United States Government Accountability Office

Report to Congressional Addressees

December 2022

COVID-19 IN NURSING HOMES

Outbreak Duration Averaged 4 Weeks and Was Strongly Associated with Community Spread

Accessible Version

GAO-23-104291

GAO Highlights

Highlights of GAO-23-104291, a report to congressional addressees

December 2022

COVID-19 IN NURSING HOMES

Outbreak Duration Averaged 4 Weeks and Was Strongly Associated with Community Spread

Why GAO Did This Study

The COVID-19 pandemic has had a disproportionate effect on the more than 1 million residents in the nation's nursing homes. The initial unknown nature of the virus and the scope of the pandemic created unprecedented challenges. The Department of Health and Human Services, primarily through CMS and CDC, is responsible for taking steps to address COVID-19 in nursing homes, such as issuing relevant requirements and guidance.

Many studies have explored the factors associated with the presence or severity of COVID-19 in nursing homes. However, little was known about the factors associated with the duration of COVID-19 outbreaks within nursing homes.

The CARES Act directs GAO to monitor the federal pandemic response. GAO was also asked to review CMS oversight of nursing homes in light of the pandemic. This report examines how COVID-19 outbreaks affected nursing homes, and determines how nursing home factors were associated with outbreak duration.

GAO analyzed CDC and CMS nursing home data from June 2020 through December 2021, in a statistical model, and conducted a literature review. GAO also interviewed representatives from nursing homes and state agencies from a non-generalizable sample of four states. The states were selected for variation in factors such as number of nursing home beds and COVID-19 cases.

View GAO-23-104291. For more information, contact John Dicken at (202) 512-7114 or dickenj@gao.gov.

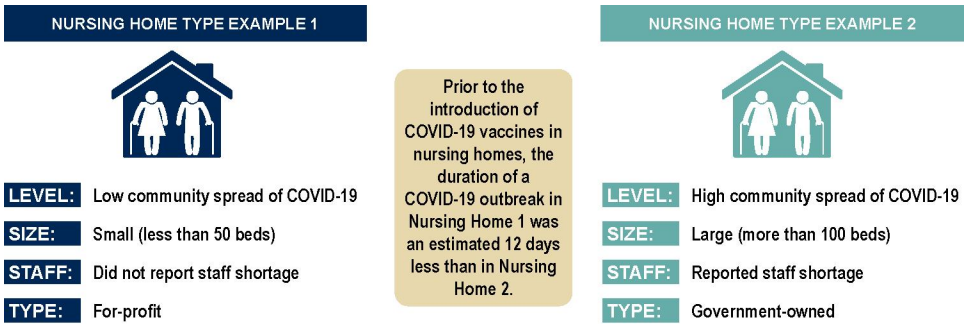
What GAO Found

GAO analysis of data from the Centers for Disease Control and Prevention (CDC) shows that, from June 2020 through December 2021, nursing homes faced many separate COVID-19 outbreaks, with the average outbreak lasting 4 weeks. Officials GAO interviewed at six selected nursing homes in four states described a range of outbreak experiences, including critical challenges and some successes. For example, two critical challenges included:

- **Staff shortages**. Officials from five nursing homes described experiencing staffing shortages during outbreaks. For example, officials from one nursing home described a staffing crisis, noting that at one point the home was down about 25 percent of its workforce.
- **Low staff morale**. Officials from three nursing homes discussed the psychosocial effect the pandemic had on their staff and the difficulties in maintaining staff morale. For example, officials from one nursing home described how the outbreaks took away the joy of caregiving from staff, and officials believed that many staff were left traumatized.

GAO's analysis of CDC and Centers for Medicare & Medicaid Services (CMS) data found that transmission of COVID-19 in the community surrounding a nursing home, known as community spread, had the strongest association with the duration of an outbreak. Controlling for other factors, prior to the introduction of COVID-19 vaccines, nursing homes in counties experiencing low community spread had outbreaks that ended an estimated 7 days earlier than nursing homes in counties experiencing high community spread. GAO also found that most outbreaks (75 percent) began with a reported staff case during the first week. These results could indicate that, during times of higher community spread, staff have a greater likelihood of being exposed to the virus in the community and bringing it into the nursing home. Other factors GAO found that had a strong association with outbreak duration included nursing home size, reported staff shortages, and ownership type.

GAO Estimated COVID-19 Outbreak Duration for Nursing Homes with Selected Characteristics



Source: GAO analysis of Centers for Disease Control and Prevention and Centers for Medicare & Medicaid Services data. | GAO-23-104291

Text of GAO Estimated COVID-19 Outbreak Duration for Nursing Homes with Selected Characteristics

Nursing Home Type Example 1

- Level: Low community spread of Covid-19
- Size: small (less than 50 beds)
- Staff: Did not report staff shortage
- Type: For profit

Nursing Home Type Example

- Level: High community spread of Covid-19
- Size: Large (more than 100 beds)
- Staff: Reported staff shortage
- Type: Government owned

Source: GAO analysis of CDC and Centers for Medicare and Medicaid Services data. | GAO-23-104291.

Note: Using multivariate statistical models, GAO estimated the association of nursing home factors, such as facility characteristics, with the likelihood that an ongoing COVID-19 outbreak would end during a given week.

