peaking nationally during late November/early December
  - Percent of tests positive peaked at ~26%; currently ~1%
- Influenza A(H3N2) viruses have predominated, with co-circulation of influenza A(H1N1)pdm09 viruses.
- The cumulative influenza-associated hospitalization rate has leveled in recent weeks to ~59-60/100,000
- 117 influenza-associated pediatric deaths reported this far this season.
- Overall influenza activity is increased compared with the previous two seasons.
- U.S. influenza activity is currently low.

Acknowledgements

- Lynette Brammer
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- Katie Tastad
- Catherine Bozio
- Charisse Cummings
- Alissa O'Halloran
- Devi Sundaresan
- Dawud Ujamaa

Interim Influenza Vaccine Effectiveness against Inpatient, Emergency Department, and Outpatient Illness in the 2022–23 season

Data from the New Vaccine Surveillance Network (NVSN), Flu and Other Viruses in the Acutely Ill Network (IVY), & VISION Network

Samantha Olson MPH, Nathaniel Lewis PhD, & Mark Tenforde MD PhD

Presented to the Advisory Committee on Immunization Practices, February 22, 2023

Preliminary results

Three networks to evaluate vaccine effectiveness against laboratory-confirmed influenza-associated outpatient visits, emergency department visits, and hospitalization

2022-2023 Flu Vaccine Effectiveness Methods

Enrollees: Have acute respiratory illness

Dates of enrollment: Fall 2022- Early 2023

Design: Test-negative design

- Comparing vaccination odds among case patients with influenza A confirmed by molecular assay versus control patients testing negative for influenza and SARS-CoV-2
- Vaccination status: receipt of any 2022–23 seasonal flu vaccine according to medical records, immunization registries, claims data, and/or self-report

Analysis: VE = (1 – adjusted OR) x 100%

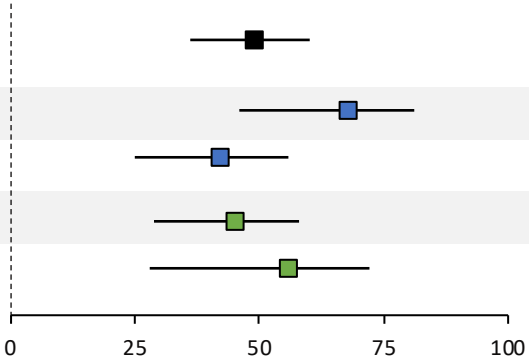
Vaccine effectiveness (VE) against influenza-associated hospitalization and emergency department visits among children aged 6 months – 17 years

New Vaccine Surveillance Network (NVSN)

Preliminary Results

NVSN 2022-2023 Influenza VE

	Vaccinated/ Total (%)		Effectiveness against laboratory confirmed Influenza A* in hospital and ED settings, VE % (95% CI)**
	Influenza positive	Influenza negative	
Influenza A			
All 6 mos – 17 years	123/640 (19)	750/2256 (33)	**49 (36 to 60)**
Inpatient	19/131 (15)	288/913 (32)	**68 (46 to 81)**
ED	104/507 (21)	461/1330 (35)	**42 (25 to 56)**
A/H3N2	98/478 (21)	750/2256 (33)	**45 (29 to 58)**
A/H1N1	23/139 (17)	750/2256 (33)	**56 (28 to 72)**



* Of 335 influenza-positive specimens sequenced, 250 were A(H3N2) clade 3C.2a1b.2a.2b and 32 were clade 3C.2a1b.2a.2a.1 and 38 were A(H1N1) clade 6B.1A.5a.2a.1. There were 16 coinfections with Influenza and SARS-CoV-2 that were excluded from the VE estimate.

