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Update on Vaccine-Derived Poliovirus Outbreaks — Worldwide, January 2020–June 2021

Mary M. Alleman, PhD[1]; Jaume Jorba, PhD[2]; Elizabeth Henderson[2]; Ousmane M. Diop, PhD[3]; Shahzad Shaukat, PhD[3]; Mohamed A. Traoré[3]; Eric Wiesen, DrPH[1]; Steven G.F. Wassilak, MD[1]; Cara C. Burns, PhD[2]

As of May 1, 2016, use of oral poliovirus vaccine (OPV) type 2 for routine and supplementary immunization activities ceased after a synchronized global switch from trivalent OPV (tOPV; containing Sabin strain types 1, 2, and 3) to bivalent OPV (bOPV; containing Sabin strain types 1 and 3) subsequent to the certified eradication of wild type poliovirus (WPV) type 2 in 2015 (*1–3*). Circulating vaccine-derived poliovirus (cVDPV) outbreaks* occur when transmission of Sabin strain poliovirus is prolonged in underimmunized populations, allowing viral genetic reversion to neurovirulence, resulting in cases of paralytic polio (*1–3*). Since the switch, monovalent OPV type 2 (mOPV2, containing Sabin strain type 2) has been used for response to cVDPV type 2 (cVDPV2) outbreaks; tOPV is used if cVDPV2 co-circulates with WPV type 1, and bOPV is used for cVDPV type 1 (cVDPV1) or type 3 (cVDPV3) outbreaks (*1–4*). In November 2020, the World Health Organization (WHO) Emergency Use Listing procedure authorized limited use of type 2 novel OPV (nOPV2), a vaccine modified to be more genetically stable than the Sabin strain, for cVDPV2 outbreak response (*3*,*5*). In October 2021, the Strategic Advisory Group of Experts on Immunization (WHO's principal advisory group) permitted wider use of nOPV2; however, current nOPV2 supply is limited (*6*). This report updates that of July 2019–February 2020 to describe global cVDPV outbreaks during January 2020–June 2021 (as of November 9, 2021)† (*3*). During this period, there were 44 cVDPV outbreaks of the three serotypes affecting 37 countries. The number of cVDPV2 cases increased from 366 in 2019 to 1,078 in 2020 (*7*). A goal of the Global Polio Eradication Initiative's (GPEI) 2022–2026 Strategic Plan is to better address the challenges to early CVDPV2 outbreak detection and initiate prompt and high coverage outbreak responses with available type 2 OPV to interrupt transmission by the end of 2023 (*8*).

* In this report, a cVDPV outbreak is defined as two or more independent isolations of genetically linked VDPVs (through AFP or environmental surveillance, or from healthy community members among themselves or following confirmation of a VDPV-positive specimen from an AFP case in a person with whom they are associated). The number of outbreaks is equivalent to the number of cVDPV emergences. In summaries in this report, a given cVDPV emergence is counted once regardless of the number of countries affected after transmission beyond international borders. For the GPEI, an emergence detected in a country is considered an outbreak for that country.

† Data as of November 9, 2021 for all emergences.

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Detection of cVDPV1

The most recently detected poliovirus genetically linked to the cVDPV1 emergence (PHL-NCR-2)[§] circulating during the previous reporting period was found in environmental surveillance samples (sewage) in Malaysia during March 2020 (*3*) (Table) (Figure 1). During this reporting period, three new cVDPV1 emergences were detected in Madagascar (MAD-ANO-1, MAD-SUE-1, and MAD-SUO-1). The YEM-SAD-1 emergence was first isolated from specimens collected during July 2019 from contacts of an acute flaccid paralysis (AFP) patient in Yemen; circulation was confirmed after the previous global update (*3*).

Detection of cVDPV2

During January 2020–June 2021, there were 38 cVDPV2 emergences in active transmission in 34 countries; 28 (82%) of these countries are in Africa (Table) (Figure 1). Nineteen (50%) of the 38 emergences were previously detected during 2017–2019, three (8%) (ETH-ORO-4, ETH-SOU-2, and NIE-SOS-7) were newly detected in 2019 but were confirmed after the last global report, and 16 (42%) were newly detected during 2020–2021 (*1*,*3*). During the reporting period, fifteen (58%) of the 26 emergences in active transmission in African countries were detected, either in AFP patients or through environmental surveillance, outside of the country of first isolation of genetically linked virus (Figure 2). No polioviruses genetically linked to two previously described emergences (CHN-XIN-1 and ZAM-LUA-1) have been detected since 2019 (*1*,*3*).

Western Africa. The previously described cVDPV2 emergence (NIE-JIS-1) (*1*,*3*), first detected in Nigeria in 2018, continued to circulate during the reporting period. Since first detected, genetically linked virus has circulated in 17 west and central African countries, from Mauritania to Cameroon; during the reporting period; circulation was documented in 16 of the 17 countries (excluding Cameroon) resulting in 310 cases of cVDPV2 in 14 countries and detection through environmental surveillance in 13 countries (*1*,*3*). The most recent detection of the previously described NIE-KGS-1 emergence was through environmental surveillance in January 2020 (*1*,*3*).

During July–September 2019, the NIE-SOS-7 emergence was detected through environmental surveillance in Nigeria; circulation was confirmed after the previous global update (*3*). Virus genetically linked to the NIE-SOS-7 emergence was detected in specimens from AFP patients and from one healthy child in Mali during 2020. NIE-SOS-7 was not detected in Nigeria during 2020; however, genetically linked virus was isolated in 2021 from specimens obtained from AFP patients and healthy children, and through environmental surveillance. Two new cVDPV2 emergences (NIE-SOS-8 and NIE-ZAS-1)

[§] Names designate the country and geographic subnational region of the emergence and the number of emergences in each subnational region.

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TABLE. Circulating vaccine-derived polioviruses detected, by serotype, source, and other selected characteristics — worldwide, January 2020–June 2021

Country	Outbreak/ Emergence designation*	Years detected†	Serotype	No. of detections§ January 2020–June 2021			Capsid protein VP1 divergence from Sabin OPV strain**(%)	Date of latest outbreak case, healthy child specimen, or environmental sample††
				From AFP cases	From other human sources (non-AFP)¶	From environmental surveillance		
Afghanistan	PAK-GB-1	2020–2021	2	225	36	271	0.7–3.4	Jun 9, 2021
	AFG-NGR-1	2020–2021	2	127	18	154	0.7–2.2	Jun 23, 2021
	AFG-HLD-1	2020–2021	2	4	0	5	0.9–1.7	Jan 28, 2021
Angola	ANG-HUI-1	2019–2020	2	2	0	0	1.3–1.5	Feb 9, 2020
	ANG-LUA-1	2019–2020	2	1	0	0	1.5	Feb 9, 2020
Benin	NIE-JIS-1	2019–2021	2	6	2	10	2.4–5.1	May 25, 2021
Burkina Faso	NIE-JIS-1	2019–2021	2	61	13	0	3.1–5.5	Jun 9, 2021
	TOG-SAV-1	2020	2	6	0	0	1.8–2.6	Oct 13, 2020
Cameroon	CHA-NDJ-1	2019–2020	2	3	0	0	1.4–1.9	Sep 20, 2020
	CAR-BER-1	2020	2	1	0	7	1.4–2.3	Sep 29, 2020
	CAR-BNG-1	2020	2	3	4	3	1.7–2.8	Jun 2, 2020
Central African Republic	CHA-NDJ-1	2020	2	3	1	0	1.4–1.7	Nov 4, 2020
	CAR-BER-1	2019–2020	2	1	0	0	1.3	Feb 5, 2020
	CAR-BNG-1	2019–2020	2	0	0	3	1.5–1.8	Feb 5, 2020
Chad	NIE-JIS-1	2019–2020	2	8	3	1	3.1–4.5	Aug 10, 2020
	CHA-NDJ-1	2019–2020	2	91	16	2	0.8–2.6	Dec 15, 2020
	CAR-BIM-3	2020	2	1	0	0	1.4	Oct 18, 2020
China	CHN-SHA-1	2020–2021	3	0	1	1	1.8–2.0	Jan 25, 2021
Côte d'Ivoire	NIE-JIS-1	2019–2020	2	63	27	175	2.9–5.1	Dec 23, 2020
	TOG-SAV-1	2020	2	1	0	0	2.0	Feb 10, 2020
Democratic Republic of the Congo	DRC-KAS-3	2019–2021	2	82	82	2	1.7–3.1	Apr 30, 2021
	DRC-MAN-2	2021	2	1	0	0	0.8	Jun 27, 2021
	DRC-TPA-2	2020	2	0	6	0	0.7–0.8	May 14, 2020
	DRC-EQT-1	2020	2	1	8	0	0.7–1.5	Sep 11, 2020
	CAR-BNG-1	2020	2	0	2	0	2.3	Oct 27, 2020
	ANG-LNO-2	2020	2	1	0	0	2.1	Feb 19, 2020
	ANG-LUA-1	2019–2020	2	2	0	0	1.0–1.3	Jan 29, 2020
Egypt	CHA-NDJ-1	2020–2021	2	0	0	11	2.1–2.5	Jun 8, 2021
Ethiopia	ETH-ORO-1	2019–2021	2	22	6	4	1.4–4.3	Mar 27, 2021
	ETH-ORO-2	2019–2020	2	2	0	0	1.3–1.5	Feb 18, 2020
	ETH-ORO-3	2019–2020	2	1	2	0	2.0–2.8	Oct 11, 2020
	ETH-ORO-4	2019–2020	2	1	0	0	2.9	Feb 23, 2020
	ETH-SOU-1	2020–2021	2	9	0	0	1.1–2.4	Apr 13, 2021
	ETH-SOU-2	2019–2021	2	5	0	0	2.1–3.0	Jun 24, 2021
	SOM-AWL-1	2020	2	2	0	0	1.5–2.3	Dec 14, 2020
	CHA-NDJ-1	2020	2	0	0	1	1.4	Dec 28, 2020
Ghana	NIE-JIS-1	2019–2020	2	11	10	34	2.9–4.1	Jun 16, 2020
Guinea	NIE-JIS-1	2020–2021	2	48	1	1	3.0–4.8	Apr 1, 2021
Guinea-Bissau	NIE-JIS-1	2021	2	2	0	0	4.1–4.5	Jun 27, 2021
Iran	PAK-GB-1	2020–2021	2	0	0	11	1.5–3.6	Feb 20, 2021
Kenya	SOM-BAN-1	2018, 2020–2021	2	0	3	2	7.2–7.6	Jan 25, 2021
Liberia	NIE-JIS-1	2020–2021	2	3	6	47	3.0–6.1	May 28, 2021
Madagascar	MAD-SUE-1	2020–2021	1	6	9	18	3.0–3.6	Jun 29, 2021
	MAD-SUO-1	2021	1	1	3	0	1.6–2.0	Feb 24, 2021
	MAD-ANO-1	2021	1	0	0	5	1.3–1.6	May 17, 2021
Malaysia	PHL-NCR-1	2019–2020	2	0	0	3	7.5	Feb 4, 2020
	PHL-NCR-2	2019–2020	1	3	0	10	3.4–4.0	Mar 13, 2020
Mali	NIE-SOS-7	2020	2	3	1	0	1.5–2.2	Jul 5, 2020
	NIE-JIS-1	2020	2	47	2	10	3.1–4.6	Dec 23, 2020
Mauritania	NIE-JIS-1	2021	2	0	0	2	3.9–4.0	Jun 30, 2021

See table footnotes on the next page.

TABLE. (*Continued*) Circulating vaccine-derived polioviruses detected, by serotype, source, and other selected characteristics — worldwide, January 2020–June 2021

Country	Outbreak/ Emergence designation*	Years detected†	Serotype	No. of detections§ January 2020–June 2021			Capsid protein VP1 divergence from Sabin OPV strain**(%)	Date of latest outbreak case, healthy child specimen, or environmental sample††
				From AFP cases	From other human sources (non-AFP)¶	From environmental surveillance		
Niger	NIE-JIS-1	2018–2020	2	11	2	11	2.8–5.1	Dec 8, 2020
	NIE-ZAS-1	2021	2	1	0	0	2.2	Jun 20, 2021
Nigeria	NIE-JIS-1	2018–2021	2	15	3	19	2.8–4.6	Jun 29, 2021
	NIE-SOS-8	2020	2	2	7	0	1.1–1.8	Sep 17, 2020
	NIE-ZAS-1	2020–2021	2	69	13	83	1.8–3.5	Jun 30, 2021
	NIE-SOS-7	2019, 2021	2	10	4	3	2.4–3.1	Jun 30, 2021
	NIE-KGS-1	2019–2020	2	1	0	1	1.4–1.5	Jan 26, 2020
Pakistan	PAK-GB-1	2019–2021	2	114	6	257	0.7–3.1	Apr 28, 2021
	PAK-TOR-1	2019–2020	2	0	1	1	1.1–1.5	Mar 4, 2020
	PAK-KHI-2	2020	2	0	0	4	0.7–1.0	Oct 14, 2020
	PAK-FSD-1	2020	2	10	1	8	0.7–1.2	Oct 13, 2020
	PAK-FSD-2	2020	2	2	0	0	0.8–1.4	Sep 29, 2020
	PAK-ZHB-1	2020	2	0	0	5	0.7–1.1	Oct 16, 2020
	AFG-NGR-1	2020–2021	2	12	2	59	0.7–2.3	May 18, 2021
	AFG-HLD-1	2020	2	2	0	0	1.3–1.4	Aug 24, 2020
	PAK-LKW-1	2020–2021	2	3	0	1	0.7–1.0	Jan 11, 2021
	PAK-KAM-1	2020–2021	2	0	0	4	0.7–0.9	Feb 9, 2021
	PAK-PWR-1	2021	2	0	0	2	0.8	Jun 14, 2021
Philippines	PHL-NCR-1	2019–2020	2	1	0	4	7.1–7.6	Jan 24, 2020
Republic of the Congo	ANG-HUI-1	2020	2	2	1	0	2.0–2.5	Nov 14, 2020
	DRC-KAS-1	2021	2	1	0	0	2.2	Jan 31, 2021
	CAR-BNG-1	2020–2021	2	0	0	4	2.3–2.6	Apr 14, 2021
	CAR-BER-1	2021	2	0	0	1	3.3	Jun 1, 2021
	ANG-LUA-1	2020	2	0	1	0	2.1	Oct 12, 2020
Senegal	NIE-JIS-1	2020–2021	2	14	30	13	3.8–5.7	Jun 14, 2021
Sierra Leone	NIE-JIS-1	2020–2021	2	15	16	10	3.4–4.6	Jun 29, 2021
Somalia	SOM-BAN-1	2017–2021	2	14	9	37	5.5–8.3	May 23, 2021
	SOM-AWL-1	2020	2	1	0	0	2.3	Aug 1, 2020
	ETH-ORO-3	2020	2	0	5	0	2.8	Sep 22, 2020
South Sudan	CHA-NDJ-1	2020–2021	2	56	24	11	1.3–3.0	Apr 8, 2021
	ETH-SOU-1	2021	2	1	0	0	2.2	Jan 8, 2021
Sudan	CHA-NDJ-1	2020	2	51	16	15	1.1–2.8	Dec 18, 2020
Tajikistan	PAK-GB-1	2020–2021	2	26	11	51	2.2–3.8	Jun 26, 2021
The Gambia	NIE-JIS-1	2021	2	0	0	14	4.0–4.6	Jun 24, 2021
Togo	NIE-JIS-1	2019–2020	2	6	8	0	2.8–4.1	July 9, 2020
	TOG-SAV-1	2019–2020	2	3	1	0	1.5–2.1	May 3, 2020
Uganda	CHA-NDJ-1	2021	2	0	0	1	4.0	Jun 1, 2021
Yemen	YEM-SAD-1	2019–2021	1	32	0	0	1.9–3.3	Jan 13, 2021
Total cVDPV	—§§	—§§	—§§	**1,335**	**423**	**1,412**	—§§	—§§

Abbreviations: AFP = acute flaccid paralysis; cVDPV = circulating vaccine-derived poliovirus; OPV = oral poliovirus; VDPV = vaccine-derived poliovirus; VP1 = viral protein 1.

* In the column "Outbreaks/Emergences," outbreaks list total cases clearly associated with cVDPVs, emergences indicate independent cVDPV outbreaks, and names of emergences designate the country and geographic subnational region of the emergence and the number of emergences in each subnational region.

† Total years detected for previously reported cVDPV outbreaks.

§ During January 2020–June 2021 with data as of November 9, 2021. For AFP cases, the number of AFP cases with a VDPV-positive specimen or in which a direct contact of the case had a VDPV-positive specimen when the case did not; for other human sources, the number of contacts or healthy children with a VDPV-positive specimen; for detections from environmental surveillance, the total VDPVs detected from environmental (sewage) collections.