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Abbreviations

CDC	Centers for Disease Control and Prevention
CMS	Centers for Medicare & Medicaid Services
HHS	Department of Health and Human Services

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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December 15, 2022

Congressional Addressees

COVID-19 emerged as a new and highly contagious respiratory disease that has resulted in catastrophic loss of life. These devastating consequences have been particularly pronounced for the nation's more than 1 million nursing home residents. A disproportionate share of all COVID-19 deaths reported by the Centers for Disease Control and Prevention (CDC) has been among nursing home residents.[1] The initial unknown nature of the virus that causes COVID-19, along with the scope of the pandemic, created unprecedented challenges for the state and federal agencies working to ensure the quality of care delivered in the more than 15,000 Medicare- and Medicaid-certified nursing homes.[2]

Nursing home residents are at a high risk of infection and death due to COVID-19, as older adults and those with underlying health conditions are at higher risk of severe disease.[3] In addition, the congregate nature of nursing homes, with staff caring for multiple residents and communal spaces, increases the risk that COVID-19 will easily spread. The introduction of COVID-19 vaccines in conjunction with improved infection prevention and control practices coincided with a sharp decline in nursing home cases and deaths from their initial peaks in December 2020.

[1]Combined nursing home resident and staff deaths from COVID-19 consistently represented about 30 percent of all COVID-19 deaths in the U.S. from May 2020 through February 2021. In May 2021, this percentage declined to about 23 percent and further decreased to about 16 percent in May 2022. See Centers for Disease Control and Prevention, *COVID Data Tracker*, accessed September 7, 2022, https://covid.cdc.gov/covid-data-tracker.

[2]Federal statutes and their implementing regulations use the terms "skilled nursing facility" (Medicare) and "nursing facility" (Medicaid). For the purposes of this report, we use the term "nursing home" to refer to both skilled nursing facilities and nursing facilities.

Medicare, the federal health insurance program for people age 65 and older, individuals under age 65 with certain disabilities, and individuals diagnosed with end-stage renal disease, covers some short-term skilled nursing and rehabilitative care for beneficiaries following an acute care hospital stay. Medicaid, a joint federal-state health program for certain low-income and medically needy individuals, is the nation's primary payer of long-term services and supports for children and adults with disabilities and aged individuals.

[3]Centers for Disease Control and Prevention, *COVID-19: People Who Live in a Nursing Home or Long-Term Care Facility,* accessed January 5, 2021, https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-in-nursing-homes.html.

However, the emergence of more transmissible virus variants led to the highest resident and staff case rates in nursing homes thus far in January 2022.

While there have been several studies exploring the factors associated with the presence and severity of COVID-19 in nursing homes, little is known about the factors that are associated with the duration of outbreaks once the virus enters the home.[4]

The CARES Act includes a provision directing us to monitor the federal response to the COVID-19 pandemic.[5] Further, you asked us to examine the Centers for Medicare & Medicaid Services' (CMS) oversight of infection prevention and control protocols and the adequacy of emergency preparedness standards for emerging infectious diseases in nursing homes, as well as CMS's response to the pandemic. Since 2020, we have examined multiple aspects of the response to COVID-19 in nursing homes. Some reports are published while work on others is ongoing.[6]

This report (1) examines how COVID-19 outbreaks affected nursing homes and (2) determines how certain nursing home factors were associated with the duration of COVID-19 outbreaks.

To understand how COVID-19 outbreaks have affected nursing homes, we analyzed CDC data on nursing home COVID-19 cases. To help inform nursing home response efforts, CDC defines the start of a COVID-19 outbreak as the week a nursing home reports a new COVID-19 case in a

[4]Studies have found a range of factors, such as COVID-19 transmission in the surrounding community, racial disparities, and staffing levels, that are associated with the presence or severity of COVID-19 cases and deaths in nursing homes. See appendix I for a list of such studies.

[5]Pub. L. No. 116-136, § 19010(b), 134 Stat. 281, 580 (2020). Throughout the pandemic, we regularly issued government-wide reports on the federal response to COVID-19. All government-wide reports are available on GAO's website at https://www.gao.gov/coronavirus.

[6]For example, see GAO, *Infection Control Deficiencies Were Widespread and Persistent in Nursing Homes Prior to COVID-19 Pandemic*, GAO-20-576R (Washington, D.C.: May 20, 2020); *COVID-19 in Nursing Homes: Most Homes Had Multiple Outbreaks and Weeks of Sustained Transmission from May 2020 through January 2021*, GAO-21-367 (Washington, D.C.: May 19, 2021); and *COVID-19 in Nursing Homes: CMS Needs to Continue to Strengthen Oversight of Infection Prevention and Control*, GAO-22-105133 (Washington, D.C.: Sep. 14, 2022).

resident or staff member and defines the end as when the nursing home has 2 consecutive weeks where it reports no such cases.[7] Using this definition of an outbreak, we first generated descriptive statistics, including the number and duration of outbreaks each of the over 15,000 Medicare- and Medicaid-certified nursing homes experienced. We did not include the 2 consecutive weeks without a new COVID-19 case when calculating an outbreak's duration.

In addition, we interviewed state officials and nursing home officials in a non-generalizable sample of four states: California, Florida, Maryland, and Michigan. These states were selected to provide variation across: (1) geographic location; (2) number of nursing home beds; and (3) number of nursing home residents and staff with confirmed positive cases of COVID-19.[8] In each of these four states, we interviewed state survey agency and state long-term care ombudsman officials, as well as officials from at least one nursing home.[9] In total, we interviewed officials from six nursing homes that we selected to obtain variation in factors such as bed count and profit or not-for-profit status.[10] We asked nursing home officials to describe how COVID-19 outbreaks affected their nursing home, as well as to describe the challenges faced while preventing and managing COVID-19 outbreaks.