** Multivariable logistic regression models adjusted for site, age, and calendar time.

NVSN

Preliminary interim estimates—NVSN

- Through January 25, 2023, influenza vaccination significantly reduced laboratory confirmed medically attended influenza
  - 68% (95% CI: 46, 81) against pediatric hospitalizations
  - 42% (95% CI: 25, 56) against pediatric ED visits

- Important protection against both A/H3N2 and A/H1N1 associated illness

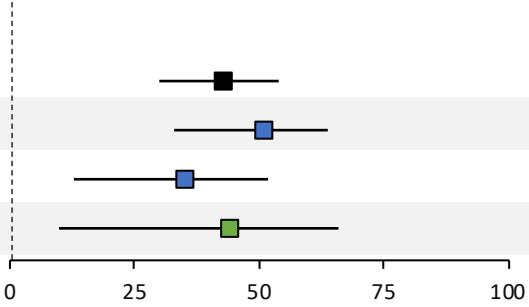
VE against influenza-associated hospitalization among patients aged ≥18 years

Investigating Respiratory Viruses in the Acutely Ill (IVY)

Preliminary Results

IVY 2022-2023 Influenza VE

	Vaccinated/Total (%)		Effectiveness against laboratory confirmed Influenza A* in inpatient settings, VE % (95% CI)**
	Influenza positive	Influenza negative	
Influenza A			
All adults ≥18 years	219/701 (31)	921/2130 (43)	**43 (30 to 54)**
18-64 years	84/378 (22)	365/1021 (36)	**51 (33 to 64)**
≥65 years	135/323 (42)	556/1109 (50)	**35 (13 to 52)**
Immunocompromised***	45/122 (37)	238/474 (50)	**44 (10 to 66)**



* Of 77 influenza-positive specimens sequenced, 50 were A(H3N2) clade 3C.2a1b.2a.2. and 27 were A(H1N1) clade 6B.1A.5a.2. A total of 45 influenza/SARS-CoV-2 coinfections were excluded from the VE estimate

** Multivariable logistic regression models adjusted for Census region, age, sex, race/ethnicity, and month.

*** Includes active solid-organ cancer, active hematologic cancer, solid-organ transplant, bone marrow/stem cell transplant, HIV infection, congenital immunodeficiency syndrome, use of an immunosuppressive medication within the past 30 days, splenectomy, graft-versus-host disease (currently or in the past), or any other condition that causes moderate or severe immunosuppression.

IVY

Preliminary interim estimates—IVY

- Through January 31, 2023, influenza vaccination significantly reduced laboratory confirmed medically attended influenza
  - 43% (95%CI: 30% to 54%) against adult hospitalizations

- Important protection among adults aged 18-64 and ≥65 years, and immunocompromised adults

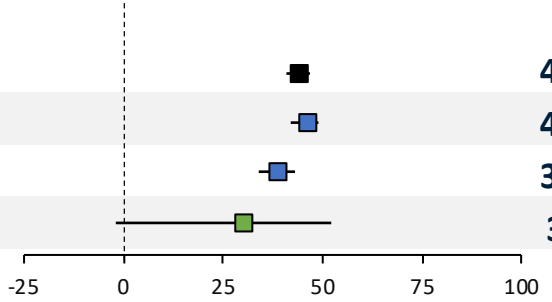
Influenza vaccine effectiveness (VE) against influenza-associated hospitalization and emergency department / urgent care visits among adults aged ≥18 years

VISION Network

Preliminary Results

VISION ED/ UC 2022-2023 Influenza VE

	Vaccinated/ Total (%)		Effectiveness against laboratory confirmed Influenza A in ED and urgent care settings, VE % (95% CI)*
	Influenza positive	Influenza negative	
Influenza A			
All adults ≥18 years	3278/14011 (23)	15752/43196 (36)	**44 (41 to 47)**
18-64 years	1600/10590 (15)	6695/27545 (24)	**46 (42 to 49)**
≥65 years	1678/3421 (49)	9057/15651 (58)	**39 (34 to 43)**
Immunocompromised**	64/179 (36)	553/1363 (41)	**30 (-2 to 52)**