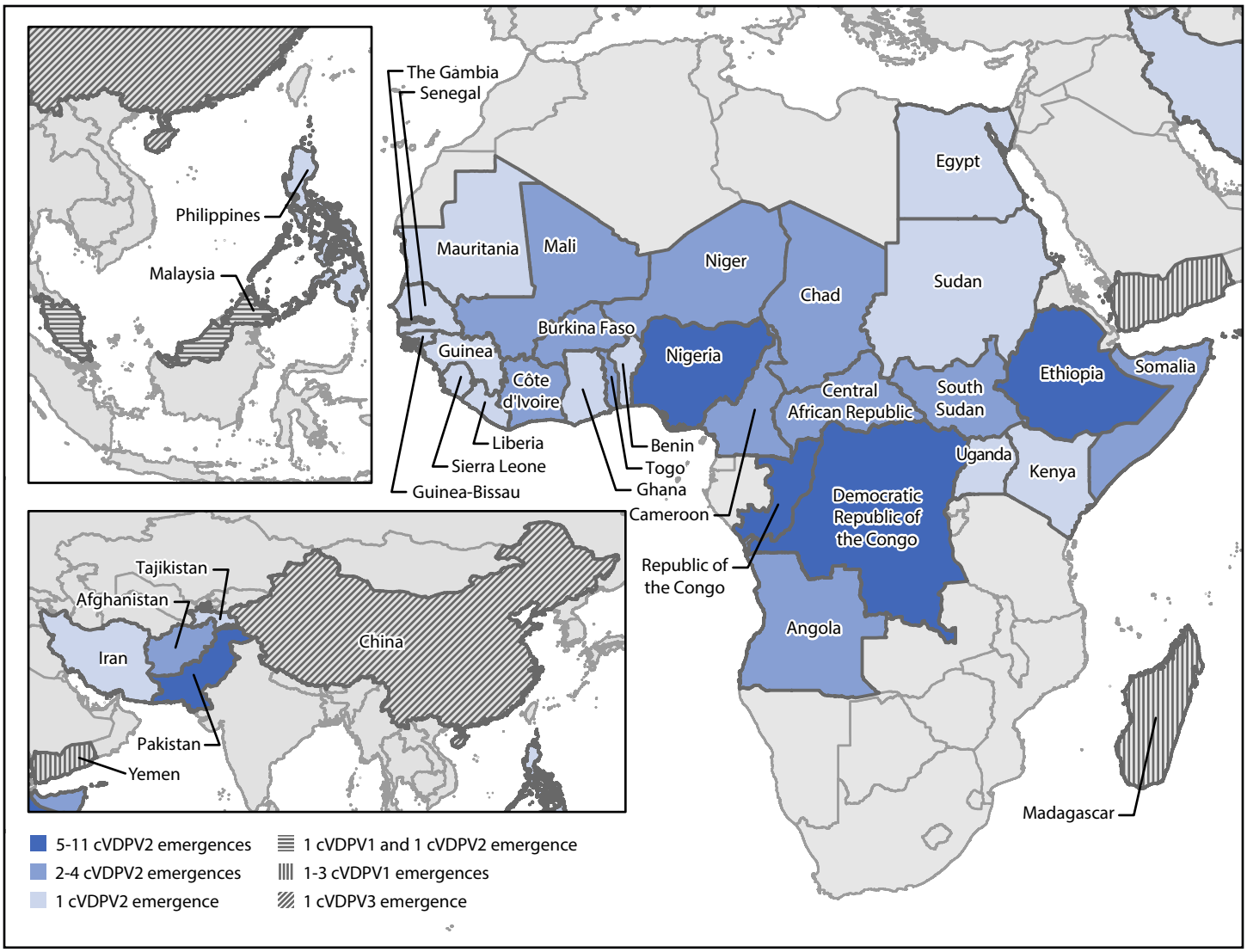
¶ Contacts and healthy child specimen sampling during January 2020–June 2021 with data as of November 9, 2021 for all emergences.

** Percentage of divergence is estimated from the number of nucleotide differences in the VP1 region from the corresponding parental OPV strain.

†† For AFP cases, dates refer to date of paralysis onset; for contacts, healthy children, and environmental (sewage) samples, dates refer to date of collection during January 2020–June 2021 with data as of November 9, 2021.

§§ Dashes indicate data were not cumulative.

FIGURE 1. Ongoing circulating vaccine-derived poliovirus outbreaks — worldwide, January 2020–June 2021*



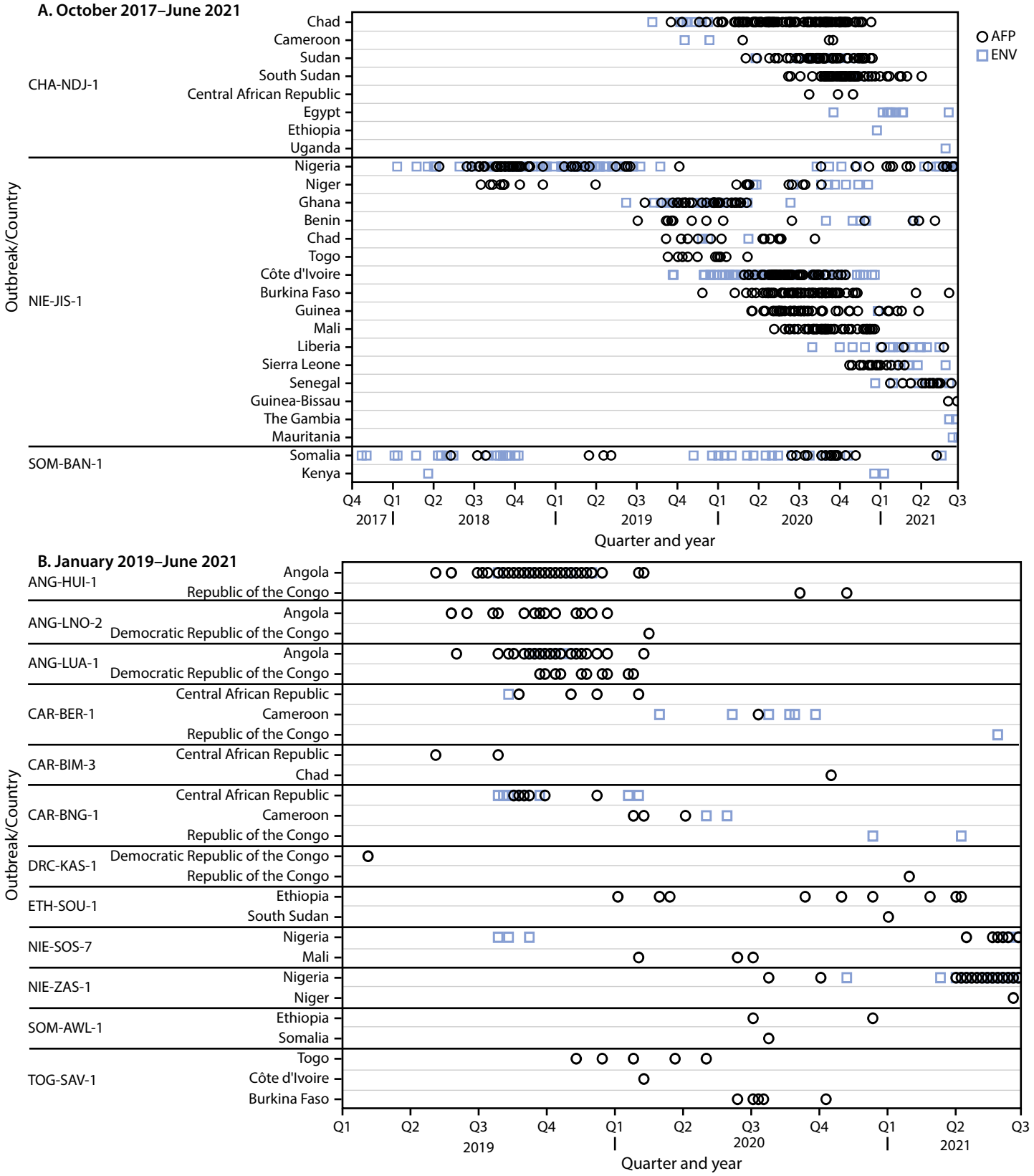
Abbreviations: cVDPV = circulating vaccine-derived poliovirus; cVDPV1 = cVDPV type 1; cVDPV2 = cVDPV type 2; cVDPV3 = cVDPV type 3.
* Data as of November 9, 2021.

were detected and circulated in Nigeria during the reporting period, with the most recent detections in September 2020 and June 2021, respectively. During June 2021, NIE-ZAS-1 emergence was detected in Niger. There was no evidence of continued circulation of any other previously described emergences first detected in Nigeria (*1*,*3*). The previously reported TOG-SAV-1 cVDPV2 emergence circulated in Burkina Faso, Côte d'Ivoire, and Togo during the reporting period (*3*).

Central Africa. The most recent detection of the ANG-HUI-1 emergence in Angola was in February 2020; however, genetically linked virus was isolated from specimens collected from AFP patients and one healthy child during late 2020 in the Republic of the Congo (*1*,*3*). The ANG-LUA-1 emergence was most recently detected in the Democratic Republic of the Congo and Angola in specimens from AFP patients with paralysis onset in January and February 2020, respectively and in a healthy child in the Republic of the Congo in October 2020 (*3*). The ANG-LNO-2 emergence was last detected in Angola in December 2019; the most recent isolation of genetically linked virus was in the Democratic Republic of the Congo from specimens from an AFP patient with paralysis onset in February 2020 (*1*,*3*). No polioviruses genetically linked to two previously described emergences (ANG-LNO-1 and ANG-MOX-1) were detected during the reporting period (*1*,*3*).

The CHA-NDJ-1 emergence was first detected in Chad and then Cameroon during 2019; genetically linked virus was detected during the reporting period in Cameroon, the Central African Republic, Chad, Egypt, Ethiopia, South Sudan, Sudan, and Uganda (*3*). Genetically linked virus was most recently detected in Egypt and Uganda through environmental

FIGURE 2. Acute flaccid paralysis cases and environmental samples positive for circulating vaccine-derived poliovirus type 2 associated with outbreaks ongoing during January 2020–June 2021 that involved international spread since emergence, by outbreak and country — Africa, October 2017–June 2021 (A)*,† and January 2019–June 2021 (B)*,†



Abbreviations: AFP = acute flaccid paralysis; ENV = environmental samples.

* Dates (quarter and year) refer to the date of paralysis onset of AFP cases; ENV (sewage) dates refer to date of collection. When dates are the same, symbols will overlap; thus, not all isolates are visible. Outbreaks are illustrated for the country where the emergence was first detected and for countries where outbreaks with genetically linked virus were ongoing during January 2020–June 2021.

† Data as of November 9, 2021.

surveillance during June 2021. This emergence resulted in 204 paralytic cases in five of these eight countries during the reporting period.

Of the seven emergences first detected in the Central African Republic during 2019 (CAR-BAM-1, CAR-BAM-2, CAR-BER-1, CAR-BIM-1, CAR-BIM-2, CAR-BIM-3, and CAR-BNG-1), three (CAR-BER-1, CAR-BIM-3, and CAR-BNG-1) continued to circulate and spread internationally during the reporting period (*1*,*3*). Virus genetically linked to CAR-BER-1 was detected in Cameroon, the Central African Republic, and the Republic of the Congo; to CAR-BIM-3 was detected in Chad; and to CAR-BNG-1 was detected in Cameroon, the Central African Republic, the Republic of the Congo, and the Democratic Republic of the Congo.

Two previously described emergences (DRC-KAS-1 and DRC-KAS-3) detected in the Democratic Republic of the Congo in 2019 continued to circulate (*1*,*3*). After being first detected in 2019 in specimens from an AFP patient and healthy children (*1*), the DRC-KAS-1 emergence was not detected again until early 2021 in the Republic of the Congo in the specimens from an AFP patient. During the current reporting period, the DRC-KAS-3 emergence resulted in 82 paralytic cases in the Democratic Republic of the Congo, with the most recent paralysis onset in April 2021. Three new emergences (DRC-EQT-1, DRC-MAN-2, and DRC-TPA-2) were detected during the reporting period. There was no evidence of continued circulation of any other previously described emergences first detected in the Democratic Republic of the Congo (*1*,*3*).

Horn of Africa. The previously described SOM-BAN-1 emergence continued to circulate during the reporting period; genetically linked virus was detected each year during 2017–2021 in Somalia, and during 2018 and 2020–2021 in neighboring Kenya (*1*,*3*). During 2020, a new emergence (SOM-AWL-1) resulted in one case in Somalia and two cases in Ethiopia. Three previously described cVDPV2 emergences (ETH-ORO-1, ETH-ORO-2, and ETH-ORO-3) detected in Ethiopia in 2019 were detected during the reporting period in Ethiopia and Somalia (*3*). Two new emergences (ETH-ORO-4 and ETH-SOU-2) were confirmed after the previous global update (*3*) and subsequently resulted in six paralytic cases in Ethiopia. During 2020–2021, an additional new emergence (ETH-SOU-1) that circulated in Ethiopia and South Sudan resulted in ten paralytic cases. There have been no detections of the previously described ETH-SOM-1 emergence since 2019 (*3*).

Afghanistan, Iran, Pakistan, and Tajikistan. Among the five previously described cVDPV2 emergences detected in 2019 in Pakistan (PAK-GB-1, PAK-GB-2, PAK-GB-3, PAK-KOH-1, and PAK-TOR-1) only PAK-GB-1 and PAK-TOR-1 continued to be detected during the reporting period (*3*). The latest detection of PAK-TOR-1 was in a healthy child in Pakistan in early 2020. During the reporting period, PAK-GB-1 spread internationally resulting in a total of 251 cases in Afghanistan and Tajikistan, and 114 cases in Pakistan. There have been 11 environmental surveillance isolations of PAK-GB-1 in Iran, but no paralytic cases. During the reporting period, seven cVDPV2 emergences (PAK-FSD-1, PAK-FSD-2, PAK-KAM-1, PAK-KHI-2, PAK-LKW-1, PAK-PWR-1, and PAK-ZHB-1) were newly detected in Pakistan resulting in 15 paralytic cases; two cVDPV2 emergences (AFG-HLD-1 and AFG-NGR-1) were newly detected in Afghanistan during 2020 and spread to Pakistan. An additional cVDPV2 emergence (PAK-PB-1) was first and most recently detected through environmental surveillance in Pakistan in December 2019; confirmation of circulation occurred after the last global report (*3*).

Malaysia and the Philippines. The most recent detection of the PHL-NCR-1 cVDPV2 emergence in the Philippines was in January 2020 (*3*). The most recent detection of this emergence globally was through environmental surveillance during February 2020 in Malaysia (*3*).

Detection of cVDPV3

The most recent isolation of the CHN-SHA-1 cVDPV3 emergence, the only cVDPV3 in transmission during the reporting period, was through environmental surveillance in January 2021 in China (Table) (Figure 1). No paralytic cases were reported as of November 9, 2021.

Outbreak Control

As of October 31, 2021, no transmission was detected for >12 months for outbreaks in certain countries related to three cVDPV1 and 46 cVDPV2 emergences that circulated during 2018–2020, indicating probable interruption of transmission in those countries (>12 months since the most recent date of paralysis onset in an AFP patient, or of collection of environmental surveillance sample or other sample [e.g., healthy child], positive for genetically linked virus as of October 31, 2021) (*1*,*3*,*9*) (Table) (Supplementary Table; https://stacks.cdc.gov/view/cdc/112105). In addition, as of October 31, 2021, there have been no genetically linked isolations for 7 to 12 months, indicating possible outbreak cessation of AFG-HLD-1 in Afghanistan; TOG-SAV-1 in Burkina Faso; CHA-NDJ-1 in the Central African Republic, Chad, Ethiopia, and Sudan; CAR-BIM-3 in Chad; CHN-SHA-1 in China; NIE-JIS-1 in Côte d'Ivoire, Mali, and Niger; CAR-BNG-1 in the Democratic Republic of the Congo; ETH-ORO-1, ETH-ORO-3, and SOM-AWL-1 in Ethiopia; MAD-SUO-1 in Madagascar; PAK-FSD-1, PAK-KAM-1, PAK-KHI-2,

Summary

What is already known about this topic?

Circulating vaccine-derived polioviruses (cVDPVs) can emerge in settings with low poliovirus population immunity and cause paralysis.

What is added by this report?

During January 2020–June 2021, 44 cVDPV outbreaks were ongoing, resulting in 1,335 paralytic cases; 38 (86%) were cVDPV type 2 (cVDPV2). Initial use of novel type 2 oral poliovirus vaccine (OPV), modified to be more genetically stable than Sabin strain poliovirus, began in March 2021 for cVDPV2 outbreak responses; current supplies are limited.

What are the implications for public health practice?

A goal of the Global Polio Eradication Initiative's 2022–2026 Strategic Plan is to better address the challenges to early cVDPV2 outbreak detection and initiate prompt and high coverage outbreak responses with available type 2 OPV to interrupt transmission by the end of 2023.