Additionally, we interviewed researchers with work related to nursing homes and COVID-19, as well as national associations with knowledge of nursing homes issues. These associations included the American Health Care Association and National Consumer Voice for Quality Long-Term

[7]See Centers for Disease Control and Prevention, *Interim Infection Prevention and Control Recommendations to Prevent SARS-CoV-2 Spread in Nursing Homes*, accessed April 18, 2022, https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care.html.

[8]Nursing home characteristics data were as of June 2020, and COVID-19 case rates were as of November 1, 2020.

[9]CMS enters into agreements with survey agencies in each state (known as state survey agencies) to monitor compliance with federal quality of care standards by conducting both recurring comprehensive standard surveys (inspections) and as-needed investigations.

Under the federal Older Americans Act, every state is required to have an Ombudsman Program that addresses complaints and advocates for improvements in the long-term care system, including nursing homes, as a condition of receiving funds under the act.

[10]We conducted the original interviews from December 2020 through August 2021 and followed up with officials at each state survey agency, state long-term care ombudsman, and nursing home from November 2021 through March 2022.

Care. We discussed with researchers and association representatives the challenges faced by nursing homes during the pandemic.

To determine how certain nursing home factors were associated with the duration of COVID-19 outbreaks, we analyzed CMS data on nursing home staffing levels, resident demographics, and facility characteristics; CDC data on county-level COVID-19 community transmission levels and nursing home COVID-19 cases; and Health Resources and Services Administration data on county-level metropolitan, micropolitan, and rural designations. We developed multivariate statistical models to determine the significance of each selected factor in estimating the probability of an outbreak ending at any given week from June 14, 2020, through January 2, 2022 (the last full week of the 2021 calendar year).

Specifically, our statistical models controlled for the transmission levels of COVID-19 in the surrounding community, several nursing home characteristics, several measures of nursing home staffing levels, and several other factors, including prior infection prevention and control deficiencies. We could not control for all factors that may affect outbreak duration, such as state and local COVID-19 policies, local compliance with those policies, or nursing home adherence to infection prevention and control practices. Therefore, our model provides information on possible associations in the data and does not establish a causal relationship between the factors and outbreak duration.

To provide context to these findings, we conducted a literature review to determine what is known about the factors associated with COVID-19 outbreaks in nursing homes and identified 40 pertinent studies, which we reviewed. For a description of our literature review methodology and its findings, see appendix I.

We assessed the reliability of the various data sets we used by reviewing relevant CDC, CMS, and Health Resources and Services Administration data documentation, interviewing knowledgeable agency officials, and performing tests of the data to identify any outliers or anomalies. We determined that these datasets were sufficiently reliable for the purposes of our reporting objectives. For additional information about our descriptive and statistical analyses and model, see appendix II.

We conducted this performance audit from April 2020 to December 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our

findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The Department of Health and Human Services (HHS), primarily through CMS and CDC, has led the response to the COVID-19 pandemic in nursing homes. CMS is the federal oversight agency responsible for ensuring that nursing homes meet federal quality standards to be eligible to participate in the Medicare and Medicaid programs.[11] CDC issues guidance with recommendations for preventing and managing infectious diseases and operates infectious disease surveillance systems. CDC also provides technical assistance through programs aimed at supporting and assessing infection prevention and control in nursing homes, and tracking infection prevention and control data.[12]

The COVID-19 pandemic has had a disproportionate effect on nursing home residents thus far. Nursing home residents are at a high risk of infection and death due to COVID-19, as older adults and those with underlying health conditions are at a higher risk of severe disease. In addition, the congregate nature of nursing homes increases the risk of transmission.[13] We have previously reported on a number of COVID-19 issues in nursing homes, including challenges nursing homes have faced

[11]To monitor compliance with these standards, CMS enters into agreements with survey agencies in each state to conduct recurring comprehensive standard surveys and as-needed investigations. Beginning in March 2020, CMS required state survey agencies to conduct focused infection control surveys, a new type of survey in response to the pandemic with a narrower scope than a standard survey, for 20 percent of nursing homes in their state annually, prioritizing those facilities that report new COVID-19 cases and low vaccination rates. If a state survey agency determines that a nursing home violated a federal standard, the nursing home is cited for the deficiency.

[12]According to CDC officials, this includes developing resources to support implementation of prevention and surveillance activities, conducting and supporting onsite and remote infection prevention and control assessments, and supporting outbreak field investigations.

[13]According to CDC, COVID-19 is spread in three main ways: (1) breathing in small droplets or particles exhaled by an infected person; (2) having these small droplets and particles land on the eyes, nose, or mouth, especially through a cough or a sneeze; and (3) touching eyes, nose, or mouth with hands that have the virus on them. See Centers for Disease Control and Prevention, *How COVID-19 Spreads*, accessed April 16, 2022, https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html.

and the number and duration of outbreaks early in the pandemic. For example, our past work found that most nursing homes had multiple outbreaks and weeks of sustained COVID-19 transmission from May 2020 through January 2021.[14]

Many studies have explored the factors associated with the presence or severity of COVID-19 in nursing homes, finding a range of associated factors, such as COVID-19 in the surrounding community, nursing home size, and racial disparities. For example, several studies all found that nursing homes with fewer beds were associated with less severe outbreaks.[15]

The duration of an outbreak within a nursing home is also important as it may indicate how well a nursing home can control the spread of the virus, as well as having implications related to staffing needs, space constraints, and resident well-being. For example, CDC guidance recommends a nursing home maintain dedicated space for residents with confirmed infections during a COVID-19 outbreak, if possible.[16] This can require additional nursing staff and strain a home's available space and resources. In addition, in March 2020, CMS released guidance restricting visitation and suspending group dining and activities to prevent the spread of the virus. Initially these restrictions were at all times; starting in September 2020, visitation was restricted only during active COVID-19

[14]For challenges, see, for example, GAO, *COVID-19: Urgent Actions Needed to Better Ensure an Effective Federal Response*, GAO-21-191 (Washington, D.C.: Nov. 30, 2020). For number and duration of outbreaks, see GAO, *COVID-19 in Nursing Homes: Most Homes Had Multiple Outbreaks and Weeks of Sustained Transmission from May 2020 through January 2021*, GAO-21-367 (Washington, D.C.: May 19, 2021).