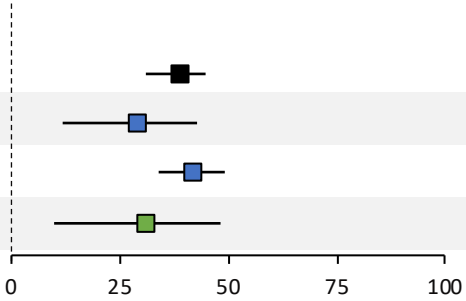


* Adjusted for patient age, study site, and calendar time.

** Defined as at least one discharge diagnosis for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.

VISION Inpatient 2022-2023 Influenza VE

	Vaccinated/Total (%)		Effectiveness against laboratory confirmed Influenza A in inpatient settings, VE % (95% CI)*
	Influenza positive	Influenza negative	
Influenza A			
All adults ≥18 years	671/1760 (38)	4561/9377 (49)	**39 (31 to 45)**
18-64 years	146/623 (23)	802/2739 (29)	**29 (12 to 43)**
≥65 years	525/1137 (46)	3759/6638 (57)	**42 (34 to 49)**
Immunocompromised**	130/297 (44)	1172/2316 (51)	**31 (10 to 48)**



* Adjusted for patient age, study site, and calendar time.

** Defined as at least one discharge diagnosis for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.

Preliminary interim estimates—VISION

- Through January 2023, influenza vaccination significantly reduced laboratory confirmed medically attended influenza
  - 39% (95%CI: 31, 45) against adult hospitalizations
  - 44% (95%CI: 41, 47) against adult ED or UC visits
  - VE observed across age group and immunocompromised

- Estimates higher than VE estimates against hospitalization (25%) and ED or UC visits (25%) from the 2021–22 season at the same VISION sites

- Limitations include lack of VE by influenza A subtype

Summary of Three Flu VE Networks

- Across three Flu VE platforms, we observed **consistent influenza vaccine effectiveness** during the 2022-2023 season.

- Influenza **vaccination provided substantial protection** against inpatient, emergency department, and outpatient illness **among all ages**.

- Influenza **vaccination provided substantial protection among important high-risk groups** (ages 65+ and immunocompromised).

New Vaccine Surveillance Network (NVSN) Contributors

- **Children's Hospital of Pittsburgh:** Marian Michaels, John Williams
- **Children's Mercy Hospital:** Rangaraj Selvarangan, Jennifer Schuster
- **Cincinnati Children's:** Mary Staat
- **Seattle Children's:** Janet Englund, Eileen Klein
- **Texas Children's Hospital:** Julie Boom, Leila Sahni
- **University of Rochester:** Geoffrey Weinberg, Peter Szilagyi
- **Vanderbilt University:** Natasha Halasa, Laura Stewart
- **CDC:** Samantha Olson, Callie McLean, Ashley Price, Juliana DaSilva, Angie Foust, John Barnes, Rebecca Kondor, Thomas Stark, Brendan Flannery, Carrie Reed, Ben Clopper, Ariana Perez, Heidi Moline

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Cassandra Johnson, Vanderbilt UMC

Wes Self, Vanderbilt UMC

IVY

Baylor, Scott and White, Temple, Texas
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Centers for Disease Control and Prevention (CDC), Atlanta, Georgia
Cleveland Clinic, Cleveland, Ohio
Emory University, Atlanta, Georgia
Hennepin County Medical Center, Minneapolis, Minnesota
Intermountain Medical Center, Murray, Utah
Johns Hopkins University, Baltimore, Maryland
Montefiore Medical Center, Bronx, New York
Ohio State Medical Center, Columbus, Ohio
Oregon Health and Sciences University, Portland, Oregon
Stanford University, Stanford, California
University of California-Los Angeles, Los Angeles, California
University of Colorado, Aurora, Colorado
University of Iowa, Iowa City, Iowa
University of Miami, Miami, Florida
University of Michigan, Ann Arbor, Michigan
University of Washington, Seattle, Washington
Vanderbilt University Medical Center, Nashville, Tennessee
Wake Forest University, Winston-Salem, North Carolina
Washington University, St. Louis, Missouri