PAK-LKW-1 and PAK-ZHB-1 in Pakistan; ANG-HUI-1, ANG-LUA-1, and DRC-KAS-1 in the Republic of the Congo; ETH-SOU-1 in South Sudan; PAK-GB-1 in Iran; SOM-BAN-1 in Kenya; and YEM-SAD-1 in Yemen (*1*,*3*).

Discussion

During January 2020–June 2021, GPEI continued to be challenged by cVDPV outbreaks, 86% of which were type 2 outbreaks affecting 28 African countries. The SOM-BAN-1, NIE-JIS-1, and CHA-NDJ-1 cVDPV2 emergences first detected in 2017, 2018, and 2019, respectively have continued to circulate well beyond the countries of first detection; these and numerous other old and new emergences have cumulatively resulted in 1,293 paralytic cVDPV2 cases during the reporting period (*1*,*3*).

Disruptions in AFP and environmental surveillance, partly because of the COVID-19 pandemic, might have resulted in case undercounts and delayed cVDPV2 outbreak detection during the reporting period (*3*,*8*,*10*). Outbreak response supplementary immunization activities were suspended during March–June 2020 (initial months of the COVID-19 pandemic) (*8*). Many outbreak response supplementary immunization activities conducted before and after the suspension have been of poor quality, and, in many countries, there have been delays of weeks to months in supplementary immunization activities implementation after outbreak confirmation, all leading to lingering and geographically expanding cVDPV2 transmission and seeding of new emergences (*1*,*3*,*8*).

A goal of the GPEI 2022–2026 Strategic Plan is to interrupt all cVDPV2 transmission by the end of 2023 by better addressing the challenges to early outbreak detection and effective outbreak responses (*8*). Initial nOPV2 outbreak response supplementary immunization activities, anticipated for late 2020 after the Emergency Use Listing was announced, were delayed until March 2021 (*3*,*6*,*8*); to date approximately 100 million nOPV2 doses have been administered in seven countries (Benin, Liberia, Niger, Nigeria, the Republic of the Congo, Sierra Leone, and Tajikistan) (*6*). The improved genetic stability of nOPV2 over that of the Sabin vaccine strain and its effectiveness in interrupting cVDPV2 transmission are being monitored because this vaccine is now authorized for wider use (*6*). In the interim, the initiative is confronted with multiple cVDPV2 outbreaks and limited nOPV2 supply because of manufacturing delays resulting from the COVID-19 pandemic and larger than anticipated nOPV2 consumption (*6*). Therefore, the recommendation from the Strategic Advisory Group of Experts on Immunization,¶ WHO Director-General's Emergency Committee for the International Health Regulations regarding the spread of poliovirus as a Public Health Emergency of International Concern (*9*), and the GPEI Independent Monitoring Board** is that countries should initiate rapid outbreak response with available type 2 OPV, whether that is Sabin or the novel vaccine (*6*).

¶ http://apps.who.int/iris/bitstream/handle/10665/341623/WER9622-eng-fre.pdf

** https://polioeradication.org/wp-content/uploads/2021/07/20th-IMB-report-20210631.pdf

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Corresponding author: Mary M. Alleman; mea4@cdc.gov; 404-639-8703.

[1]Global Immunization Division, Center for Global Health, CDC; [2]Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, CDC; [3]Polio Eradication Department, World Health Organization, Geneva, Switzerland.

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References

1. Jorba J, Diop OM, Iber J, et al. Update on vaccine-derived poliovirus outbreaks—worldwide, January 2018–June 2019. MMWR Morb Mortal Wkly Rep 2019;68:1024–8. PMID:31725706 https://doi.org/10.15585/mmwr.mm6845a4
2. Global Polio Eradication Initiative. Standard operating procedures. Responding to a poliovirus event or outbreak. Geneva, Switzerland: World Health Organization; 2020. https://polioeradication.org/wp-content/uploads/2020/04/POL-SOP-V3.1-20200424.pdf
3. Alleman MM, Jorba J, Greene SA, et al. Update on vaccine-derived poliovirus outbreaks—worldwide, July 2019–February 2020. MMWR Morb Mortal Wkly Rep 2020;69:489–95. PMID:32324719 https://doi.org/10.15585/mmwr.mm6916a1
4. Moffett DB, Llewellyn A, Singh H, et al. Progress toward poliovirus containment implementation—worldwide, 2019–2020. MMWR Morb Mortal Wkly Rep 2020;69:1330–3. PMID:32941411 https://doi.org/10.15585/mmwr.mm6937a7
5. World Health Organization. Polio vaccine—novel oral (nOPV) monovalent type 2. Geneva, Switzerland: World Health Organization; 2020. https://extranet.who.int/pqweb/vaccines/polio-vaccine-novel-oral-nopv-monovalent-type-2
6. Global Polio Eradication Initiative. Independent experts advise move to next use phase for novel oral polio vaccine type 2. Geneva, Switzerland: World Health Organization; 2021. https://polioeradication.org/news-post/independent-experts-advise-transition-to-next-use-phase-for-novel-oral-polio-vaccine-type-2-nopv2/
7. Global Polio Eradication Initiative. Circulating vaccine-derived poliovirus. Global circulating vaccine-derived poliovirus (cVDPV) as of 30 November 2021; Geneva, Switzerland: World Health Organization. Accessed November 30, 2021. https://polioeradication.org/polio-today/polio-now/this-week/circulating-vaccine-derived-poliovirus/
8. Global Polio Eradication Initiative. Polio eradication strategy 2022–2026: delivering on a promise. Geneva, Switzerland: World Health Organization; 2021. https://polioeradication.org/gpei-strategy-2022-2026/
9. World Health Organization. Statement of the twenty-ninth Polio IHR Emergency Committee. Geneva, Switzerland: World Health Organization; 2021. https://www.who.int/news/item/20-08-2021-statement-of-the-twenty-ninth-polio-ihr-emergency-committee
10. Zomahoun DJ, Burman AL, Snider CJ, et al. Impact of COVID-19 pandemic on global poliovirus surveillance. MMWR Morb Mortal Wkly Rep 2021;69:1648–52. PMID:33382673 https://doi.org/10.15585/mmwr.mm695152a4

Comparative Effectiveness and Antibody Responses to Moderna and Pfizer-BioNTech COVID-19 Vaccines among Hospitalized Veterans — Five Veterans Affairs Medical Centers, United States, February 1–September 30, 2021

Kristina L. Bajema, MD[1,*]; Rebecca M. Dahl, MPH[1,*]; Steve L. Evener, MPH[1,2]; Mila M. Prill, MSPH[1]; Maria C. Rodriguez-Barradas, MD[3,4]; Vincent C. Marconi, MD[5,6,7]; David O. Beenhouwer, MD[8,9]; Mark Holodniy, MD[10,11,12]; Cynthia Lucero-Obusan, MD[10,11]; Sheldon T. Brown, MD[13,14]; Maraia Tremarelli, MSPH[1,15]; Monica Epperson, PhD[1]; Lisa Mills, PhD[1]; So Hee Park[1]; Gilberto Rivera-Dominguez, MD[3,4]; Rosalba Gomez Morones, MD[3,4]; Ghazal Ahmadi-Izadi[5]; Rijalda Deovic, MPH[5]; Chad Mendoza[8]; Chan Jeong[8]; Stephanie J. Schrag, DPhil[1]; Elissa Meites, MD[1]; Aron J. Hall, DVM[1]; Miwako Kobayashi, MD[1]; Meredith McMorrow, MD[1]; Jennifer R. Verani, MD[1]; Natalie J. Thornburg, PhD[1,*]; Diya Surie, MD[1,*]; SUPERNOVA COVID-19 Surveillance Group

The mRNA COVID-19 vaccines (Moderna and Pfizer-BioNTech) provide strong protection against severe COVID-19, including hospitalization, for at least several months after receipt of the second dose (*1*,*2*). However, studies examining immune responses and differences in protection against COVID-19–associated hospitalization in real-world settings, including by vaccine product, are limited. To understand how vaccine effectiveness (VE) might change with time, CDC and collaborators assessed the comparative effectiveness of Moderna and Pfizer-BioNTech vaccines in preventing COVID-19–associated hospitalization at two periods (14–119 days and ≥120 days) after receipt of the second vaccine dose among 1,896 U.S. veterans at five Veterans Affairs medical centers (VAMCs) during February 1–September 30, 2021. Among 234 U.S. veterans fully vaccinated with an mRNA COVID-19 vaccine and without evidence of current or prior SARS-CoV-2 infection, serum antibody levels (anti-spike immunoglobulin G [IgG] and anti-receptor binding domain [RBD] IgG) to SARS-CoV-2 were also compared. Adjusted VE 14–119 days following second Moderna vaccine dose was 89.6% (95% CI = 80.1%–94.5%) and after the second Pfizer-BioNTech dose was 86.0% (95% CI = 77.6%–91.3%); at ≥120 days VE was 86.1% (95% CI = 77.7%–91.3%) for Moderna and 75.1% (95% CI = 64.6%–82.4%) for Pfizer-BioNTech. Antibody levels were significantly higher among Moderna recipients than Pfizer-BioNTech recipients across all age groups and periods since vaccination; however, antibody levels among recipients of both products declined between 14–119 days and ≥120 days. These findings from a cohort of older, hospitalized veterans with high prevalences of underlying conditions suggest the importance of booster doses to help maintain long-term protection against severe COVID-19.[†]

During February 1–September 30, 2021, adults aged ≥18 years hospitalized at five VAMCs (Atlanta, Georgia; the New York City borough of the Bronx; Houston, Texas; Los Angeles, California; and Palo Alto, California) were screened for inclusion in this test-negative case-control assessment (*1*,*3*). Patients with COVID-19–like illness[§] who received a positive SARS-CoV-2 nucleic acid amplification test result were included as case-patients and those with COVID-19–like illness and negative SARS-CoV-2 test results were included as controls[¶] (*4*).

Data on demographic characteristics, clinical history, and COVID-19 vaccination history were abstracted from electronic health records.[**] Full vaccination was defined as receipt of 2 doses of an mRNA COVID-19 vaccine (Moderna or Pfizer-BioNTech) ≥14 days before the SARS-CoV-2 test. Participants who received only 1 dose of an mRNA COVID-19 vaccine, 2 mRNA doses with receipt of the second dose <14 days before the SARS-CoV-2 test, mixed mRNA vaccine products, 3 vaccine doses, or the Janssen (Johnson & Johnson) COVID-19 vaccine were excluded from the analysis.[††]

Available residual clinical serum specimens were collected from fully vaccinated hospitalized control patients at all sites and tested at CDC. Specimens were tested using the V-PLEX SARS-CoV-2 panel 2 kit (Meso Scale Diagnostics)[§§] to measure binding IgG levels against three SARS-CoV-2 antigens: the spike protein (anti-spike), the receptor-binding domain of the spike protein (anti-RBD), and the nucleocapsid protein (anti-nucleocapsid). Levels were reported in international binding antibody units (BAU) per milliliter (mL). Control participants with anti-nucleocapsid antibodies (>11.8 BAU/mL), suggesting a prior SARS-CoV-2 infection, were excluded from the final analysis.

[*] These authors contributed equally to this report.

[†] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/booster-shot.html

[§] COVID-19–like illness was defined as fever, new or worsened cough or shortness of breath, loss of taste or smell, oxygen saturation on room air <94%, requirement for noninvasive ventilation or endotracheal intubation with mechanical ventilation, or chest radiograph or computed tomography pulmonary findings consistent with pneumonia.

[¶] The test-negative study design is commonly used to assess vaccine effectiveness in observational studies. In this study design, case-patients with symptomatic COVID-19 who test positive for SARS-CoV-2 are compared with controls with the same clinical syndrome who test negative for SARS-CoV-2. This approach is used to reduce bias from differences in health care-seeking behavior and access to testing and care.

[**] In the Atlanta and Houston VAMCs, COVID-19 vaccination status was further verified through a review of state immunization registries.

[††] Sixty-one participants received the Janssen (Johnson & Johnson) COVID-19 vaccine and were therefore excluded from the analysis.

[§§] https://www.mesoscale.com/en/products/sars-cov-2-panel-2-igg-k15383u/

VE to prevent COVID-19–associated hospitalization (calculated as 1 – adjusted odds ratio [aOR] × 100)[¶¶] was estimated using multivariable logistic regression to compare the odds of full vaccination between case-patients and controls. Models were adjusted for VAMC site, admission date, and age (with the use of cubic splines), sex, and race/ethnicity.[***] VE between subgroups was compared using 95% CIs. In the antibody analysis, pairwise comparisons of median anti-spike IgG and anti-RBD IgG levels using the Wilcoxon rank-sum test and p-values were calculated among participants by age category, vaccine product received, and time since vaccination (14–119 days and ≥120 days after the second vaccine dose). Because vaccines might not elicit a strong immune response[†††] in some persons with immunocompromising conditions,[§§§] differences including and excluding this group were examined. Analyses were conducted using SAS (version 9.4; SAS Institute). For all analyses, statistical significance was set at p<0.05. Protocols were reviewed and approved by the VAMC Research and Development Committee at each site. The activity was also reviewed by CDC and conducted consistent with applicable federal law and CDC policy.[¶¶¶]

During February 1–September 30, 2021, a total of 2,329 hospitalized U.S. veterans with COVID-19–like illness met inclusion criteria. After excluding 433 persons with missing data or ineligible vaccination status,[****] 755 case-patients and 1,141 controls were included in the analysis. Among these 1,896 patients, 1,758 (92.7%) were male, the median age was 67 years (IQR = 59–75 years), 942 (49.7%) were Black, and 162 (8.5%) were Hispanic (Table 1). Effectiveness of the Moderna vaccine was 89.6% (95% CI = 80.1%–94.5%) 14–119 days after the second vaccine dose and 86.1% (95% CI = 77.7%–91.3%) at ≥120 days (Table 2). Effectiveness of the Pfizer-BioNTech vaccine was 86.0% (95% CI = 77.6%–91.3%) at 14–119 days and 75.1% (95% CI = 64.6%–82.4%) at ≥120 days.

Antibody testing was performed on sera available from 259 of 638 (40.6%) fully vaccinated controls. No significant differences in age, sex, or vaccine product received were observed between fully vaccinated controls with and without available sera (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/112103). After excluding

TABLE 1. Characteristics of COVID-19 case-patients and controls* among hospitalized veterans — five Veterans Affairs medical centers, United States, February 1–September 30, 2021

Characteristic	No. (%) Total N = 1,896	Case-patients n = 755	Controls n = 1,141
Male sex	**1,758 (92.7)**	**679 (89.9)**	**1,079 (94.6)**
Age, median (IQR), yrs	**67 (59–75)**	**63 (51–74)**	**70 (62–76)**
Age group, yrs			
18–49	241 (12.7)	166 (22.0)	75 (6.6)
50–64	551 (29.1)	238 (31.5)	313 (27.4)
65–74	621 (32.8)	189 (25.0)	432 (37.9)
75–84	334 (17.6)	114 (15.1)	220 (19.3)
≥85	149 (7.9)	48 (6.4)	101 (8.9)
Race/Ethnicity			
Black, non-Hispanic	942 (49.7)	377 (49.9)	565 (49.5)
White, non-Hispanic	748 (39.5)	277 (36.7)	471 (41.3)
Hispanic, any race	162 (8.5)	82 (10.9)	80 (7.0)
Other, non-Hispanic[†]	44 (2.3)	19 (2.5)	25 (2.2)
Resident in long-term care facility[§] (unknown = 20)	**114 (6.1)**	**28 (3.7)**	**86 (7.6)**
Study site			
Atlanta, Georgia	615 (32.4)	243 (32.2)	372 (32.6)
Bronx, New York City[¶]	102 (5.4)	33 (4.4)	69 (6.0)
Houston, Texas	713 (37.6)	372 (49.3)	341 (29.9)
Los Angeles, California	328 (17.3)	74 (9.8)	254 (22.3)
Palo Alto, California	138 (7.3)	33 (4.4)	105 (9.2)
Month of admission			
Feb–Mar	451 (23.8)	151 (20.0)	300 (26.3)
Apr–Jun	442 (23.3)	118 (15.6)	324 (28.4)
Jul–Sep	1,003 (52.9)	486 (64.4)	517 (45.3)
COVID-19 fully vaccinated**	**799 (42.1)**	**161 (21.3)**	**638 (55.9)**
COVID-19 vaccine type among fully vaccinated			
Pfizer BioNTech	521 (65.2)	118 (73.3)	403 (63.2)
Moderna	278 (34.8)	43 (26.7)	235 (36.8)
Time between vaccine dose 2 and SARS-CoV-2 test among fully vaccinated, median (IQR), days	**130 (70–169)**	**157 (125–184)**	**120 (63–163)**
Underlying medical condition			
Cardiovascular			
Atherosclerotic cardiovascular disease[††]	538 (29.2)	157 (22.0)	381 (33.8)
Atrial fibrillation	265 (14.0)	88 (11.7)	177 (15.5)
Congestive heart failure	428 (22.6)	94 (12.5)	334 (29.3)
Hypertension	1,312 (69.2)	478 (63.3)	834 (73.1)
Venous thromboembolism	110 (5.8)	41 (5.4)	69 (6.0)
Metabolic			
Diabetes	805 (42.5)	300 (39.7)	505 (44.3)
Dyslipidemia	813 (42.9)	296 (39.2)	517 (45.3)
Obesity[§§] (unknown = 3)	897 (47.4)	396 (52.6)	501 (43.9)
Pulmonary			
Asthma	125 (6.6)	36 (4.8)	89 (7.8)
COPD or emphysema	442 (23.3)	94 (12.5)	348 (30.5)
Obstructive sleep apnea	352 (18.6)	142 (18.8)	210 (18.4)

See table footnotes on the next page.