[15]See appendix I. For example, Elizabeth M. White et al., "Variation in SARS-CoV-2 Prevalence in U.S. Skilled Nursing Facilities," *Journal of the American Geriatrics Society*, vol. 68, no. 10 (2020): 2167-2173, and Sheryl Zimmerman, et al., "Nontraditional Small House Nursing Homes Have Fewer COVID-19 Cases and Deaths," *JAMDA*, vol. 22, no. 3 (2021): 489-493.

[16]CDC guidance specifies that staff assigned to the COVID-19 unit only work in this unit when it is in use and that, at a minimum, such staff include the primary nursing assistants and nurses assigned to care for these residents. See Centers for Disease Control and Prevention, *Interim Infection Prevention and Control Recommendations to Prevent SARS-CoV-2 Spread in Nursing Homes*, accessed July 24, 2022, https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care.html.

outbreaks.[17] These restrictions had unintended consequences on residents, such as isolation and declining health.[18] The longer a nursing home is responding to a COVID-19 outbreak, the longer staff and residents face these issues. However, we found that little was known about the factors that contribute to the length of outbreaks once the virus enters the home.[19]

CMS has required that nursing homes report COVID-19 information weekly to CDC, including resident and staff case and death counts, since May 2020.[20] CDC data show that, for the week ending May 31, 2020, through the end of 2020, there were fluctuations in new weekly confirmed cases among residents and staff. The introduction of vaccines in nursing homes at the end of December 2020, in conjunction with improved infection prevention and control practices, was a key turning point when cases and deaths began to decline. COVID-19 nursing home cases and deaths remained low through the first part of 2021, but, from the summer of 2021 through the end of that calendar year (coinciding with the emergence of the COVID-19 Delta variant), nursing home cases began to rise. Then, in January 2022 (coinciding with the emergence of the COVID-19 Omicron variant), cases in residents and staff quickly jumped to levels far exceeding the peak seen prior to the introduction of COVID-

[17]CMS initially restricted visitation and suspended group dining and activities in March 2020. After the initial restrictions, CMS changed its guidance multiple times—in September 2020, March 2021, and April 2021—to allow for more visitation and group activities, while identifying some situations where limitations would be appropriate. In November 2021, all visitation limitations were fully lifted. See Centers for Medicare & Medicaid Services, *Guidance for Infection Control and Prevention of COVID-19 in Nursing Homes*, QSO-20-14-NH, (Baltimore, Md.: March 13, 2020) and Centers for Medicare & Medicaid Services, *Nursing Home Visitation no COVID-19*, QSO-20-39-NH, (Baltimore, Md.: Sept. 17, 2020), revised March 10, 2021, April 27, 2021, and November 12, 2021.

[18]We have reported on the worsening of several key indicators of nursing home resident mental and physical health during 2020 and 2021. Nursing home officials and national organizations attributed this worsening in part to the isolation residents experienced. See GAO, *COVID-19 in Nursing Homes: CMS Needs to Continue to Strengthen Oversight of Infection Prevention and Control*, GAO-22-105133 (Washington, D.C: Sept. 14, 2022).

[19]One study in our literature review examined the number of weeks a nursing home was in the top decile of the national distribution of weekly confirmed resident COVID-19 cases, which is described as the persistence of the outbreak. The study found that nursing home quality ratings were associated with COVID-19 persistence. See Christianna S. Williams, et al., “The association of nursing home quality ratings and spread of COVID-19,” *Journal of the American Geriatrics Society*, vol. 69, no. 8 (2021): 2070-2078.