VISION Network Contributors

- **Kaiser Permanente Northern California:** Nicola Klein MD, PhD
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- **Health Partners:** Malini DeSilva MD, MPH; Gabriella Vazquez-Benitez PhD, MSc
- **Westat:** Zachary Weber PhD; Duck-Hye Yang PhD; Sarah Ball ScD, MPH
- **CDC:** Mark Tenforde MD, PhD; Brendan Flannery PhD; Shikha Garg MD

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

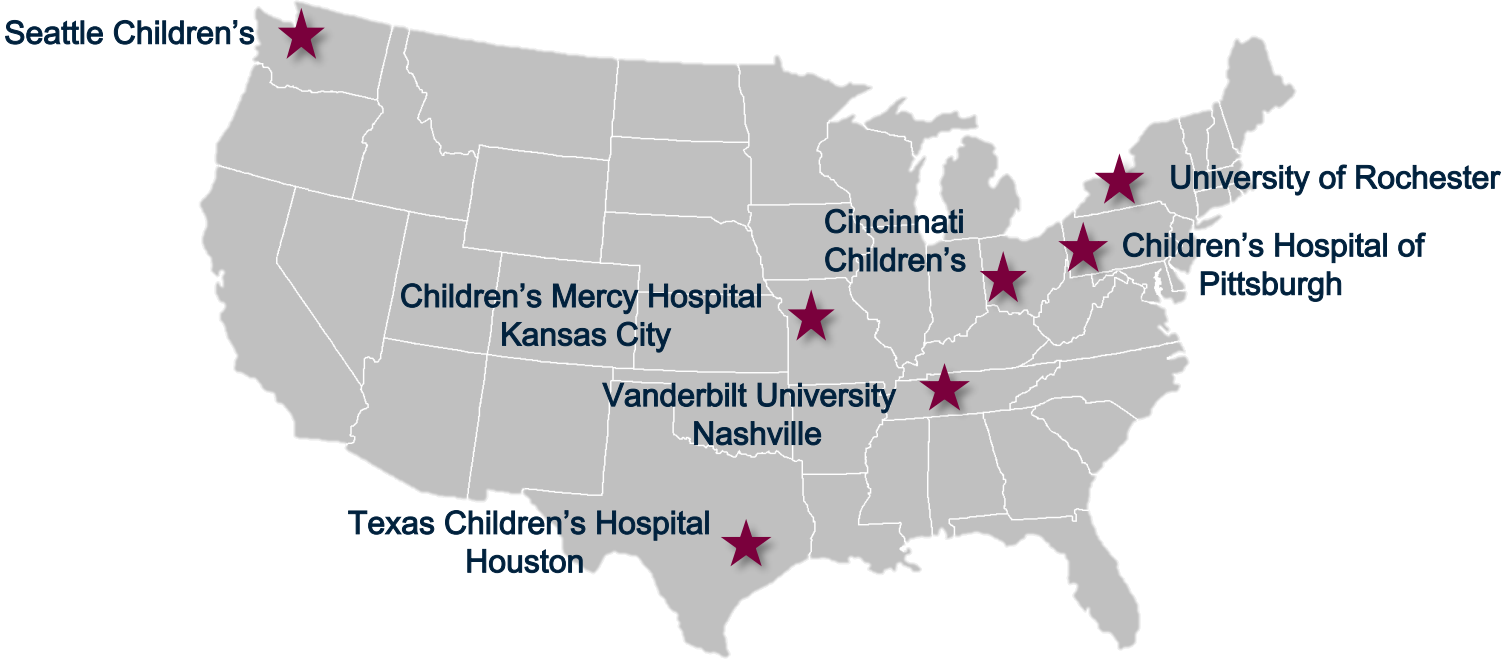
The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Combined ED/UC and hospital vaccine product by age group, among vaccinated with known product type