[¶¶] https://www.who.int/publications/i/item/WHO-2019-nCoV-vaccine_effectiveness-measurement-2021.1

[***] Additional factors were included if they changed the aOR by ≥5% when added individually to the base model.

[†††] https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/fully-vaccinated-people.html

[§§§] Included HIV/AIDS, malignancy, history of solid organ or stem cell transplant, or receipt of immunosuppressive therapy (systemic steroids, chemotherapy, or other immunosuppressive therapy) within 1 month of SARS-CoV-2 test.

[¶¶¶] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

[****] Included 103 veterans with missing demographic data, vaccination date, or product information; 260 who received only 1 dose of mRNA COVID-19 vaccine or 2 doses <14 days before the qualifying SARS-CoV-2 test; three who received mixed mRNA COVID-19 vaccine products; 61 who received the Janssen (Johnson & Johnson) COVID-19 vaccine; and six fully vaccinated persons who received a third vaccine dose.

25 (9.7%) control specimens with anti-nucleocapsid antibodies, the analysis included 90 (38.5%) controls fully vaccinated with the Moderna vaccine (median age = 72 years; median interval from second dose to serum collection = 75 days; 24 [26.7%] with an immunocompromising condition) and 144 (61.5%) who were fully vaccinated with the Pfizer-BioNTech vaccine (median age = 73 years; median interval from second dose to serum collection = 102 days; 38 [26.4%] with an immunocompromising condition). Among fully vaccinated Moderna controls, anti-spike IgG levels were higher among persons with sera collected 14–119 days after the second vaccine dose

TABLE 1. (*Continued*) Characteristics of COVID-19 case-patients and controls* among hospitalized veterans — five Veterans Affairs medical centers, United States, February 1–September 30, 2021

Characteristic	No. (%) Total N = 1,896	Case-patients n = 755	Controls n = 1,141
Neurologic			
Dementia	111 (5.9)	39 (5.2)	72 (6.3)
Stroke or transient ischemic attack	188 (9.9)	60 (7.9)	128 (11.2)
Renal			
Chronic kidney disease	372 (19.6)	122 (16.2)	250 (21.9)
End stage renal disease, on dialysis	82 (4.3)	19 (2.5)	63 (5.5)
Liver			
Liver disease	165 (8.7)	50 (6.6)	115 (10.1)
Immunocompromising condition			
Immunocompromise or therapy¶¶	275 (14.9)	64 (9.0)	211 (18.8)
Tobacco use* **			
Current	347 (18.3)	91 (12.1)	256 (22.4)
Former	559 (29.5)	170 (22.5)	389 (34.1)
No. of hospitalizations during past year (unknown = 45)			
0	1,138 (61.5)	534 (72.7)	604 (54.1)
1	364 (19.7)	120 (16.3)	244 (21.9)
≥2	349 (18.9)	81 (11.0)	268 (24.0)
Outcome			
Intensive care unit admission (unknown = 10)	392 (20.7)	179 (23.8)	213 (18.7)
Death (unknown = 12)	108 (5.7)	64 (8.6)	44 (3.9)

Abbreviations: COPD = chronic obstructive pulmonary disease; VAMC = Veterans Affairs medical center.

* Case-patients were defined as patients with COVID-19–like illness (i.e., presence of fever, new or worsened cough or shortness of breath, loss of taste or smell, oxygen saturation on room air <94%, requirement for noninvasive ventilation or endotracheal intubation with mechanical ventilation, or chest radiograph or computed tomography pulmonary findings consistent with pneumonia) who tested positive for SARS-CoV-2 by nucleic acid amplification test performed within 14 days before admission or during the first 72 hours of hospitalization. Controls were defined as patients with COVID-19–like illness and negative SARS-CoV-2 test results during the same period.

† Included non-Hispanic American Indian and Alaska Native, non-Hispanic Asian and Other Pacific Islander, non-Hispanic multiple races, or non-Hispanic Other race.

§ Included residence before admission to VAMC and non-VAMC nursing facilities as well as other VAMC long-term housing (e.g., domiciliary).

¶ The Bronx is a borough in New York City.

** COVID-19 vaccination status includes unvaccinated, defined as no receipt of any SARS-CoV-2 vaccine, and fully vaccinated, defined as receipt of both doses of an mRNA (Pfizer-BioNTech or Moderna) ≥14 days before the first SARS-CoV-2 test performed within 14 days before admission or during the first 72 hours of hospitalization.

†† Included coronary artery disease, myocardial infarction, peripheral vascular disease, carotid artery stenosis.

§§ Body mass index ≥30 kg/m^2.

¶¶ Included HIV/AIDS, malignancy, history of solid organ or stem cell transplant, or immunosuppressive therapy (systemic steroids, chemotherapy, or other immunosuppressive therapy within 1 month of SARS-CoV-2 test).

*** Tobacco use was defined as smoking of cigarettes, cigars, or pipes. Current use of tobacco was defined as use within the previous 12 months of hospitalization, whereas former use occurred >12 months before hospitalization.

TABLE 2. Characteristics of case-patients and controls and adjusted effectiveness* of full vaccination† with mRNA COVID-19 vaccines against COVID-19–associated hospitalization among veterans — five Veterans Affairs medical centers,§ United States, February 1–September 30, 2021

Characteristic	No./Total no. (%) Case-patients vaccinated/total	Controls vaccinated/total	Adjusted VE % (95% CI)
Overall	**161/755 (21.3)**	**638/1,141 (55.9)**	**83.7 (78.8–87.5)**
Age group, yrs			
18–64			
Pfizer-BioNTech and Moderna vaccine products	33/404 (8.2)	164/388 (42.3)	92.2 (87.4–95.2)
Pfizer-BioNTech	23/404 (5.7)	86/388 (22.2)	89.4 (80.9–94.1)
Moderna	10/404 (2.5)	78/388 (20.1)	94.5 (88.4–97.4)
≥65			
Pfizer-BioNTech and Moderna vaccine products	128/351 (36.5)	474/753 (62.9)	75.6 (66.2–82.4)
Pfizer-BioNTech	95/351 (27.1)	317/753 (42.1)	72.9 (61.1–81.2)
Moderna	33/351 (9.4)	157/753 (20.8)	78.6 (64.9–86.9)
COVID-19 vaccine product†			
Pfizer-BioNTech			
All periods since vaccination¶	118/755 (15.6)	403/1,141 (35.3)	79.8 (72.7–85.1)
14–119 days	26/755 (3.4)	200/1,141 (17.5)	86.0 (77.6–91.3)
≥120 days	92/755 (12.2)	203/1,141 (17.8)	75.1 (64.6–82.4)
Moderna			
All periods since vaccination¶	43/755 (5.7)	235/1,141 (20.6)	87.0 (80.7–91.2)
14–119 days	12/755 (1.6)	119/1,141 (10.4)	89.6 (80.1–94.5)
≥120 days	31/755 (4.1)	116/1,141 (10.2)	86.1 (77.7–91.3)
No. of days since vaccination, age group			
14–119 days			
≥18 yrs	38/755 (5.0)	319/1,141 (28.0)	87.8 (81.8–91.7)
18–64 yrs	8/404 (2.0)	89/388 (22.9)	95.1 (89.1–97.8)
≥65 yrs	30/351 (8.5)	230/753 (30.5)	81.2 (69.9–88.2)
≥120 days			
≥18 yrs	123/755 (16.3)	319/1,141 (28.0)	80.0 (72.7–85.4)
18–64 yrs	25/404 (6.2)	75/388 (19.3)	89.2 (80.8–93.9)
≥65 yrs	98/351 (27.9)	237/753 (31.5)	72.9 (60.0–81.7)

Abbreviation: VE = vaccine effectiveness.

* All nonstratified models adjusted for study site, time (admission date), age, sex, and race/ethnicity. Stratified models exclude adjustment for stratification variable.

† Includes unvaccinated, defined as no receipt of any SARS-CoV-2 vaccine, and fully vaccinated, defined as receipt of both doses of an mRNA (Pfizer-BioNTech or Moderna) ≥14 days before the first SARS-CoV-2 test performed within 14 days before admission or during the first 72 hours of hospitalization.

§ The five Veterans Affairs medical centers are located in Atlanta, Georgia; the New York City borough of the Bronx; Houston, Texas; Los Angeles, California; and Palo Alto, California.

¶ Among fully vaccinated, time since second dose of COVID-19 mRNA vaccine.

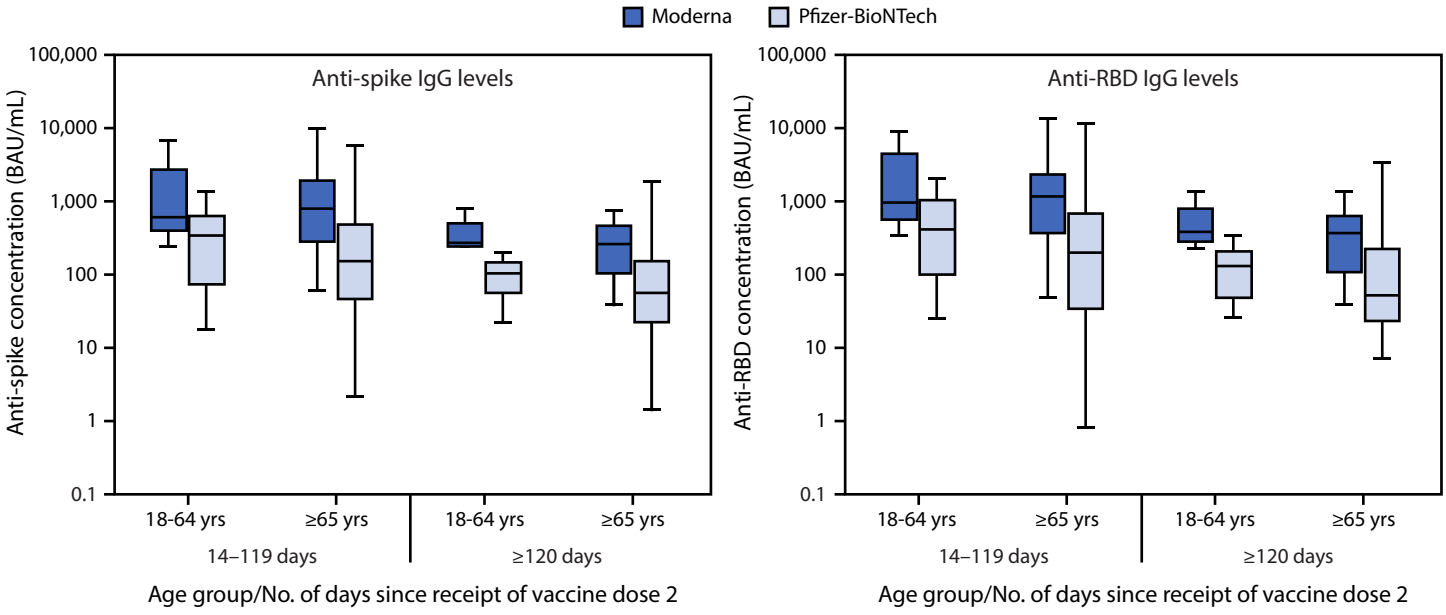
(median = 759 BAU/mL; IQR = 348–2,086 BAU/mL) compared with ≥120 days (median = 266 BAU/mL; IQR = 133–441 BAU/mL) (p = 0.002) (Figure). Anti-spike IgG levels were also higher among fully vaccinated Pfizer-BioNTech controls at 14–119 days after receipt of dose 2 (median = 187 BAU/mL; IQR = 50–493 BAU/mL) than at ≥120 days (median = 62 BAU/mL; IQR = 25–141 BAU/mL) (p = 0.001). At 14–119 days after the second dose, anti-spike IgG levels were higher among controls fully vaccinated with the Moderna vaccine compared with those who received the Pfizer-BioNTech vaccine among persons aged 18–64 years (median = 612 versus 340; p = 0.018) and ≥65 years (median = 792 versus 152; p<0.001). At ≥120 days, anti-spike IgG levels were also higher among controls fully vaccinated with the Moderna vaccine compared with the Pfizer-BioNTech vaccine among persons aged 18–64 years (median = 267 versus 106; p = 0.006) and ≥65 years (median = 266 versus 57; p = 0.003). Relative differences in anti-RBD IgG levels across groups were similar to differences in anti-spike IgG levels (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/112104), and differences in anti-SARS-CoV-2 antibody levels were similar across groups with immunocompromised persons included or excluded from the analysis.

Discussion

Among U.S. veterans hospitalized at five VAMCs during February–September 2021, mRNA COVID-19 vaccines remained effective in preventing COVID-19–associated hospitalizations ≥120 days after receipt of the second dose of Moderna (VE = 86%) or Pfizer-BioNTech vaccines (VE = 75%). Among recipients of Moderna and Pfizer-BioNTech vaccines, anti-SARS-CoV-2 spike and RBD IgG levels declined with increasing time since vaccination, although U.S. veterans who received the Moderna vaccine consistently had higher antibody levels compared with recipients of the Pfizer-BioNTech vaccine across age groups and time since vaccination. These findings from a cohort of older, hospitalized veterans with high prevalences of underlying conditions suggest the importance of booster doses to help maintain long-term protection against severe COVID-19.

Although an immune correlate of protection for COVID-19 vaccination has yet to be established, studies have shown a relationship between binding antibody levels, neutralizing antibody levels, and vaccine efficacy in clinical trials (*5*, *6*). Pairing antibody levels from the same population in which COVID-19 VE is estimated can inform how changes in humoral immunity relate to real-world protection against

FIGURE. Serum anti-spike and anti-receptor binding domain immunoglobulin G levels* after full vaccination among hospitalized veterans without current or previous SARS-CoV-2 infection† — five Veterans Affairs medical centers,§ United States, February 1–September 30, 2021¶



Abbreviations: BAU = binding antibody units; IgG = immunoglobulin G; RBD = receptor binding domain.

* Anti-spike and anti-RBD IgG levels were measured in sera of hospitalized veterans collected at or within 2 days of hospital admission. In these box and whisker plots, the central horizontal line of each box plot represents the median, with the box denoting the IQR, and the whiskers representing 1.5 x IQR.

† Excluded 25 controls with anti-nucleocapsid antibodies (>11.8 BAU/mL), suggesting a previous SARS-CoV-2 infection.

§ The five Veterans Affairs medical centers are located in Atlanta, Georgia; the New York City borough of the Bronx; Houston, Texas; Los Angeles, California; and Palo Alto, California.

¶ Serum specimens collected during March 22–August 31, 2021.

Summary

What is already known about this topic?

mRNA COVID-19 vaccines are effective in preventing severe COVID-19. Some studies have shown declines in vaccine effectiveness against severe COVID-19 with increasing time since vaccination.

What is added by this report?

During February 1–September 30, 2021, mRNA vaccine effectiveness in preventing COVID-19–associated hospitalizations among U.S. veterans ≥120 days after receipt of the second dose was 86% for Moderna and 75% for Pfizer-BioNTech vaccines. Antibody responses to both vaccines decreased over time. Moderna vaccine recipients had higher antibody levels than did Pfizer-BioNTech recipients.

What are the implications for public health practice?

These findings from a cohort of older, hospitalized veterans with high prevalences of underlying conditions suggest the importance of booster doses to help maintain long-term protection against severe COVID-19.

COVID-19. Although this analysis was not powered to detect small differences in VE by mRNA product as seen in other hospitalized settings (*7*), significantly higher post-Moderna vaccination antibody levels compared with Pfizer-BioNTech were observed, which is consistent with findings from other studies (*7*,*8*). Potential reasons for this difference include higher antigen content and a longer interval between doses for the Moderna vaccine compared with the Pfizer-BioNTech vaccine (*8*). Overall, for both vaccine products, antibody levels in this cohort of older U.S. veterans with high prevalences of underlying medical conditions were substantially lower than levels seen among younger, healthy volunteers or health care personnel in other studies (*7*,*9*). Consistent with results from studies among younger, healthy persons, antibody levels appeared to wane over time but remained detectable ≥120 days after vaccination (*9*,*10*). Although not statistically significant, VE point estimates also declined between 14–119 days and ≥120 days from receipt of second vaccine dose.