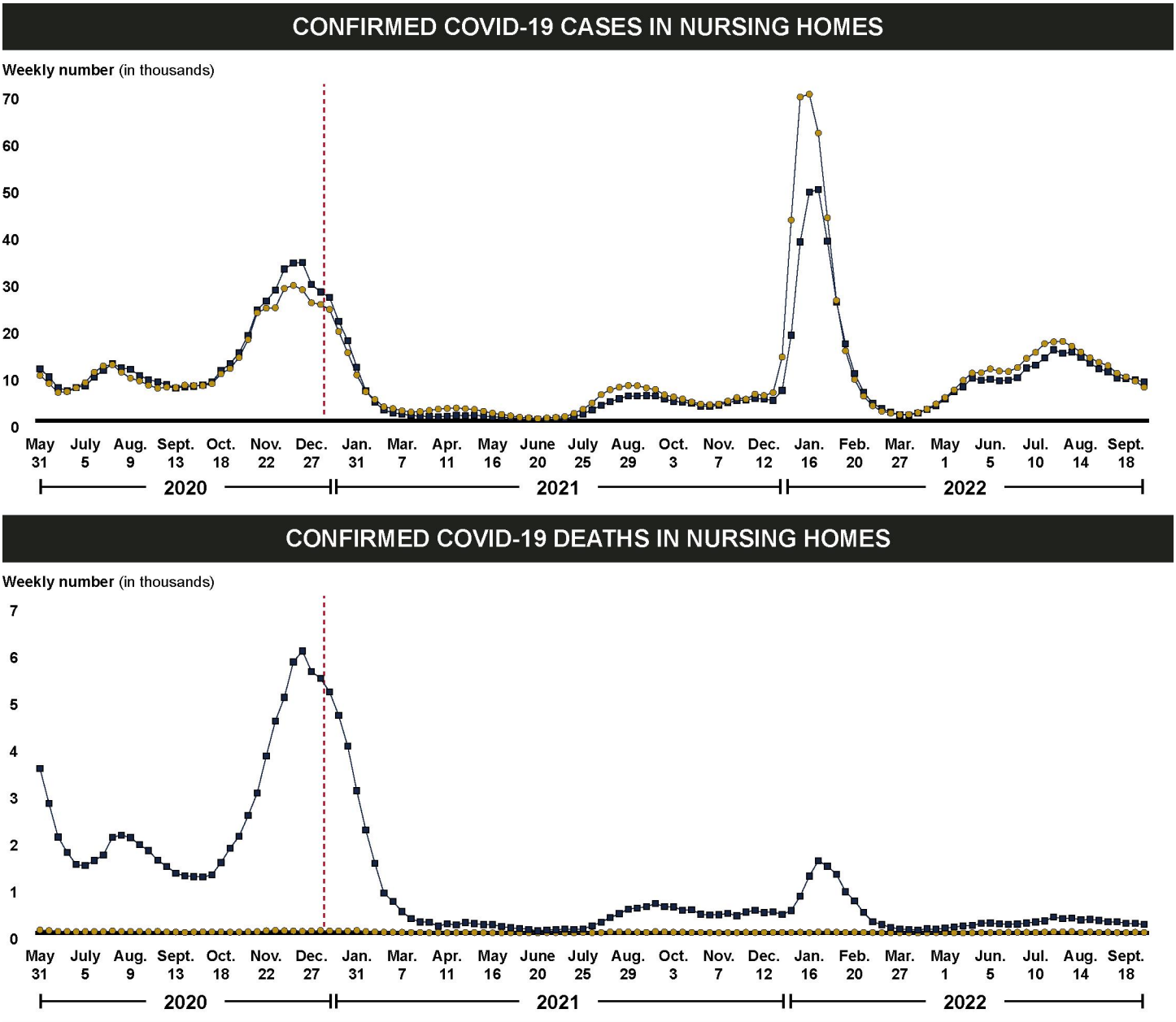
[20]42 C.F.R. § 483.80(g) (2021).

19 vaccines.[21] However, COVID-19 deaths have not risen at the same rate during these more recent peaks in cases, likely due to protection from severe illness and death provided by vaccines.[22] See figure 1.

[21]According to CDC, viruses, such as the virus that causes COVID-19, constantly change through mutation, and new variants are expected to occur. The Delta variant became the dominant COVID-19 strain circulating in the U.S. during the week ending July 3, 2021. The Omicron variant superseded the Delta variant to become the dominant COVID-19 strain circulating in the U.S. during the week ending December 25, 2021. As of April 5, 2022, CDC has reported the presence of multiple sublineages of the Omicron variant in the U.S., including BA.2; BA.2 became the dominant strain circulating in the U.S. during the week ending March 26, 2022.

[22]As of May 1, 2022, according to CDC data, nursing homes reported that 88.2 percent of residents and 89.7 percent of staff had a complete vaccination—meaning the resident had received all doses required to be fully vaccinated (two doses of a two-dose mRNA series or one dose of a single-dose vaccine). Additionally, nursing homes reported that 80.6 percent of residents and 53.2 percent of staff had received an additional primary or booster dose of the vaccine.

Figure 1: New Weekly Confirmed COVID-19 Cases and Deaths among U.S. Nursing Home Residents and Staff, Weeks Ending May 31, 2020, through October 2, 2022



Source: GAO analysis of Centers for Disease Control and Prevention (CDC) data. | GAO-23-104291

Data table of Figure 1: New Weekly Confirmed COVID-19 Cases and Deaths among U.S. Nursing Home Residents and Staff, Weeks Ending May 31, 2020, through October 2, 2022

Report Date	Resident Cases # Weekly count	Resident Deaths # Weekly count	Staff Cases # Weekly count	Staff Deaths # Weekly count
05/31/20	11105	3502	9704	62
06/07/20	9393	2757	7991	48
06/14/20	7054	2044	6068	33
06/21/20	6476	1717	6233	33
06/28/20	7121	1457	7051	24
07/05/20	7444	1435	8165	29
07/12/20	9390	1543	10392	27
07/19/20	10772	1662	11714	27
07/26/20	12181	2036	11986	43
08/02/20	11348	2086	10371	30
08/09/20	10991	2032	9124	32
08/16/20	9678	1879	8534	31
08/23/20	8787	1754	7607	24
08/30/20	8356	1551	6976	35
09/06/20	7749	1418	7200	22
09/13/20	7004	1274	7111	20
09/20/20	7246	1218	7633	12
09/27/20	7389	1198	7520	19
10/04/20	7701	1192	7541	23
10/11/20	8268	1238	7955	22
10/18/20	10736	1498	10052	22
10/25/20	12162	1805	11154	17
11/01/20	14543	2058	13521	19
11/08/20	18254	2502	17352	24
11/15/20	23664	2981	23038	27
11/22/20	25543	3768	24037	46
11/29/20	27860	4515	24116	54
12/06/20	32372	5021	28236	47
12/13/20	33632	5778	28897	42
12/20/20	33747	6010	27970	36
12/27/20	29100	5572	25182	43
01/03/21	27477	5426	24828	51
01/10/21	26335	5135	23755	45
01/17/21	21250	4637	19068	43