	18-64 yrs	≥65 yrs
SD-IIV4	5203/5546 (94%)	786/12,572 (6%)
High-dose	42/5546 (<1%)	8348/12,572 (66%)
Adjuvanted	33/5546 (<1%)	3308/12,572 (26%)
Other*	268/5546 (5%)	130/12,572 (1%)

*Includes live attenuated vaccine, recombinant, cell-based, other

NVSN* Pediatric Inpatient & ED Network sites, 2022-2023



*NVSN-New Vaccine Surveillance Network

NVSN Methods

Enrollees: Inpatient and ED patients aged >6 months to 17 years with acute respiratory illness within 10 days of illness onset

Dates of enrollment: September 13, 2022–January 25, 2023

Design: Test-negative design

- Comparing vaccination odds among case patients with RT-PCR confirmed influenza versus control patients testing negative for influenza and SARS-CoV-2
- Vaccination status: receipt of at least one dose of any 2022–23 seasonal flu vaccine according to medical records, immunization registries, and/or self-report

Analysis: VE = (1 – adjusted OR) x 100%

- Adjustment for site, age, and calendar time of admission

Preliminary Data

Vaccine effectiveness against laboratory confirmed influenza A* in hospital and ED settings, September 13, 2022–January 25, 2023**

	Influenza positive		Influenza negative[1]		Vaccine Effectiveness			
					Unadjusted		Adjusted[2]	
	N vaccinated /Total	(%)	N vaccinated /Total	(%)	VE %	95% CI	VE %	95% CI
Influenza A								
All 6 mos – 17 years	123/640	19	750/2256	33	52	(41 to 62)	**49**	**(36 to 60)**
Inpatient	19/131	15	288/913	32	63	(39 to 78)	**68**	**(46 to 81)**
ED	104/507	21	461/1330	35	51	(38 to 62)	**42**	**(25 to 56)**
A/H3N2	98/478	21	750/2256	33	48	(34 to 59)	**45**	**(29 to 58)**
A/H1N1	23/139	17	750/2256	33	60	(37 to 75)	**56**	**(28 to 72)**

* Of 335 influenza-positive specimens sequenced, 250 were A(H3N2) clade 3C.2a1b.2a.2b and 32 were clade 3C.2a1b.2a.2a.1 and 38 were A(H1N1) clade 6B.1A.5a.2a.1. There were 16 coinfections with Influenza and SARS-CoV-2 that were excluded from the VE estimate.