The findings in this report are subject to at least four limitations. First, there was insufficient statistical power to detect potential small differences in VE by vaccine product or period since vaccination. Second, it was not possible to assess antibody levels or VE beyond 4 months since receipt of second vaccine dose. Third, residual clinical sera were only available from 41% of fully vaccinated controls. Finally, binding antibody levels are a surrogate correlate of protection against SARS-CoV-2 and other components of immunity, such as cell-mediated immune responses, were not measured.

Both mRNA COVID-19 vaccines that are approved by the Food and Drug Administration or authorized for use in the United States remain effective against COVID-19–associated hospitalization among U.S. veterans. Antibody levels in this cohort of older persons with high prevalences of underlying medical conditions were lower than those in younger, healthier populations and declined over time. Continued monitoring of the effectiveness of COVID-19 vaccines alongside anti-SARS-CoV-2 antibody levels is needed to better understand the duration of protection of these vaccines and the correlation of antibody levels with protection. These findings suggest the importance of booster doses to help maintain long-term protection against severe COVID-19.

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Surveillance Platform for Enteric and Respiratory Infectious Organisms at the VA (SUPERNOVA) COVID-19 Surveillance Group

Joy Burnette, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Gustavo Capo, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Lauren Epstein, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Julia Gallini, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Telisha Harrison, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Amy Hartley, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Liliana Hernandez, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Elena Morales, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Nina Patel, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Kim Rooney, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Tehquin Tanner, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Ernest Tate, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Ashley Tunson, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Alexis Whitmire, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Juton Winston, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; Katherine Elliot, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Ilda Graham, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Diki Lama, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Ismael Pena, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Adrienne Perea, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Guerry Anabelle Perez, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Johane Simelane, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Sarah Smith, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Gabriela Tallin, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Amelia Tisi, James J. Peters Veterans Affairs Medical Center, Bronx, New York; Alonso Arellano Lopez, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas; Miguel Covarrubias Gonzalez, Michael E. DeBakey Veterans

Affairs Medical Center, Houston, Texas; Bashir Lengi, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas; Mariana Vanoye Tamez, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas; Babak Aryanfar, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Ian Lee-Chang, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Anthony Matolek, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Aleksandra Poteshkina, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Saadia Naeem, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Evan Goldin, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; Madhuri Agrawal, Veterans Affairs Palo Alto Health Care System, Palo Alto, California; Jessica Lopez, Veterans Affairs Palo Alto Health Care System, Palo Alto, California; Theresa Peters, Veterans Affairs Palo Alto Health Care System, Palo Alto, California; Geliya Kudryavtseva, Veterans Affairs Palo Alto Health Care System, Palo Alto, California; Jordan Cates, CDC; Anita Kambhampati, CDC

Corresponding author: Kristina L. Bajema, kbajema@cdc.gov.

[1]CDC COVID-19 Response Team; [2]Karna, LLC, Atlanta, Georgia; [3]Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas; [4]Department of Medicine, Baylor College of Medicine, Houston, Texas; [5]Atlanta VA Medical Center, Atlanta, Georgia; [6]Department of Medicine, Emory University School of Medicine, Atlanta, Georgia; [7]Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia; [8]Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California; [9]Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, California; [10]Veterans Affairs Palo Alto Health Care System, Palo Alto, California; [11]Public Health Program Office, Department of Veterans Affairs, Washington, DC; [12]Department of Medicine, Stanford University, Stanford, California; [13]Department of Medicine, Icahn School of Medicine at Mount Sinai, New York, New York; [14]James J. Peters Veterans Affairs Medical Center, Bronx, New York, New York; [15]General Dynamics Information Technology, Falls Church, Virginia.

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References

1. Bajema KL, Dahl RM, Prill MM, et al.; SUPERNOVA COVID-19; Surveillance Group; Surveillance Platform for Enteric and Respiratory Infectious Organisms at the VA (SUPERNOVA) COVID-19 Surveillance Group. Effectiveness of COVID-19 mRNA vaccines against COVID-19–associated hospitalization—five Veterans Affairs Medical Centers, United States, February 1–August 6, 2021. MMWR Morb Mortal Wkly Rep 2021;70:1294–9. PMID:34529636 https://doi.org/10.15585/mmwr.mm7037e3
2. Tenforde MW, Self WH, Naioti EA, et al.; IVY Network Investigators; IVY Network. Sustained effectiveness of Pfizer-BioNTech and Moderna vaccines against COVID-19–associated hospitalizations among adults—United States, March–July 2021. MMWR Morb Mortal Wkly Rep 2021;70:1156–62. PMID:34437524 https://doi.org/10.15585/mmwr.mm7034e2
3. Meites E, Bajema KL, Kambhampati A, et al. Adapting the Surveillance Platform for Enteric and Respiratory Infectious Organisms at United States Veterans Affairs Medical Centers(SUPERNOVA) for COVID-19 among hospitalized adults: surveillance protocol. Front Public Health 2021;9:739076. PMID:34778173 https://doi.org/10.3389/fpubh.2021.739076
4. Jackson ML, Nelson JC. The test-negative design for estimating influenza vaccine effectiveness. Vaccine 2013;31:2165–8. PMID:23499601 https://doi.org/10.1016/j.vaccine.2013.02.053
5. Khoury DS, Cromer D, Reynaldi A, et al. Neutralizing antibody levels are highly predictive of immune protection from symptomatic SARS-CoV-2 infection. Nat Med 2021;27:1205–11. PMID:34002089 https://doi.org/10.1038/s41591-021-01377-8
6. Gilbert PB, Montefiori DC, McDermott A, et al. Immune correlates analysis of the mRNA-1273 COVID-19 vaccine efficacy trial. medRxiv [Preprint posted online August 15, 2021]. https://www.medrxiv.org/content/10.1101/2021.08.09.21261290v4
7. Self WH, Tenforde MW, Rhoads JP, et al.; IVY Network. Comparative effectiveness of Moderna, Pfizer-BioNTech, and Janssen (Johnson & Johnson) vaccines in preventing COVID-19 hospitalizations among adults without immunocompromising conditions—United States, March–August 2021. MMWR Morb Mortal Wkly Rep 2021;70:1337–43. PMID:34555004 https://doi.org/10.15585/mmwr.mm7038e1
8. Steensels D, Pierlet N, Penders J, Mesotten D, Heylen L. Comparison of SARS-CoV-2 antibody response following vaccination with BNT162b2 and mRNA-1272. JAMA 2021;326:1533–5. PMID:34459863 https://doi.org/10.1001/jama.2021.15125
9. Laing ED, Weiss CD, Samuels EC, et al. Durability of antibody responses and frequency of clinical and sub-clinical SARS-CoV-2 infection six months after BNT162b2 COVID-19 vaccination in healthcare workers. medRxiv [Preprint posted online October 18, 2021]. https://www.medrxiv.org/content/10.1101/2021.10.16.21265087v1
10. Doria-Rose N, Suthar MS, Makowski M, et al.; mRNA-1273 Study Group. Antibody persistence through 6 months after the second dose of mRNA-1273 vaccine for COVID-19. N Engl J Med 2021;384:2259–61. PMID:33822494 https://doi.org/10.1056/NEJMc2103916

Community-Based Testing Sites for SARS-CoV-2 — United States, March 2020–November 2021

Mark F. Miller, PhD[1,2]; Min Shi, PhD[1]; Alison Motsinger-Reif, PhD[1]; Clarice R. Weinberg, PhD[1]; Joseph D. Miller, PhD[3,4]; Erin Nichols, PhD[2,4,5]

Immediately following the March 13, 2020 declaration of COVID-19 as a national emergency (*1*), the U.S. government began implementing national testing programs for epidemiologic surveillance, monitoring of frontline workers and populations at higher risk for acquiring COVID-19, and identifying and allocating limited testing resources. Effective testing supports identification of COVID-19 cases; facilitates isolation, quarantine, and timely treatment measures that limit the spread of SARS-CoV-2 (the virus that causes COVID-19); and guides public health officials about the incidence of COVID-19 in a community. A White House Joint Task Force, co-led by the Department of Health and Human Services (HHS) and the Federal Emergency Management Agency (FEMA), created the Community-Based Testing Sites (CBTS) program working with state and local partners (*2*). This report describes the timeline, services delivered, and scope of the CBTS program. During March 19, 2020–April 11, 2021, the CBTS program conducted 11,661,923 SARS-CoV-2 tests at 8,319 locations across the United States and its territories, including 402,223 (3.5%) administered through Drive-Through Testing, 10,129,142 (86.9%) through Pharmacies+ Testing, and 1,130,558 (9.7%) through Surge Testing programs. Tests administered through the CBTS program yielded 1,176,959 (10.1%) positive results for SARS-CoV-2. Among tested persons with available race data,* positive test results were highest among American Indian or Alaska Native (14.1%) and Black persons (10.4%) and lowest among White persons (9.9%), Asian persons (7.3%), and Native Hawaiian or Other Pacific Islanders (6.4%). Among persons with reported ethnicity, 25.3% were Hispanic, 15.9% of whom received a positive test result. Overall, 82.0% of test results were returned within 2 days, but the percentage of test results returned within 2 days was as low as 40.7% in July 2020 and 59.3% in December 2020 during peak testing periods. Strong partnerships enabled a rapid coordinated response to establish the federally supported CBTS program to improve access to no-charge diagnostic testing, including for frontline workers, symptomatic persons and close contacts, and persons living in high-prevalence areas. In April 2021, the CBTS Pharmacies+ Testing and Surge Testing programs were expanded into the Increasing Community Access to Testing (ICATT) program. As of November 12, 2021, the CBTS and ICATT programs conducted approximately 26.6 million tests with approximately 10,000 active testing sites. Although the CBTS program represented a relatively small portion of overall U.S. SARS-CoV-2 testing, with its successful partnerships and adaptability, the CBTS program serves as a model to guide current community-based screening, surveillance, and disease control programs, and responses to future public health emergencies.

The CBTS program was created by a White House Joint Task Force, co-led by HHS and FEMA in March 2020 (*1*). The program comprised three distinct efforts to provide federally funded, no-charge testing: 1) Drive-Through Testing, in collaboration with state and local partners; 2) Pharmacies+ Testing, through a federal government collaboration with commercial partners, including retail pharmacies and other contract service providers; and 3) Surge Testing, for rapid surveillance of at-risk communities through increased testing capacity in support of state, tribal, local, and territorial health agencies. Individual testing sites provided predominantly nucleic acid amplification tests and were established with varying dates and durations of operation to meet the needs of the specific communities served.

Within 72 hours of its initiation on March 13, 2020, the CBTS Drive-Through Testing program developed a concept of operations for federally supported, state-managed, and locally executed testing facilities (*2*). Ultimately, 39 sites provided low transmission–risk testing, increased the availability of local resources, and provided access for at-risk populations.† State and local agencies provided facilities, staffing, public communications, and operational management. The federal government provided a Chief Medical Officer under whose medical license all SARS-CoV-2 medical testing was ordered and reported. In addition, the federal government provided supportive staffing in the form of U.S. Public Health Service officers with medical expertise, additional operational management and logistical distribution of testing supplies, and personal protective equipment. The federal government also contracted with the private sector to provide services, such as specimen transport, sample analysis, and communication of results. Positive test results were reported to state and local

* Information on race was collected separately from information on ethnicity, and the results for race are reported irrespective of ethnicity and vice versa.

† Sites included counties with higher social vulnerability as measured by the Social Vulnerability Index. Mean Social Vulnerability Index of 0.57, indicating 57% of counties in the nation are less vulnerable than the average of selected sites. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

health departments for follow-up contact tracing and local support services. Specimen collection began on March 19, 2020, and continued until operations were transferred to the state or until other local testing programs met community demand and the site was closed; all 39 locations were closed or transitioned to state and local programs by July 31, 2020.

With projections that substantial testing would be needed to track and control the spread of COVID-19, an expanded CBTS Pharmacies+ Testing program was launched on April 5, 2020, establishing partnerships with retail pharmacies and other providers leveraging their expansive networks to increase community-level testing access. Testing was provided at 7,708 locations nationwide at sites supported through HHS contracts and operated through collaborations between pharmacies and analytical laboratories. As the pandemic progressed, the CBTS Surge Testing program was established on July 7, 2020 and, through April 11, 2021, provided increased testing capacity in 658 communities where a sharp increase in COVID-19 incidence was occurring or predicted.

The number of testing locations, tests administered, and results (positive, negative, and indeterminate) were assessed for the Drive-Through Testing, Pharmacies+ Testing, and Surge Testing programs. The age, race and ethnicity, and symptom status of persons tested through these programs was also assessed. Because of variations in reporting across states, aggregate data on these variables were unavailable for persons tested in the CBTS Drive-Through Testing program; thus, these data were not included in analyses. Data for this analysis came from COVIDResponder,[§] a data platform supported by FEMA and HHS. This platform provided an interface for testing sites to submit results and a secure central data repository for site-level and aggregate data, site reports, and supply tracking, including interactive dashboards, to inform ongoing response decisions. Statistical testing was not performed because of the large number of tests conducted, which could result in statistically significant differences in the absence of clinical significance. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.[¶]

During March 19, 2020–April 11, 2021, the CBTS program conducted 11,661,923 SARS-CoV-2 tests at 8,319 locations across the United States and its territories. The program included 402,223 (3.5%) tests administered through Drive-Through Testing, 10,129,142 (86.9%) through Pharmacies+ Testing, and 1,130,558 (9.7%) through Surge Testing. Tests administered through all CBTS programs yielded 1,176,959 (10.1%) positive results, 10,430,749 (89.4%) negative results, and 54,215 (0.5%) indeterminate results, including 59,195 (14.7%) positive results, 337,255 (83.9%) negative results, and 5,773 (1.4%) indeterminate results from the CBTS Drive-Through Testing program.

Among persons tested through the Pharmacies+ Testing and Surge Testing programs, 67.8% were adults aged 20–54 years, and 42.3% were symptomatic (Table 1). Among 9,396,284 (83.5%) tested persons for whom race was reported, 54.3% were White persons (9.9% of whom received positive test results), 11.6% were Black persons (10.4% positive), 6.6% were Asian persons (7.3% positive), 0.5% were American Indian or Alaska Native persons (14.1% positive), 0.9% were Native Hawaiian or Other Pacific Islanders (6.4% positive), and 27.5% were other races (9.8% positive). Among 6,121,887 (54.4%) tested persons with reported ethnicity, 25.3% were Hispanic, 15.9% of whom received a positive test result. Overall, the highest percentage of positive test results was among persons aged <20 years and 45–54 years (10.7%) and among persons aged ≥85 years (11.5%). The percentage of positive test results was higher among males (10.8%) than among females (9.2%).

Among symptomatic and asymptomatic community members seeking testing, 17.1% and 5.1%, respectively, received a positive result (Table 2). Among asymptomatic persons, the highest percentages of positive test results were among those aged ≥85 years (7.4%) and <20 years (6.3%) (Table 2). Overall, 82.0% of test results were returned within 2 days (time from sample collection to result reported), with declines to 40.7% in July 2020 and 59.3% in December 2020, corresponding to the first and second peaks in national testing volume and cases (Figure). The percentage of test results returned within 2 days was approximately the same for the Pharmacies+ Testing (82.5%) and Surge Testing (80.7%) programs, though the percentage was lower for Surge Testing through September, 2020. The percentage of CBTS program tests with positive results increased in parallel with increases seen in reported cases nationwide (Supplementary Figure, https://stacks.cdc.gov/view/cdc/111229).

Discussion

During March 19, 2020–April 11, 2021, the CBTS program conducted 11,661,923 no-charge SARS-CoV-2 tests (approximately 3% of the national testing volume during the same period) at 8,319 locations across the United States and its territories, providing a model for geographically diverse, national, community-centered testing facilities in response to an infectious disease outbreak. Analyses suggest that both symptomatic and asymptomatic persons across a broad distribution of age, race and ethnicity, and sex categories accessed testing through the CBTS program. Results were consistent with other reports showing higher percentages of positive

[§] Decommissioned September 30, 2021.

[¶] 45 C.F.R. part 46.102(l)(2); 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

test results among Black, Hispanic, and American Indian or Alaska Native populations (*3*,*4*). Through the combined efforts of federal, state, local, and territorial responders, industry experts, medical suppliers, and service providers, the CBTS program helped meet the diagnostic demands created by an unprecedented public health emergency. Partnerships leveraged across government and the private sector facilitated national reach in a short timeframe.