Report Date	Resident Cases # Weekly count	Resident Deaths # Weekly count	Staff Cases # Weekly count	Staff Deaths # Weekly count
01/24/21	17119	3980	14545	40
01/31/21	11469	3032	9796	51
02/07/21	6407	2194	6220	29
02/14/21	4051	1485	4570	22
02/21/21	2302	850	3000	16
02/28/21	1718	671	2633	15
03/07/21	1436	455	2169	13
03/14/21	1191	302	1899	9
03/21/21	1026	234	1978	11
03/28/21	964	227	2224	5
04/04/21	915	144	2510	7
04/11/21	1004	195	2670	6
04/18/21	1149	169	2739	6
04/25/21	1080	221	2605	12
05/02/21	1193	199	2436	9
05/09/21	1045	177	2054	8
05/16/21	805	178	1659	3
05/23/21	764	137	1383	4
05/30/21	700	110	1077	4
06/06/21	464	97	791	2
06/13/21	409	74	684	2
06/20/21	338	45	493	3
06/27/21	359	59	632	7
07/04/21	485	65	761	7
07/11/21	513	80	918	3
07/18/21	818	72	1602	2
07/25/21	1509	85	2494	10
08/01/21	2311	153	3807	5
08/08/21	3329	230	5605	8
08/15/21	4091	324	6653	22
08/22/21	4733	411	7182	22
08/29/21	5342	507	7545	21
09/05/21	5298	530	7512	16
09/12/21	5380	561	7022	12
09/19/21	5295	624	6689	28
09/26/21	4660	560	5552	21

Report Date	Resident Cases # Weekly count	Resident Deaths # Weekly count	Staff Cases # Weekly count	Staff Deaths # Weekly count
10/03/21	4161	554	5102	14
10/10/21	4044	486	4674	17
10/17/21	3738	492	4037	10
10/24/21	3179	400	3596	12
10/31/21	3084	382	3483	8
11/07/21	3372	390	3614	5
11/14/21	3903	415	4246	7
11/21/21	4306	366	4960	7
11/28/21	4465	443	4631	13
12/05/21	4785	480	5715	9
12/12/21	4666	432	5415	11
12/19/21	4392	451	6043	10
12/26/21	6499	393	13605	12
01/02/22	18266	479	42824	10
01/09/22	38144	785	69038	13
01/16/22	48736	1210	69650	8
01/23/22	49340	1540	61379	19
01/30/22	38312	1423	43281	22
02/06/22	25363	1253	25679	16
02/13/22	16438	877	14936	10
02/20/22	10106	686	8828	15
02/27/22	6127	435	5273	11
03/06/22	3775	241	3235	9
03/13/22	2624	178	2063	5
03/20/22	1867	120	1663	3
03/27/22	1290	81	1320	5
04/03/22	1225	74	1371	5
04/10/22	1651	58	1774	0
04/17/22	2474	87	2515	3
04/24/22	3202	76	3625	7
05/01/22	4701	104	4963	3
05/08/22	6190	124	6601	3
05/15/22	7284	152	8647	1
05/22/22	9154	160	10198	4
05/29/22	8633	204	10276	7
06/05/22	8872	210	11083	6

Report Date	Resident Cases # Weekly count	Resident Deaths # Weekly count	Staff Cases # Weekly count	Staff Deaths # Weekly count
06/12/22	8548	194	10646	12
06/19/22	8671	182	10528	14
06/26/22	9181	188	11375	14
07/03/22	11291	212	13346	13
07/10/22	11922	232	14626	10
07/17/22	13403	255	16468	17
07/24/22	15178	338	16862	23
07/31/22	14407	308	16949	22
08/07/22	14639	317	15913	29
08/14/22	13593	278	14677	10
08/21/22	12315	287	13447	20
08/28/22	11126	268	12496	12
09/04/22	10481	238	11770	14
09/11/22	9171	239	10165	9
09/18/22	9055	203	9390	9
09/25/22	8807	204	8493	13
10/02/22	8281	180	7169	11

Notes: Dates refer to the end of a week (e.g., May 31, 2020, refers to the entire week from May 25, 2020, through May 31, 2020).

According to CDC, data used in this figure are part of a live data set, meaning that facilities can correct the data at any time. This figure reflects data downloaded as of October 24, 2022, and includes data through the week ending October 2, 2022. We excluded data for the week ending May 24, 2020, because it is the first week for which data are available and includes cases and deaths from multiple weeks dating back to January 1, 2020.

Weekly case and death counts are likely underreported because they do not include data for the nursing homes that did not report COVID-19 data to CDC for that week or from nursing homes that submitted data that failed data quality assurance checks. Additionally, CMS does not require nursing homes to report data prior to May 2020, although nursing homes may do so voluntarily.

Nursing Home COVID-19 Outbreaks Lasted 4 Weeks on Average and Selected Nursing

Homes Described a Range of Outbreak Experiences

From June 14, 2020, through January 2, 2022, nursing home COVID-19 outbreaks lasted an average of 4 weeks.[23] Officials we interviewed at six selected nursing homes described a range of experiences during such outbreaks, including many challenges and some areas of success.