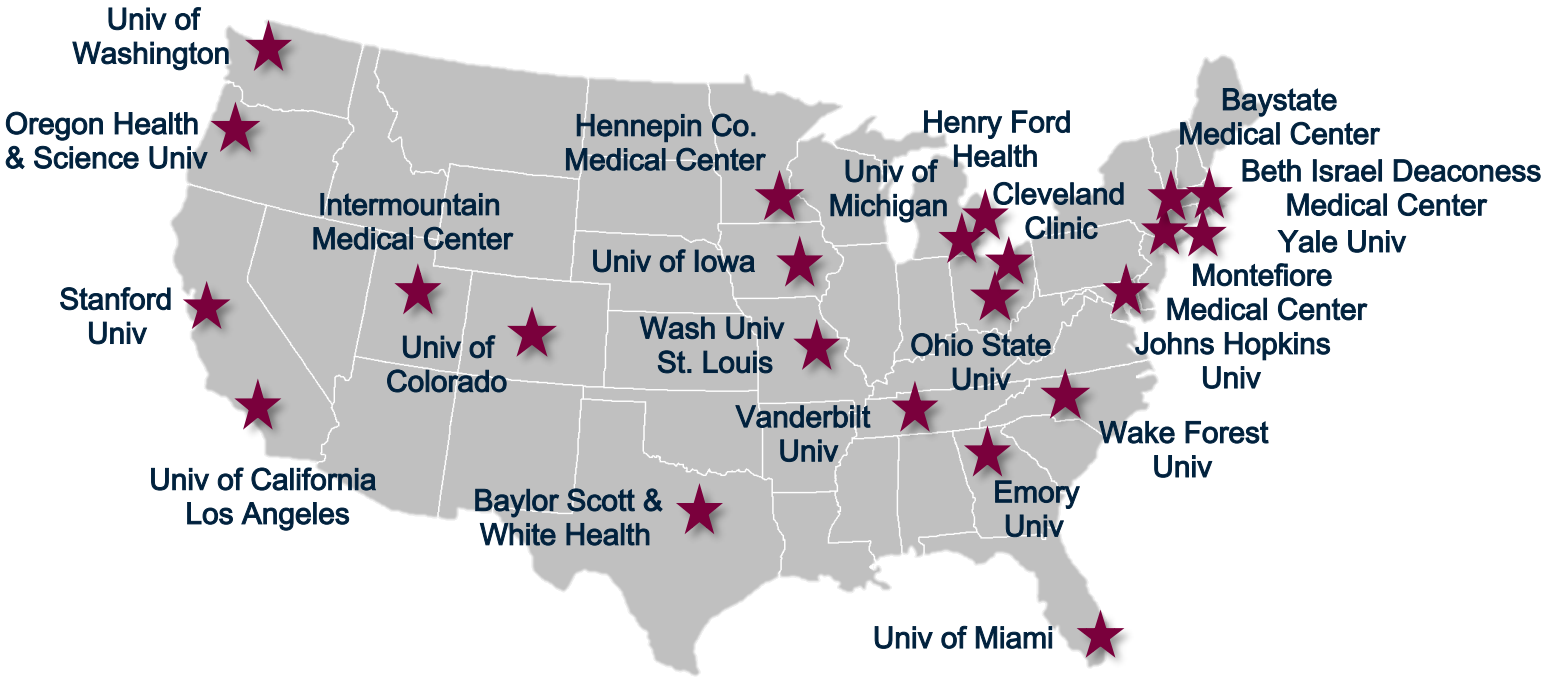
** Site specific influenza seasons were determined from local influenza activity at each site.

[1] Persons testing negative for both influenza and SARS-CoV-2 using molecular assays.

[2] Multivariable logistic regression models adjusted for site, age, and calendar time.

NVSN

IVY* Adult Inpatient Network sites, 2022–2023



*IVY—Investigating Respiratory Viruses in the Acutely Ill

IVY Methods

Enrollees: Inpatient patients aged ≥18 years with acute respiratory illness with fever or cough ≤7 days duration

Dates of enrollment: October 1–January 31, 2023

Design: Test-negative design

- Comparing vaccination odds among influenza RT-PCR positive cases and influenza RT-PCR negative controls, excluding persons testing positive for SARS-CoV-2
- Vaccination status: receipt of at least one dose of any 2021–22 seasonal flu vaccine according to medical records, immunization registries, and/or self-report

Analysis: VE = (1 – adjusted OR) x 100%

- Adjustment for census region, age, sex, race/ethnicity and month of onset

Vaccine effectiveness against laboratory confirmed influenza A* in inpatient settings, October 1, 2022–January 31, 2023

	Influenza positive		Influenza negative[1]		Vaccine Effectiveness			
					Unadjusted		Adjusted[2]	
	N vaccinated /Total	(%)	N vaccinated /Total	(%)	VE %	95% CI	VE %	95% CI
≥18 years	219/701	31	921/2130	43	40	(29 to 50)	**43**	**(30 to 54)**
18–64 years	84/378	22	365/1021	36	49	(33 to 61)	**51**	**(33 to 64)**
≥65 years	135/323	42	556/1109	50	29	(8 to 44)	**35**	**(13 to 52)**
Immunocompromised[3]	45/122	37	238/474	50	42	(13 to 62)	**44**	**(10 to 66)**