In April 2021, the CBTS Pharmacies+ Testing and Surge Testing programs were expanded into the ICATT program under the HHS Testing and Diagnostics Work Group (*5*). In the early stages of the pandemic, testing data from CBTS were

TABLE 1. Demographic characteristics of persons receiving SARS-CoV-2 testing, by positive test result and symptom status — Community-Based Testing Sites program, United States, March 2020–September 2021

	Pharmacies+ Testing sites			Surge Testing sites			Combined sites		
		No./total no. (%)			No./total no. (%)			No./total no. (%)	
Characteristic	No. (%)*	Positive test results†	Symptomatic§	No. (%)*	Positive test results†	Symptomatic§	No. (%)*	Positive test results†	Symptomatic§
Total	**10,129,142 (100)**	**1,039,495/10,084,450 (10.3)**	**3,441,713/7,857,366 (43.8)**	**1,130,558 (100)**	**78,269/1,126,808 (6.9)**	**304,316/1,006,749 (30.2)**	**11,259,700 (100)**	**1,117,764/11,211,258 (10.0)**	**3,746,029/8,864,115 (42.3)**
Race,¶ irrespective of ethnicity									
White	4,394,142 (43.4)	452,277/4,382,208 (10.3)	1,722,676/3,829,514 (45.0)	710,707 (62.9)	49,503/709,025 (7.0)	208,484/646,484 (32.3)	5,104,849 (45.3)	501,780/5,091,233 (9.9)	1,931,160/4,475,998 (43.1)
AI/AN	49,030 (0.5)	6,880/48,838 (14.1)	21,807/42,858 (50.9)	0 (—)	0 (—)	0 (—)	49,030 (0.4)	6,880/48,838 (14.1)	21,807/42,858 (50.9)
Asian	534,095 (5.3)	42,426/532,584 (8.0)	175,596/451,399 (39.0)	86,885 (7.7)	2,702/86,725 (3.1)	16,035/83,945 (19.1)	620,980 (5.5)	45,128/619,309 (7.3)	191,631/535,344 (35.8)
Black	959,567 (9.5)	105,435/956,309 (11.1)	348,210/780,820 (44.6)	136,348 (12.1)	7,620/135,732 (5.6)	29,904/106,511 (28.1)	1,095,915 (9.7)	113,055/1,092,041 (10.4)	378,114/887,331 (42.6)
NH/OPI	63,209 (0.6)	4,947/63,042 (7.9)	19,790/57,483 (34.4)	19,748 (1.8)	380/19,741 (1.9)	2,936/19,468 (15.1)	82,957 (0.7)	5,327/82,783 (6.4)	22,726/76,951 (29.5)
Other	2,345,069 (23.2)	226,120/2,324,965 (9.7)	801,445/1,835,589 (43.7)	97,484 (8.6)	11,068/96,808 (11.4)	30,126/81,923 (36.8)	2,442,553 (21.7)	237,188/2,421,773 (9.8)	831,571/1,917,512 (43.4)
NR	1,784,030 (17.6)	201,410/1,776,504 (11.3)	352,189/859,703 (41.0)	79,386 (7.0)	6,996/78,777 (8.9)	16,831/68,418 (24.6)	1,863,416 (16.6)	208,406/1,855,281 (11.2)	369,020/928,121 (39.8)
Ethnicity,¶ irrespective of race									
Hispanic	1,325,263 (13.1)	217,404/1,319,638 (16.5)	508,835/1,013,936 (50.2)	223,335 (19.8)	28,059/221,348 (12.7)	69,280/176,940 (39.2)	1,548,598 (13.8)	245,463/1,540,986 (15.9)	578,115/1,190,876 (48.6)
Non-Hispanic	3,991,221 (39.4)	394,131/3,979,848 (9.9)	1,516,108/3,425,792 (44.3)	582,068 (51.5)	31,998/581,008 (5.5)	158,274/536,526 (29.5)	4,573,289 (40.6)	426,129/4,560,856 (9.3)	1,674,382/3,962,318 (42.3)
NR	4,812,658 (47.5)	427,960/4,784,964 (8.9)	1,416,770/3,417,638 (41.5)	325,155 (28.8)	18,212/324,452 (5.6)	76,762/293,283 (26.17)	5,137,813 (45.6)	446,172/5,109,416 (8.7)	1,493,532/3,710,921 (40.3)
Age group, yrs									
<20	1,039,254 (10.3)	117,084/1,034,942 (11.3)	340,168/902,962 (37.7)	193,073 (17.1)	13,691/192,465 (7.1)	45,341/176,020 (25.8)	1,232,327 (10.9)	130,775/1,227,407 (10.7)	385,509/1,078,982 (35.7)
20–44	5,561,506 (54.9)	564,088/5,538,423 1(0.2)	2,044,632/4,313,280 (47.4)	536,519 (47.5)	38,165/534,790 (7.1)	163,547/481,332 (34.0)	6,098,025 (54.2)	602,253/6,073,213 (9.9)	2,208,179/4,794,612 (46.1)
45–54	1,388,279 (13.7)	151,829/1,382,595 (11.0)	465,781/1,044,003 (44.6)	150,816 (13.3)	11,978/150,192 (8.0)	43,511/130,600 (33.3)	1,539,095 (13.7)	163,807/1,532,787 (10.7)	509,292/1,174,603 (43.4)
55–64	1,240,657 (12.3)	121,718/1,235,830 (9.9)	378,804/933,555 (40.6)	141,644 (12.5)	9,176/141,217 (6.5)	33,959/123,988 (27.4)	1,382,301 (12.3)	130,894/1,377,047 (9.5)	412,763/1,057,543 (39.0)
65–74	614,020 (6.1)	51,364/611,626 (8.4)	160,412/453,740 (35.4)	80,014 (7.1)	3,858/79,756 (4.8)	14,122/69,919 (20.2)	694,034 (6.2)	55,222/691,382 (8.0)	174,534/523,659 (33.3)
75–84	159,570 (1.6)	15,617/158,931 (9.8)	40,304/116,406 (34.6)	23,928 (2.1)	1,114/23,844 (4.7)	3,252/20,861 (15.6)	183,498 (1.6)	16,731/182,775 (9.2)	43,556/137,267 (31.7)
≥85	28,928 (0.3)	3,529/28,789 (12.3)	7,093/21,153 (33.5)	4,564 (0.4)	287/4,544 (6.3)	584/4,029 (14.5)	33,492 (0.3)	3,816/33,333 (11.5)	7,677/25,182 (30.5)
NR	86,926 (0.9)	9,558/85,959 (11.1)	4,519/72,267 (6.3)	193,073 (17.1)	13,691/192,465 (7.1)	0 (—)	96,928 (0.9)	14,266/93,314 (15.3)	4,519/72,267 (6.3)
Gender									
Male	4,387,423 (43.3)	488,500/4,368,196 (11.2)	1,463,152/3,463,678 (42.2)	502,376 (44.4)	38,122/500,619 (7.6)	129,437/448,448 (28.9)	4,889,799 (43.4)	526,622/4,868,815 (10.8)	1,592,589/3,912,126 (40.7)
Female	5,553,635 (54.8)	528,193/5,531,368 (9.6)	1,972,138/4,373,187 (45.1)	627,993 (55.6)	40,146/626,001 (6.4)	174,841/558,112 (31.3)	6,181,628 (54.9)	568,339/6,157,369 (9.2)	2,146,979/4,931,299 (43.5)
Other	5,020 (0.1)	318/4,992 (6.4)	1,744/3,130 (55.7)	0 (—)	0 (—)	0 (—)	5,020 (0.0)	318/4,992 (6.4)	1,744/3,130 (55.7)
NR	183,064 (1.8)	22,484/179,894 (12.5)	4,679/17,371 (26.9)	189 (0.0)	1/188 (0.5)	38/189 (20.1)	183,253 (1.6)	22,485/180,082 (12.5)	4,717/17,560 (26.9)

Abbreviations: AI/AN = American Indian or Alaska Native; NH/OPI = Native Hawaiian or Other Pacific Islander; NR = not reported.

* Percentage of the total and the number of tested persons is shown.

† Percentage of tests with positive results. The two numbers are the number of tests with positive results and the total number of tested persons with known test results.

§ Percentage of tested persons who were symptomatic at testing. The two numbers are the number of persons symptomatic at testing and the total number of tested persons with known symptom status.

¶ Race and ethnicity percentages calculated among the total tested population, including those who did not report race or ethnicity. Data reported in the text do not include those who did not report race or ethnicity.

informative for the tracking of COVID-19 cases and designing continuing response efforts, including the subsequent ICATT program. With funding from the American Rescue Plan, the ICATT program supported school openings and scaled to reach new populations, including testing at crowded public events and for unaccompanied migrating children. As of November 12, 2021, the CBTS and ICATT programs have conducted approximately 26.6 million tests with approximately

TABLE 2. Positive SARS-CoV-2 test result rates by symptom status — Community-Based Testing Sites program, United States, March 2020–September 2021

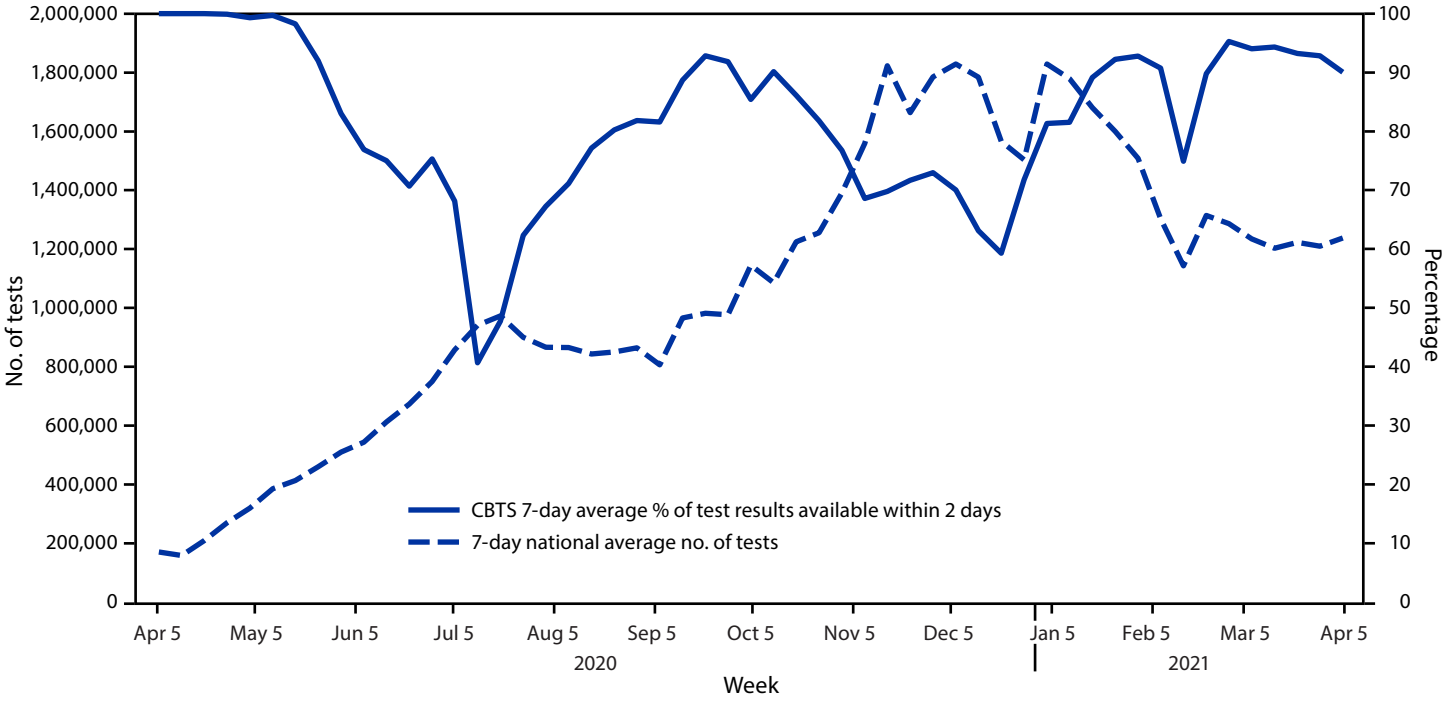
	Positive test results, no./total no. (%)					
	Pharmacies+ Testing sites		Surge Testing sites		Combined sites	
Characteristic	Symptomatic*	Asymptomatic†	Symptomatic*	Asymptomatic†	Symptomatic*	Asymptomatic†
Total	**590,770/3,427,392 (17.2)**	**239,240/4,399,816 (5.4)**	**47,069/302,876 (15.5)**	**20,244/700,340 (2.9)**	**637,839/3,730,268 (17.1)**	**259,484/5,100,156 (5.1)**
Race, irrespective of ethnicity						
White	298,851/1,718,578 (17.4)	100,632/2,101,800 (4.8)	31,942/207,761 (15.4)	11,711/437,111 (2.7)	330,793/1,926,339 (17.2)	112,343/2,538,911 (4.4)
AI/AN	4,413/21,730 (20.3)	1,558/20,977 (7.4)	0 (—)	0 (—)	4,413/21,730 (20.3)	1,558/20,977 (7.4)
Asian	24,516/175,116 (14)	10,683/275,136 (3.9)	1,757/15,960 (11.0)	799/67,829 (1.2)	26,273/191,076 (13.8)	11,482/342,965 (3.3)
Black	58,542/347,202 (16.9)	28,935/431,240 (6.7)	3,638/29,724 (12.2)	2,190/76,234 (2.9)	62,180/376,926 (16.5)	31,125/507,474 (6.1)
NH/OPI	2,923/19,738 (14.8)	1,379/37,622 (3.7)	211/2,934 (7.2)	146/16,527 (0.9)	3,134/22,672 (13.8)	1,525/54,149 (2.8)
Other	131,547/794,084 (16.6)	60,672/1,027,219 (5.9)	6,378/29,828 (21.4)	2,737/51,446 (5.3)	137,925/823,912 (16.7)	63,409/1,078,665 (5.9)
NR	69,978/350,944 (19.9)	35,381/505,822 (7.0)	3,143/16,669 (18.9)	2661/51,193 (5.2)	73,121/367,613 (19.9)	38,042/557,015 (6.8)
Ethnicity, irrespective of race						
Hispanic	109,464/506,898 (21.6)	49,634/503,179 (9.9)	15,183/68,403 (22.2)	6,659/106,648 (6.2)	124,647/575,301 (21.7)	56,293/609,827 (9.2)
Non-Hispanic	251,337/1,512,103 (16.6)	90,129/1,904,812 (4.73)	21,156/157,890 (13.4)	8,124/377,630 (2.2)	272,493/1,669,993 (16.3)	98,253/2,282,442 (4.3)
NR	229,969/1,408,391 (16.3)	99,477/1,991,825 (5.0)	10,730/76,583 (14.0)	5,461/216,062 (2.5)	240,699/1,484,974 (16.2)	104938/2207887 (4.8)
Age group, yrs						
<20	62,339/338,838 (18.4)	38,434/560,867 (6.9)	7,027/45,144 (15.6)	4,867/130,285 (3.7)	69,366/383,982 (18.1)	43,301/691,152 (6.3)
20–44	331,541/2,035,992 (16.3)	113,650/2,260,735 (5.0)	24,502/162,785 (15.1)	8,301/316,899 (2.6)	356,043/2,198,777 (16.2)	121,951/2,577,634 (4.7)
45–54	88,211/463,816 (19.0)	31637/576,214 (5.5)	7,368/43,268 (17.0)	2,793/86,754 (3.2)	95,579/507,084 (18.9)	34,430/662,968 (5.2)
55–64	69,808/377,323 (18.5)	28,141/552,925 (5.1)	5,478/33,817 (16.2)	2,466/89,786 (2.8)	75,286/411,140 (18.3)	30,607/642,711 (4.8)
65–74	28,465/159,780 (17.8)	13,593/292,316 (4.7)	2,041/14,045 (14.5)	1,270/55,637 (2.3)	30,506/173,825 (17.6)	14,863/347,953 (4.3)
75–84	8,138/40,136 (20.3)	4,580/75,830 (6.0)	533/3,236 (16.5)	410/17,550 (2.3)	8,671/43,372 (19.99)	4,990/93,380 (5.3)
≥85	1,706/7,052 (24.2)	1,160/14,002 (8.3)	101/511/512 (20.7)	137/3,429 (4)	1,826/7,633 (23.9)	1,297/17,431 (7.4)
NR	562/4,455 (12.6)	8,045/66,927 (12.0)	0 (—)	4,867/130,285 (3.7)	562/4,455 (12.6)	8,045/66,927 (12.0)
Gender						
Male	280,689/1,456,776 (19.3)	117,839/1,992,996 (5.9)	22,711/128,786 (17.6)	10,430/318,005 (3.3)	303,400/1,585,562 (19.1)	128,269/2,311,001 (5.6)
Female	309,428/1,964,274 (15.8)	120,630/2,393,080 (5.0)	24,357/174,053 (14.0)	9,814/382,184 (2.6)	333,785/2,138,327 (15.6)	130,444/2,775,264 (4.7)
Other	191/1,731 (11.03)	66/1,377 (4.79)	0 (—)	0 (—)	191/1,731 (11.03)	66/1,377 (4.79)
NR	462/4,611 (10.02)	705/12,363 (5.7)	1/37 (2.7)	0/151 (0)	463/4,648 (9.96)	705/12,514 (5.63)

Abbreviations: AI/AN = American Indian or Alaska Native; NH/OPI = Native Hawaiian or Other Pacific Islander; NR = not reported.