Nursing Homes Experienced Many COVID-19 Outbreaks from June 2020 through December 2021 with the Average Outbreak Lasting 4 Weeks

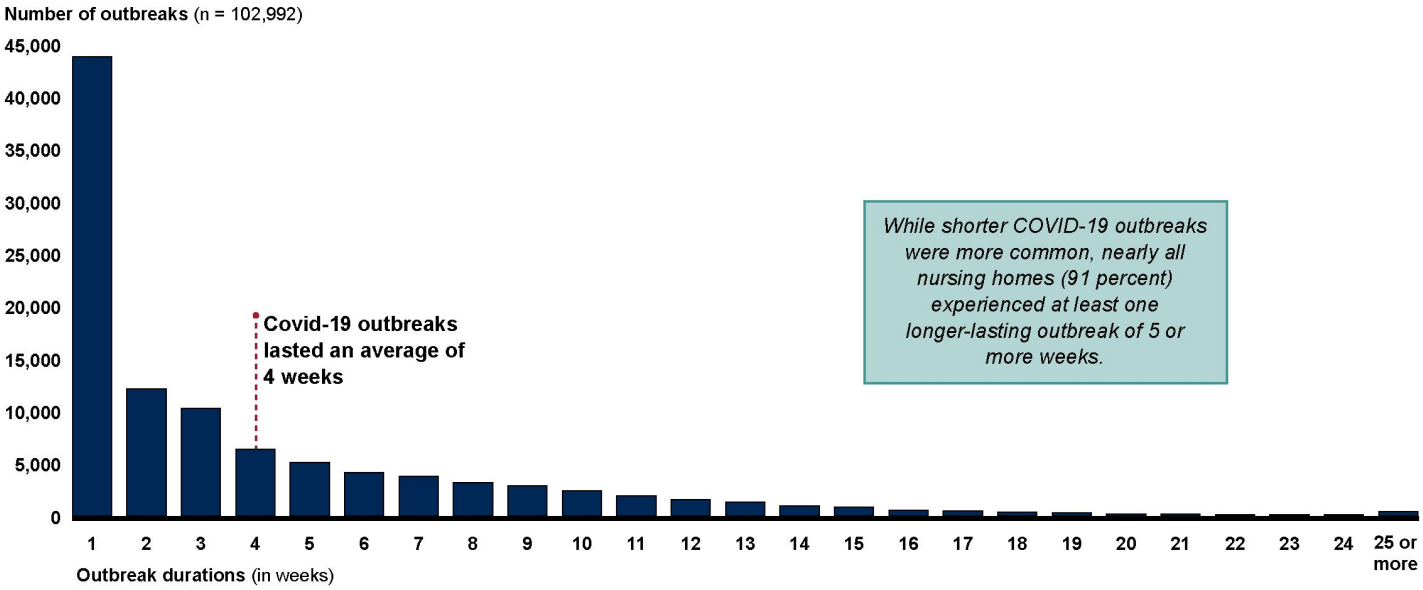
Nursing homes experienced many COVID-19 outbreaks from June 14, 2020, through January 2, 2022, with the average outbreak lasting 4 weeks. Specifically, the 15,281 nursing homes in our analysis experienced from one to 16 outbreaks, with an average of 7.6 outbreaks and a total of 102,992 outbreaks across all homes during our period of review.[24] The average outbreak duration was 4 weeks, ranging from 1 week (42 percent of total outbreaks) to 53 weeks (less than 1 percent of total outbreaks). While shorter outbreaks were more common, nearly all nursing homes (13,898 of 15,281 nursing homes, or 91 percent) experienced at least one longer-lasting outbreak of 5 or more weeks.[25] (See fig. 2). This illustrates how nursing homes were heavily affected by the COVID-19 pandemic—requiring nursing home staff to respond to, and residents to experience, repeated outbreaks and weeks of continued spread of the virus.

[23]An outbreak begins when a nursing home reports a new case of COVID-19 in a resident or staff member, and an outbreak ends when the nursing home has 2 consecutive weeks without a new COVID-19 case. The outbreak duration does not include the 2 consecutive weeks without a new COVID-19 case.

[24]During our period of review, 25 nursing homes reported zero COVID-19 outbreaks.

[25]We previously reported that, from May 2020 through January 2021—a shorter period of review than this analysis—most nursing homes had multiple COVID-19 outbreaks (with an average of about three outbreaks), and 85 percent of homes had outbreaks lasting 5 or more weeks. See GAO-21-367.

Figure 2: Duration of COVID-19 Outbreaks in Nursing Homes, June 14, 2020, through January 2, 2022



Source: GAO analysis of Centers for Disease Control and Prevention data. | GAO-23-104291

Data table for Figure 2: Duration of COVID-19 Outbreaks in Nursing Homes, June 14, 2020, through January 2, 2022