* Of 77 influenza-positive specimens sequenced, 50 were A(H3N2) clade 3C.2a1b.2a.2. and 27 were A(H1N1) clade 6B.1A.5a.2. A total of 45 influenza/SARS-CoV-2 coinfections were excluded from the VE estimate

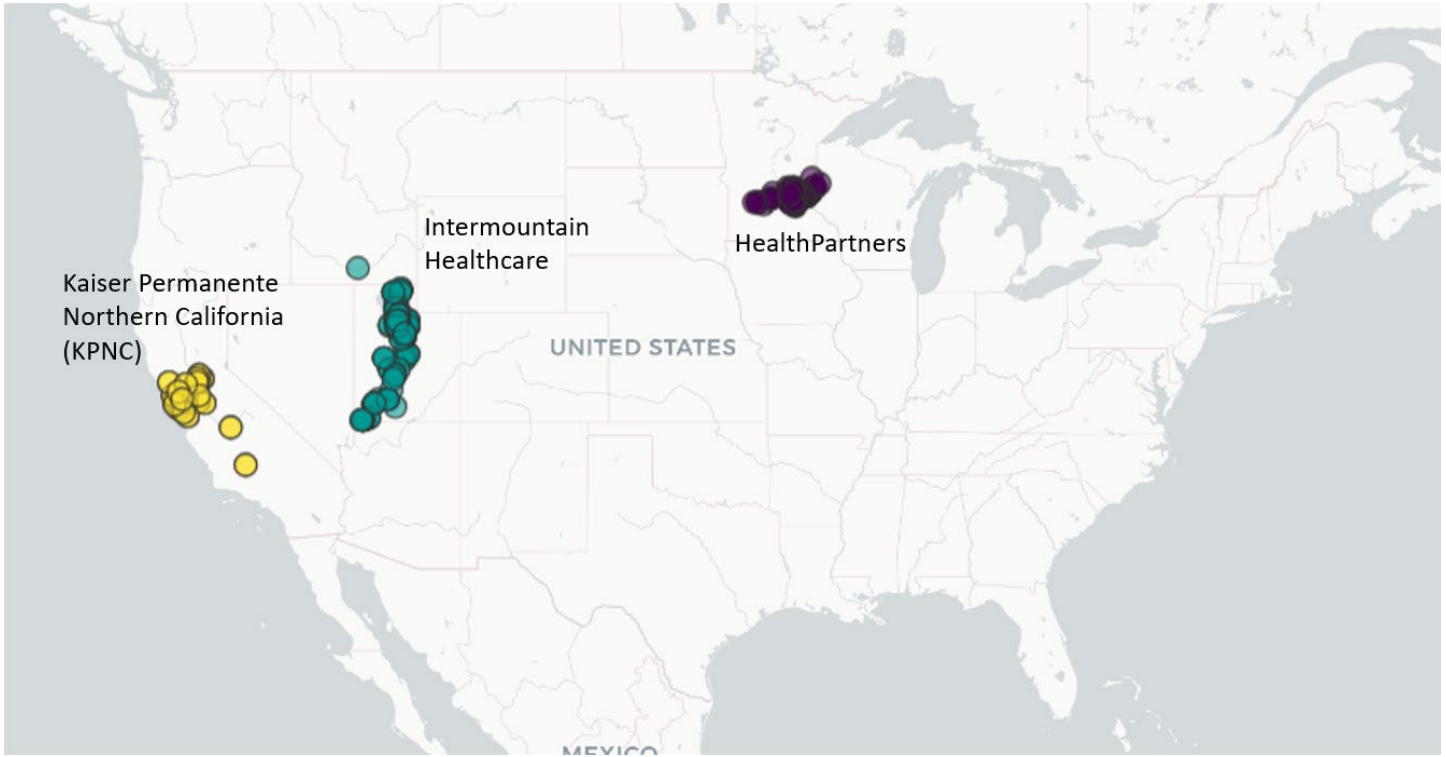
[1] Persons testing negative for influenza and SARS-CoV-2 using molecular assays.