* Positive rate among tested persons who were symptomatic at testing. The two numbers are the number of persons testing positive among those who were symptomatic at testing and the total number of persons who were symptomatic at testing.

† Positive rate among tested persons who were asymptomatic at testing. The two numbers are the number of persons testing positive among those who were asymptomatic at testing and the total number of persons who were asymptomatic at testing.

FIGURE. Average number of SARS-CoV-2 tests nationwide and percentage of SARS-CoV-2 tests available within 2 days from the Community-Based Testing Sites Pharmacies+ Testing and Surge Testing programs, by week — United States, April 5, 2020–April 5 2021



Abbreviation: CBTS = community-based testing sites.

10,000 active testing sites. The ICATT program has expanded the reach of its testing through specimen pooling (enhancing efficiency by batching multiple samples for a single test), incentives, mobile pharmacy sites, and point-of-care and self-testing. The program has also contributed to whole genome sequencing of viral isolates and begun linking ICATT program data to self-reported immunization status to identify infections in vaccinated persons. The ICATT program is supported by the HHS Protect platform, integrating approximately 200 separate COVID-19 data sources from federal, state, and local governments, along with data from health care industry partners and nongovernmental organizations.**

Various innovations have been implemented throughout the CBTS program to improve patient safety, conserve testing resources, and expand the program's reach. For example, a shift from nasopharyngeal swabbing by a medical provider to anterior nares self-swabbing enabled less invasive sample collection, reduced patient-provider contact, conserved personal protective equipment, and eliminated the need for powered air-purifying respirators. Other innovations included the provision of walk-up testing pods in urban areas, video-observed swabbing to reduce patient-provider contact, and mobile teams providing testing at long-term care facilities, essential industry locations, and in underresourced neighborhoods.

The collaborative approach to aligning resources and technical capabilities across partnerships, virtual platforms, and integrated data systems enhanced the success of the CBTS program. Like many SARS-CoV-2 testing operations, the CBTS program experienced periodic, extended turnaround times for receiving results during peak periods of the pandemic (*6*). Delays sometimes extended beyond 10 days, which limits the value of testing in mitigating onward transmission and for supporting persons in their considerations of COVID-19–associated exposure risk (*7*). Considering the high positivity rates among racial and ethnic minorities, use of well constructed vulnerability indices could improve the reach of community-based testing and provide an opportunity to leverage resources in communities most at risk; for example, the Pandemic Vulnerability Index uses county-level data to build local COVID-19 vulnerability measures (*8*).

The findings in this report are subject to at least two limitations. First, persons tested were self-selected from local communities during a period of shifting guidance about who should seek testing; the fact that persons were not randomly selected for testing limits the ability to extrapolate the findings of this report. Finally, age and race and ethnicity data were not

** https://protect-public.hhs.gov

Summary

What is already known about this topic?

Strong partnerships enable rapid, coordinated responses that support underresourced communities during public health emergencies.

What is added by this report?

During March 19, 2020–April 11, 2021, the Community-Based Testing Sites (CBTS) program conducted 11,661,923 SARS-CoV-2 tests at 8,319 locations across the United States and its territories, including 3% administered through Drive-Through Testing, 87% through Pharmacies+ Testing, and 10% through Surge Testing.

What are the implications for public health practice?

The CBTS program demonstrated the value of successful partnerships and collaboration for providing testing services that are responsive to local community needs. These lessons can guide current community-based screening, surveillance, and disease control programs and responses to future public health emergencies.

collected from all persons being tested, and reasons for test seeking were not ascertained.

This report highlights the value of community-based testing programs in improving access for diagnostic testing, including for symptomatic persons. Lessons learned through administering CBTS and ICATT programs demonstrate the value of cross-sector partnerships and collaboration in aligning resources and technical capabilities for providing testing services that are responsive to local community needs. Efforts should continue to improve the reach of community-based testing in communities most at risk. Although these programs provided a relatively small portion of the overall U.S. SARS-CoV-2 testing needed, their broad geographic reach, successful partnerships, and adaptability serve as a model that can inform current community-based screening, surveillance, and disease control programs and responses to future public health emergencies.

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Corresponding Author: Mark F. Miller, mark.miller2@nih.gov.

[1]National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina; [2]U.S. Public Health Service; [3]National Center for Emerging and Zoonotic Infectious Diseases, CDC; [4]CDC COVID-19 Response Team; [5]National Center for Health Statistics, CDC.

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References

1. Office of the President of the United States. Proclamation on declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak, March 13, 2020. Washington, DC: Office of the President of the United States; 2020. https://trumpwhitehouse.archives.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/
2. Office of the President of the United States. Remarks by President Trump, Vice President Pence, and members of the coronavirus task force in press briefing, March 15, 2020. Washington, DC: Office of the President of the United States; 2020. https://trumpwhitehouse.archives.gov/briefings-statements/remarks-president-trump-vice-president-pence-members-coronavirus-task-force-press-briefing-2/
3. Kaufman HW, Niles JK, Nash DB. Disparities in SARS-CoV-2 positivity rates: associations with race and ethnicity. Popul Health Manag 2021;24:20–6. PMID:32985959 https://doi.org/10.1089/pop.2020.0163
4. Hatcher SM, Agnew-Brune C, Anderson M, et al. COVID-19 among American Indian and Alaska Native persons—23 states, January 31–July 3, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1166–9. PMID:32853193 https://doi.org/10.15585/mmwr.mm6934e1
5. US Department of Health and Human Services. HHS continues Community Based Testing Sites for COVID-19 [Press release]. Washington, DC: US Department of Health and Human Services; 2021. https://www.hhs.gov/about/news/2021/01/07/hhs-continues-community-based-testing-sites-covid-19.html
6. Mervosh S, Fernandez M. 'It's like having no testing': coronavirus test results are still delayed. The New York Times. August 4, 2020. Updated September 29, 2021. https://www.nytimes.com/2020/08/04/us/virus-testing-delays.html
7. Kretzschmar ME, Rozhnova G, Bootsma MCJ, van Boven M, van de Wijgert JHHM, Bonten MJM. Impact of delays on effectiveness of contact tracing strategies for COVID-19: a modelling study. Lancet Public Health 2020;5:e452–9. PMID:32682487 https://doi.org/10.1016/S2468-2667(20)30157-2
8. Marvel SW, House JS, Wheeler M, et al. The COVID-19 Pandemic Vulnerability Index (PVI) Dashboard: monitoring county-level vulnerability using visualization, statistical modeling, and machine learning. Environ Health Perspect 2021;129:17701. PMID:33400596 https://doi.org/10.1289/EHP8690

Influenza A(H3N2) Outbreak on a University Campus — Michigan, October–November 2021

Miranda J. Delahoy, PhD[1,2]; Lindsey Mortenson, MD[3]; Laura Bauman, MPH[4]; Juan Marquez, MD[4]; Natasha Bagdasarian, MD[5]; Joseph Coyle, MPH[5]; Kelsey Sumner, PhD[1,2]; Nathaniel M. Lewis, PhD[2]; Adam S. Lauring, MD, PhD[6]; Brendan Flannery, PhD[2]; Manish M. Patel, MD[2]; Emily T. Martin, PhD[7]

On December 3, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

On November 10, 2021, the Michigan Department of Health and Human Services (MDHHS) was notified of a rapid increase in influenza A(H3N2) cases by the University Health Service (UHS) at the University of Michigan in Ann Arbor. Because this outbreak represented some of the first substantial influenza activity during the COVID-19 pandemic, CDC, in collaboration with the university, MDHHS, and local partners conducted an investigation to characterize and help control the outbreak. Beginning August 1, 2021, persons with COVID-19–like* or influenza-like illness evaluated at UHS received testing for SARS-CoV-2, influenza, and respiratory syncytial viruses by rapid multiplex molecular assay.† During October 6–November 19, a total of 745 laboratory-confirmed influenza cases were identified.§ Demographic information, genetic characterization of viruses, and influenza vaccination history data were reviewed. This activity was conducted consistent with applicable federal law and CDC policy.¶

During October 6–November 19, among 3,121 persons tested, 745 (23.9%) received a virus test result that was positive for influenza A, 137 (4.4%) for SARS-CoV-2, and 84 (2.7%) for respiratory syncytial virus. Overall, >95% of influenza cases were detected during November 1–19 (Figure), suggesting rapid spread. One patient with confirmed influenza A infection was hospitalized. Among patients with positive influenza test results, the median age was 19 years (range = 17–31 years), 54.1% were female, 60.0% resided off-campus, 34.6% resided in on-campus residence halls, and 5.4% resided in fraternity or sorority houses. Among 380 specimens sequenced for influenza, all viruses belonged to the A(H3N2) 2a.2 subgroup, which diversified recently from the influenza A(H3N2) subclade 3C.2a1b.2a viruses (i.e., full clade: 3C.2a1b.2a.2). Among 2,405 persons who received testing for influenza A during October 6–November 12, 128 of 481 persons (26.6%) with positive influenza test results and 512 of 1,924 persons (26.6%) with negative influenza test results had documented receipt of 2021–22 influenza vaccine ≥14 days before the test.**

Available influenza vaccines are designed to provide protection against four different influenza viruses: A(H1N1) pdm09, A(H3N2), B/Victoria lineage, and B/Yamagata lineage. Historically, vaccine effectiveness has been lower against influenza A(H3N2) viruses than against influenza A(H1N1) pdm09 or influenza B viruses, likely because A(H3N2) viruses evolve more rapidly and are able to escape immunity (*1*). The A(H3N2) component of the northern hemisphere 2021–22 influenza vaccines was updated in February 2021 to protect against a newly emerging 3C.2a1b.2a subclade, which now includes two subgroups (2a.1 and 2a.2) (*2*). The 2a.2 subgroup of H3N2 viruses detected in Michigan is genetically related to, but antigenically distinguishable (i.e., lower postinfection ferret antibody cross-reactivity) from 2a.1-like H3N2 virus included in the northern hemisphere 2021–22 influenza vaccines (*3*). The similar vaccination rates among persons with positive and negative influenza test results in this outbreak suggest that protection against mild infection with the 2a.2 subgroup of H3N2 viruses was low among these mostly younger adults. However, cautious interpretation of this finding is needed for reasons such as the potential for incomplete vaccination history and changing coverage with ongoing vaccination campaigns. Persons included in this analysis had mild influenza illness, and vaccination offers protection against a spectrum of outcomes such as hospitalization and death, which occur rarely and are difficult to measure in this age group (*4*). Results for this specific 2a.2 subgroup of H3N2 viruses are not generalizable to other age groups, populations at higher risk, or other influenza viruses that might circulate. Additional investigation and monitoring are needed to determine vaccine effectiveness

* Signs and symptoms consistent with COVID-19–like illness include fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, recent loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, or diarrhea.

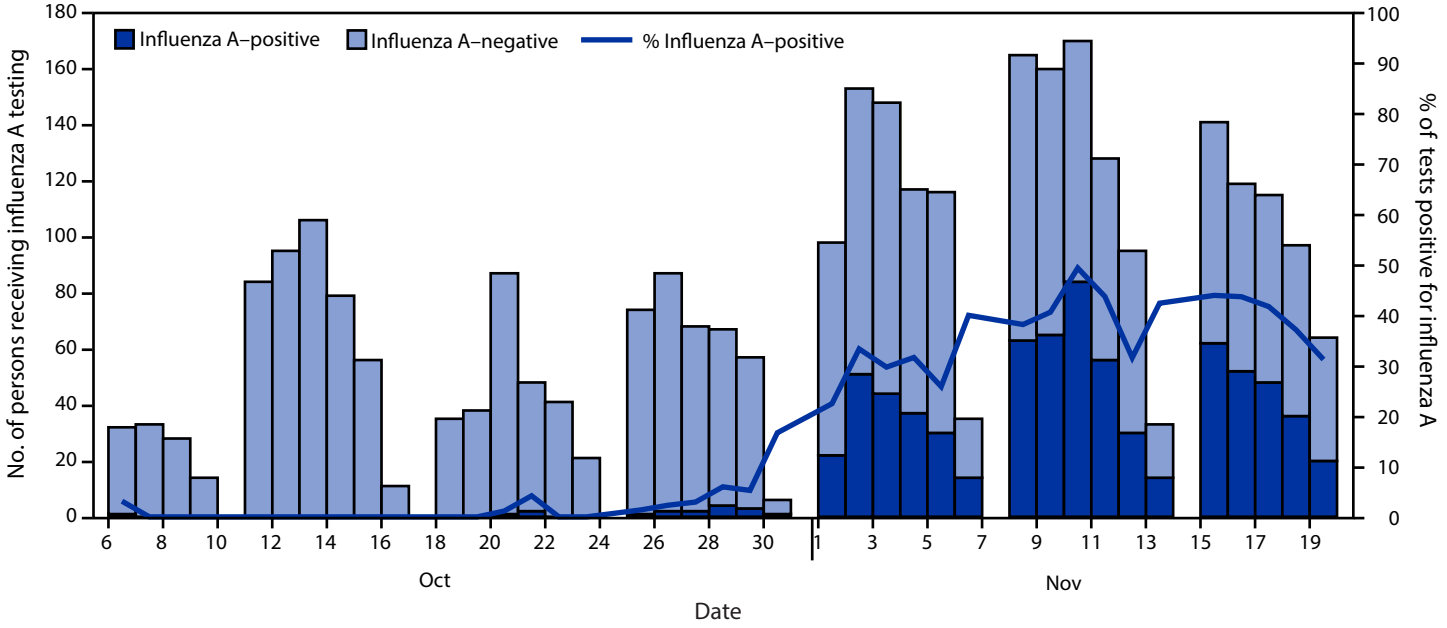
† GeneXpert (Cepheid).

§ October 6, 2021, was the date of the first confirmed influenza A case among persons with COVID-19–like or influenza-like illness who visited UHS since August 2021.

¶ 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

** Persons with documented receipt of 2021–22 influenza vaccination in the UHS record or Michigan Care Improvement Registry who had been vaccinated ≥14 days before the influenza test date were considered vaccinated. Persons without a documented 2021–22 influenza vaccination in the UHS record or Michigan Care Improvement Registry were considered unvaccinated. Persons with a documented 2021–22 influenza vaccination in the UHS record or Michigan Care Improvement Registry who had been vaccinated <14 days before the influenza test date were excluded. A total of 2,405 persons tested for influenza A during October 6–November 12 were considered vaccinated or unvaccinated, after the exclusion of persons vaccinated <14 days before the influenza test date. Vaccination data are subject to lag; therefore, an earlier cutoff was used for reporting of vaccination status compared with that for confirmed influenza A cases.

FIGURE. Number of symptomatic persons who received testing for influenza A at University Health Service (N = 3,121)* and percentage of tests positive for influenza A, by date of influenza test† — University of Michigan, October 6–November 19, 2021



* Among persons who received testing more than once during October 6–November 19, 2021, the first influenza A–positive test result was used, or if the person never received an influenza A–positive result, the first negative test result was used.
† University Health Service does not conduct influenza A testing on Sundays.

against circulating H3N2 viruses in other settings, in other groups of persons, and against other influenza viruses that might emerge this season.

The findings of this investigation highlight the importance of increasing vigilance for influenza disease this winter, as indicated in CDC's Health Alert Network Health Advisory issued on November 24, 2021 (*5*). Given the substantial impact of COVID-19 on health care systems, with a weekly rate of approximately 500 or more COVID-19 cases per 100,000 population in Michigan during the week ending November 19, 2021 (*6*), additional strategies to reduce influenza illness are important. Several measures can help mitigate severe influenza and the resulting strain on health care services. First, improving influenza vaccination coverage in persons aged ≥6 months, particularly those who are at higher risk for serious influenza complications, is critical to reducing influenza-associated illnesses, hospitalizations, and deaths. Compared with influenza vaccination coverage in 2020, coverage is lower so far this season in certain groups at higher risk for severe influenza illness, such as pregnant persons and children. Second, clinicians should consider diagnostic testing for influenza and SARS-CoV-2 infection for patients with acute respiratory illness, especially among hospitalized patients and those at higher risk for complications. Third, treatment with influenza antiviral medications can reduce influenza complications and should be used in all patients with suspected or diagnosed influenza who are hospitalized, in outpatients who develop progressive disease, and in outpatients with increased risk for complications (*7*). Influenza antivirals also can be used to reduce the risk for influenza among asymptomatic persons who have been exposed to someone who has influenza (i.e., postexposure prophylaxis) (*7*). Influenza antivirals have historically been used for postexposure prophylaxis among residents in institutional settings, such as long-term care facilities, to help control influenza outbreaks. In the context of ongoing COVID-19 surges, influenza antiviral treatment and prophylaxis could also be considered for persons living in other communal settings (e.g., shelters, university residence halls, or prisons) to reduce strain on health care services in these institutions during influenza outbreaks. Fourth, nonpharmaceutical interventions that are used for prevention of COVID-19, such as physical distancing, masking, routine surface cleaning, hand hygiene, and proper cough etiquette, might also provide protection against influenza (*8*). To help mitigate the potential severity of the influenza season, public health practitioners and clinicians should recommend and offer the current seasonal influenza vaccine to all eligible persons aged ≥6 months.