[2] Multivariable logistic regression models adjusted for Census region, age, sex, race/ethnicity, and month.

[3] Includes active solid-organ cancer, active hematologic cancer, solid-organ transplant, bone marrow/stem cell transplant, HIV infection, congenital immunodeficiency syndrome, use of an immunosuppressive medication within the past 30 days, splenectomy, graft-versus-host disease (currently or in the past), or any other condition that causes moderate or severe immunosuppression.

IVY

VISION Network sites, 2022-2023



VISION Methods

Encounters: ED/UC or inpatient encounters among adults ≥18 years tested for influenza and with ≥1 acute respiratory illness (ARI)-associated ICD-10 discharge code

Dates: October 15, 2022–January 24, 2023

Design: Test-negative design

- Comparing vaccination odds among patients with influenza A confirmed by molecular assay versus controls who tested negative for influenza and SARS-CoV-2
- Vaccination status: receipt of any 2022–23 seasonal flu vaccine ≥14 days before index date according to medical records, immunization registries, claims data

Analysis: VE = (1 – adjusted OR) x 100%

- Inverse-propensity-to-be-vaccinated weights and adjustment for patient age, study site, and calendar time

Vaccine effectiveness against laboratory confirmed influenza A in ED/UC settings, October 15, 2022–January 24, 2023*

	Influenza positive		Influenza negative		Vaccine Effectiveness			
					Unadjusted		Adjusted[1]	
	N vaccinated /Total	(%)	N vaccinated /Total	(%)	VE %	95% CI	VE %	95% CI
All adults ≥18 years	3278/14011	(23)	15752/43196	(36)	47	(44 to 49)	**44**	**(41 to 47)**
18-64 years	1600/10590	(15)	6695/27545	(24)	45	(41 to 48)	**46**	**(42 to 49)**
≥65 years	1678/3421	(49)	9057/15651	(58)	30	(25 to 35)	**39**	**(34 to 43)**
Immunocompromised [2]	64/179	(36)	553/1363	(41)	18	(-13 to 41)	**30**	**(-2 to 52)**

* Site specific influenza seasons were determined when local influenza activity was seen at site on or after October 15, 2022, and end date was the date of last available encounter.

[1] Adjusted for patient age, study site, and calendar time.

[2] Defined as at least one discharge diagnosis for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.

Vaccine effectiveness against laboratory confirmed influenza A in Hospital settings, October 15, 2022–January 21, 2023*

	Influenza positive		Influenza negative		Vaccine Effectiveness			
					Unadjusted		Adjusted[1]	
	N vaccinated /Total	(%)	N vaccinated /Total	(%)	VE %	95% CI	VE %	95% CI
All adults ≥18 years	671/1760	(38)	4561/9377	(49)	35	(28 to 41)	**39**	**(31 to 45)**
18-64 years	146/623	(23)	802/2739	(29)	26	(9 to 40)	**29**	**(12 to 43)**
≥65 years	525/1137	(46)	3759/6638	(57)	34	(25 to 42)	**42**	**(34 to 49)**
Immunocompromised [2]	130/297	(44)	1172/2316	(51)	24	(3 to 40)	**31**	**(10 to 48)**

* Site specific influenza seasons were determined when local influenza activity was seen at site on or after October 15, 2022, and end date was the date of last available encounter.

[1] Adjusted for patient age, study site, and calendar time.

[2] Defined as at least one discharge diagnosis for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.