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Corresponding author: Emily T. Martin, etmartin@umich.edu.

[1]Epidemic Intelligence Service, CDC; [2]Influenza Division, National Center for Immunization and Respiratory Diseases, CDC; [3]University of Michigan University Health Service, Ann Arbor, Michigan; [4]Washtenaw County Health Department, Ypsilanti, Michigan; [5]Michigan Department of Health and Human Services; [6]University of Michigan School of Medicine, Ann Arbor, Michigan; [7]University of Michigan School of Public Health, Ann Arbor, Michigan.

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References

1. Okoli GN, Racovitan F, Abdulwahid T, Righolt CH, Mahmud SM. Variable seasonal influenza vaccine effectiveness across geographical regions, age groups and levels of vaccine antigenic similarity with circulating virus strains: a systematic review and meta-analysis of the evidence from test-negative design studies after the 2009/10 influenza pandemic. Vaccine 2021;39:1225–40. PMID:33494964 https://doi.org/10.1016/j.vaccine.2021.01.032
2. World Health Organization. Recommended composition of influenza virus vaccines for use in the 2021–2022 northern hemisphere influenza season. Wkly Epidemiol Rec 2021;96:77–88. https://cdn.who.int/media/docs/default-source/influenza/202102_recommendation.pdf
3. World Health Organization. Recommended composition of influenza virus vaccines for use in the 2022 southern hemisphere influenza season. Wkly Epidemiol Rec 2021; 96:509–20. https://cdn.who.int/media/docs/default-source/influenza/who-influenza-recommendations/vcm-southern-hemisphere-recommendation-2022/202109_recommendation.pdf?sfvrsn=698a54b9_12&download=true
4. Ferdinands JM, Thompson MG, Blanton L, Spencer S, Grant L, Fry AM. Does influenza vaccination attenuate the severity of breakthrough infections? A narrative review and recommendations for further research. Vaccine 2021;39:3678–95. PMID:34090700 https://doi.org/10.1016/j.vaccine.2021.05.011
5. CDC. Health Alert Network: increasing seasonal influenza A (H3N2) activity, especially among young adults and in college and university settings, during SARS-CoV-2 co-circulation. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://emergency.cdc.gov/han/2021/han00458.asp
6. University of Michigan. MI safe start map: track the risk levels of COVID-19 indicators. Ann Arbor, MI: University of Michigan, School of Information and School of Public Health; 2021. https://www.mistartmap.info/cdc-indicators
7. CDC. Influenza (flu): influenza antiviral medications: summary for clinicians. Atlanta, GA: US Department of Health and Human Services, CDC; 2021.https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm
8. Olsen SJ, Winn AK, Budd AP, et al. Changes in influenza and other respiratory virus activity during the COVID-19 pandemic—United States, 2020–2021. MMWR Morb Mortal Wkly Rep 2021;70:1013–9. PMID:34292924 https://doi.org/10.15585/mmwr.mm7029a1

Notes from the Field

Deployment of an Electronic Self-Administered Survey to Assess Human Health Effects of an Industrial Chemical Facility Fire — Winnebago County, Illinois, June–July 2021

Krishna Surasi, MD[1]; Jasmine Y. Nakayama, PhD[1]; Mark Johnson, PhD[2]; Sandra Martell, DNP[3]; Sarah Patrick, PhD[4]; Lance R. Owen, PhD[5]; D. Kevin Horton, DrPH[6]; Maureen Orr, MS[6]

On June 14, 2021, an industrial fluid and grease manufacturing facility in Winnebago County, Illinois, (population = 285,350) (*1*) caught fire, releasing smoke, dust, and debris for 4 days and prompting local authorities to issue a precautionary 1-mile (1.5-km) evacuation order and 3-mile (5-km) masking advisory around the location of the facility during this time. Review of Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) data during this time demonstrated increased emergency department visits in five zip codes downwind of the fire. In response, the Winnebago County Health Department (WCHD), Illinois Department of Public Health, and Agency for Toxic Substances and Disease Registry (ATSDR) collaborated to investigate the fire's effect on human health.

ATSDR offers epidemiologic assistance to state and local public health authorities after chemical incidents through Assessment of Chemical Exposure (ACE) investigations. These investigations might use ACE and Epidemiologic Contact Assessment Symptom Exposures toolkits, which include interviewer-administered health surveys that can be quickly modified to collect relevant information (e.g., exposure and symptom data) to guide response and recovery efforts (*2*,*3*). For this investigation, these surveys were combined and adapted into a single, electronic, self-administered survey to facilitate rapid and wide distribution.

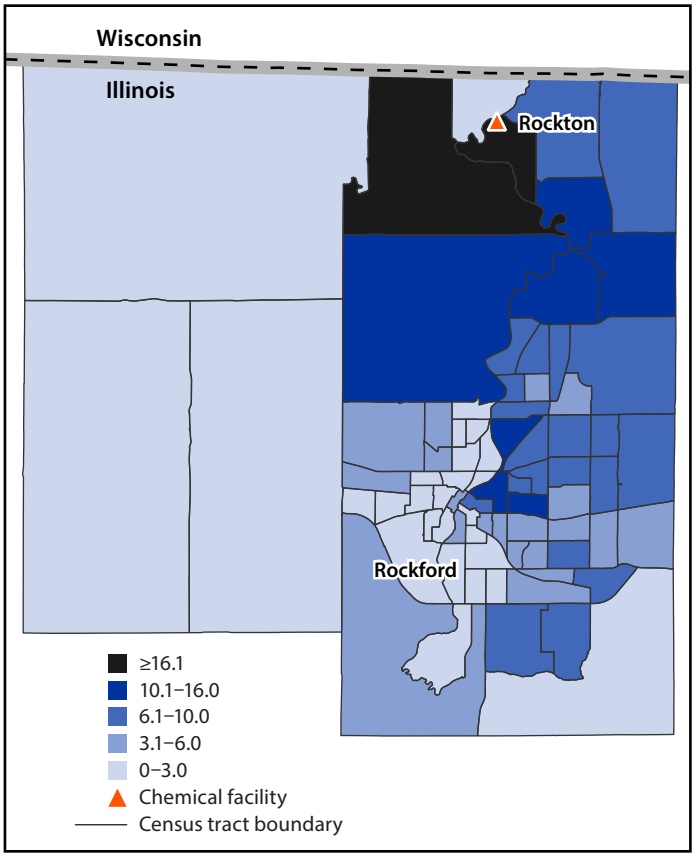
As a public health authority responsible for assessing public health events, WCHD used an existing electronic system that had previously been used for COVID-19 vaccination registration to distribute the survey by email. Survey links were emailed to all persons registered in this electronic system who had a valid email address and who resided in 11 selected zip codes (the five identified by ESSENCE data plus six additional zip codes nearby [total population = 247,059]) (*4*). This electronic system allowed only one survey to be submitted per emailed link during July 5–15, 2021. WCHD also promoted survey completion through door-to-door flyer distribution, news outlets, social media, and their own website that included a different link which could be used to submit multiple surveys during July 1–15, 2021. Geospatial analyses were performed at the U.S. Census tract level with ArcGIS Pro (version 2.8.2; Esri) to assess geographic distribution of survey respondents' reported home addresses and symptoms. Home addresses from the survey were geocoded and then joined to demographic data from the 2019 American Community Survey to calculate response rates (*5*).

Among 40,217 survey links emailed through the electronic system, 1,807 (4.5%) were accessed to submit a survey. An additional 223 surveys were received from links accessed on WCHD's website or social media, for a total of 2,030 unique survey respondents. Most respondents were White persons (1,754; 86.4%), not Hispanic or Latino persons (1,928; 95.0%), and female (1,277; 62.9%). Mean age was 50 years (range = 11–94 years). Among respondents, 916 (45.1%) reported one or more new or worsened symptom since the fire, typically related to the ears, nose, and throat (638; 69.7%); nervous system (478; 52.2%); and eyes (383; 41.8%). Four respondents reported having been hospitalized. The highest survey response rate (37.9 surveys per 1,000 residents) was from the U.S. Census tract where the facility was located (Figure); that tract also included the highest percentage of survey respondents reporting any symptom (154 of 241; 63.9%).

Survey distribution through the electronic system enabled enrollment of approximately twice as many survey respondents than that in previously reported ACE investigations (*2*). The electronic system also facilitated sending targeted follow-up questions to only those respondents whose initial survey answers indicated that they could provide additional relevant information. Geospatial analyses allowed assessment of reported home addresses and symptoms among respondents, thereby enabling rapid and focused adjustments during the survey period, including promoting the survey with informational flyers in an area close to the facility with a low response rate that was identified by geospatial mapping.

This was the first documented use of an electronic, self-administered survey in an ACE investigation. One limitation was the use of a convenience sample, mostly consisting of persons registered for the electronic COVID-19 vaccination registration system. Respondents using this system might be more comfortable with electronic communications and interested in public health activities than is the overall affected population. Also, a low response rate to the emailed survey link was reported. However, future ACE investigations might benefit from this approach, which permits efficient surveying in a wide geographic distribution after a chemical incident. In addition, this response highlights how data modernization–driven public health resources developed during the COVID-19 pandemic can be adapted to serve other public health needs.

FIGURE. Human health survey completion rate per 1,000 residents after a chemical manufacturing facility fire, by U.S. Census tract — Winnebago County, Illinois, July 1–15, 2021*



* Data from Winnebago County Health Department (health survey data responses and locations), U.S. Census Bureau American Community Survey 2019 5-year estimate (population of U.S. Census tracts), Esri (geometry of U.S. Census tracts), and Agency for Toxic Substances and Disease Registry (location of chemical facility).

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Winnebago County Health Department data team; residents of Winnebago County, Illinois.

Corresponding author: Krishna Surasi, okt3@cdc.gov, 510-620-3711.

[1]Epidemic Intelligence Service, CDC; [2]Office of Community Health and Hazard Assessment, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia; [3]Winnebago County Health Department, Rockford, Illinois; [4]Illinois Department of Public Health; [5]Geospatial Research, Analysis, and Services Program, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia; [6]Office of Innovation and Analytics, Agency for Toxic Substance and Disease Registry, Atlanta, Georgia.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Sandra Martell is the Treasurer of the Northern Illinois Public Health Consortium. No other potential conflicts of interest were disclosed.

References

1. US Census Bureau. Winnebago County, Illinois. Suitland, MD: US Department of Commerce, US Census Bureau; 2021. Accessed September 29, 2021. https://data.census.gov/cedsci/profile?g=0500000US17201
2. Agency for Toxic Substances and Disease Registry. Incident investigations: Assessment of Chemical Exposures (ACE) program. Atlanta, GA: US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; 2021. https://www.atsdr.cdc.gov/ntsip/ace.html
3. Agency for Toxic Substances and Disease Registry. Epi CASE toolkit. Atlanta, GA: US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; 2021. https://www.atsdr.cdc.gov/epitoolkit/index.html
4. US Census Bureau. 2010 decennial census by zip code tabulation areas. Suitland, MD: US Department of Commerce, US Census Bureau; 2021. https://data.census.gov/cedsci/table?q=Population%20Total%202010&g=8600000US61072,61073,61101,61103,61104,61107,61108,61109,61111,61114,61115&tid=DECENNIALSF12010.P1&hidePreview=true
5. US Census Bureau. American Community Survey. Suitland, MD: US Department of Commerce, US Census Bureau; 2021. https://data.census.gov/cedsci/table?q=DP02&g=0500000US17201%241400000&tid=ACSDP5Y2019.DP02&hidePreview=true

Errata

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In the Surveillance Summary "Abortion Surveillance — United States, 2018," on page 5, the last sentence of the second paragraph should have read, "Overall, **0.9%** of abortions were reported to CDC with unknown residence." On page 9, the fourth sentence of the first paragraph should have read, "Findings in this report on demographic characteristics of women seeking abortions were generally similar to previously published data from Guttmacher Institute's national survey of abortion patients in 2014, although the percentage of abortions accounted for by non-Hispanic Black women was **lower** and by Hispanic women was **higher** as compared with data provided to CDC (*25*)."

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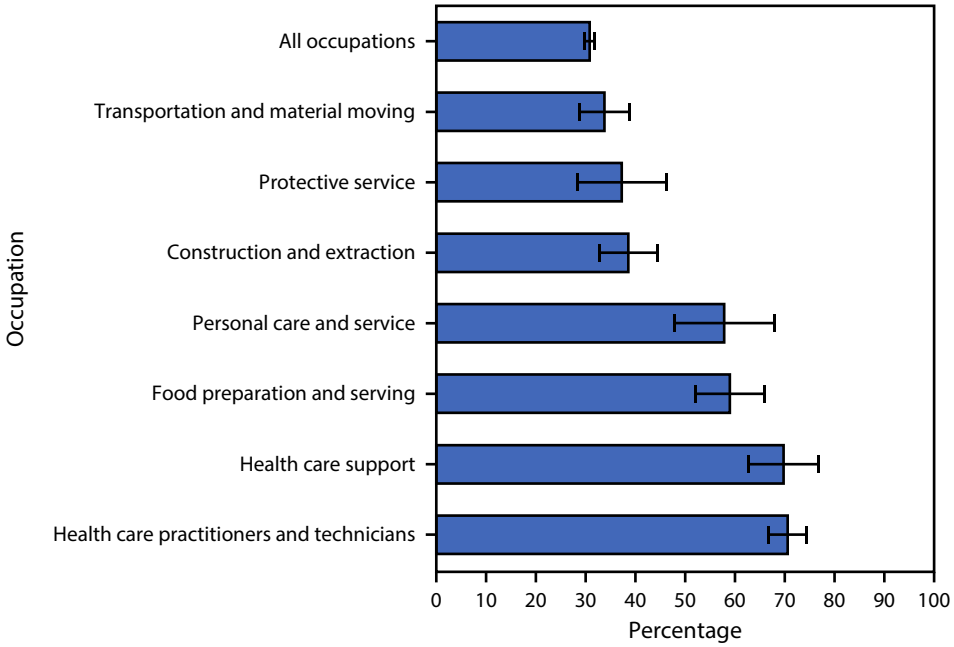
In the report "Interim Estimates of COVID-19 Vaccine Effectiveness Against COVID-19–Associated Emergency Department or Urgent Care Clinic Encounters and Hospitalizations Among Adults During SARS-CoV-2 B.1.617.2 (Delta) Variant Predominance — Nine States, June–August 2021," on page 1293, the following statements should have appeared after the author affiliations: "**All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Shaun J. Grannis reports grants from the Patient-Centered Outcomes Research Institute, Agency for Healthcare Research and Quality, National Institute of Mental Health, National Center for Advancing Translational Sciences, and California Healthcare Foundation; consulting fees from RTI International and Indiana Health Information Exchange; and two U.S. patent applications unrelated to this publication: "Method and system for creating synthetic unstructured free tax medical data for training machine learning models" (#20200035360) and "Predictive Modeling For Health Services" (#20200312457). Nicola P. Klein reports research support from Pfizer for COVID-19 vaccine clinical trials and research support from Pfizer, Merck, GlaxoSmithKline, Sanofi Pasteur, and Protein Sciences (now Sanofi Pasteur) for unrelated studies. Allison L. Naleway reports funding from Vir Biotechnology for research unrelated to this study and Pfizer research funding to Kaiser Permanente Northwest for unrelated study of meningococcal B vaccine safety during pregnancy. No other potential conflicts of interest were disclosed.**"

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Employed Adults Who Needed to Work Closer Than 6 Feet from Other Persons All or Most of the Time at Their Main Job,† by Occupation§ — National Health Interview Survey, United States, July–December 2020¶



* With 95% CIs indicated by error bars.
† Based on responses to the question, "Currently, at your main job or business, how often do you need to work closer than 6 feet to other people? Would you say all of the time, most of the time, some of the time, or none of the time?" This question was asked of all respondents who said that they were working the week before the survey.
§ Respondents who reported working more than one job were asked to identify the occupation of their main job. These occupations were categorized by the U.S. Bureau of Labor Statistics 2018 Standard Occupational Classification two-digit codes (https://www.bls.gov/soc/2018/major_groups.htm). Only occupations above the overall average (30.7%) are reported.
¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population. Questions on social distancing at work were asked during July–December 2020.

During July–December 2020, 30.7% of all currently employed workers needed to work closer than 6 ft (2 m) from other persons at their job all or most of the time. The four occupations with the highest percentages were health care practitioners and technicians (70.5%), health care support (69.7%), food preparation and serving (58.9%), and personal care and service (57.8%) occupations.

Source: National Health Interview Survey, 2020. https://www.cdc.gov/nchs/nhis/2020nhis.htm

Reported by: Abay Asfaw, PhD, AAsfaw@cdc.gov, 202-245-0635; Tim Bushnell, PhD; Toni Alterman, PhD; Regina Pana-Cryan, PhD.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/niosh/emres/2019_ncov_default.html

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