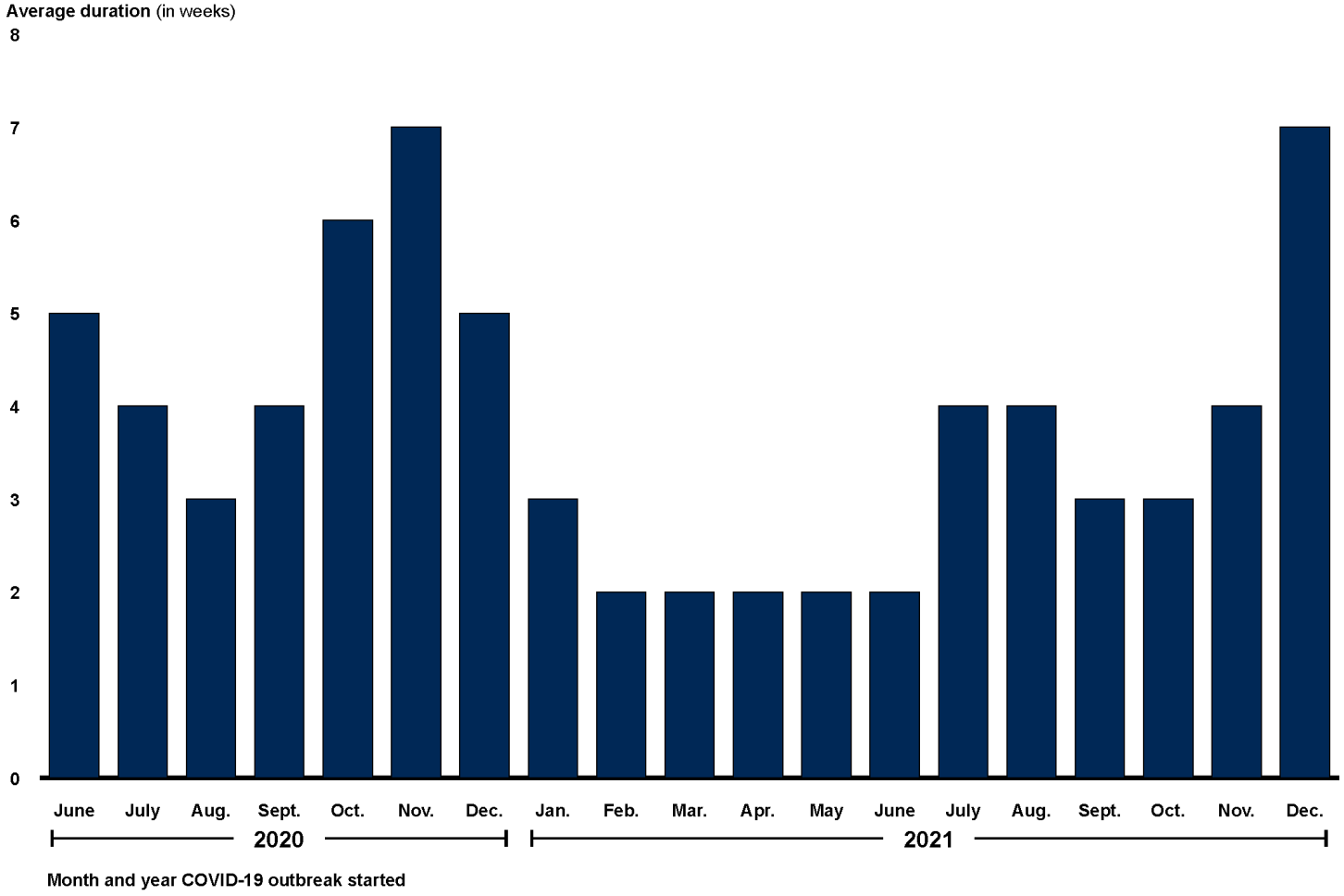
Outbreak duration (in weeks)	Number of outbreaks
1	43753
2	12092
3	10266
4	6316
5	5109
6	4140
7	3753
8	3161
9	2835
10	2364
11	1892
12	1557
13	1302
14	952
15	810
16	550

Outbreak duration (in weeks)	Number of outbreaks
17	443
18	328
19	281
20	187
21	173
22	128
23	84
24	86
25 or more	430
Total (n)	102992

Note: An outbreak begins when a nursing home reports a new case of COVID-19 in a resident or staff member, and an outbreak ends when the nursing home has 2 consecutive weeks without a new COVID-19 case. The outbreak duration does not include the 2 consecutive weeks without a new COVID-19 case.

We found that the average duration of COVID-19 outbreaks beginning near the end of both 2020 and 2021 were longer than outbreaks beginning at other points in either year. Specifically, the longest average outbreaks began in November 2020 and December 2021, lasting an average of 7 weeks and ranging from 1 to 32 weeks and from 1 to 17 weeks, respectively. (See fig. 3). These trends follow a similar pattern to the trends seen in the number of COVID-19 cases reported in nursing homes over the same periods. There were spikes in cases in late 2020, prior to the availability of vaccines in nursing homes, and at the beginning of 2022, corresponding with the emergence of the initial COVID-19 Omicron variant. However, the increases in average outbreak duration appear to precede the spikes in case numbers reported in nursing homes by approximately 1 month. This may be because any outbreaks beginning before the spike in cases continued to spread due to the growing caseloads.

Figure 3: Average Duration of COVID-19 Outbreaks in Nursing Homes by Month the Outbreak Began, June 14, 2020, through January 2, 2022



Source: GAO analysis of Centers for Disease Control and Prevention data. | GAO-23-104291

Data table for Figure 3: Average Duration of COVID-19 Outbreaks in Nursing Homes by Month the Outbreak Began, June 14, 2020, through January 2, 2022

	Month COVID-19 outbreak started	Average duration (in weeks)
2020	June	5
	July	4
	Aug.	3
	Sept.	4
	Oct.	6

	Month COVID-19 outbreak started	Average duration (in weeks)
	Nov.	7
	Dec.	5
2021	Jan.	3
	Feb.	2
	Mar.	2
	Apr.	2
	May	2
	June	2
	July	4
	Aug.	4
	Sept.	3
	Oct.	3
	Nov.	4
	Dec.	7

Note: An outbreak begins when a nursing home reports a new case of COVID-19 in a resident or staff member, and an outbreak ends when the nursing home has 2 consecutive weeks without a new COVID-19 case. The outbreak duration does not include the 2 consecutive weeks without a new COVID-19 case.

High rates of COVID-19 in the community surrounding a nursing home can increase the risk that the virus will enter the home (for example, through staff or visitors) and could spread. We found that nursing homes reported that most outbreaks began with a staff case.[26] Specifically, 74.9 percent of all outbreaks began with a reported staff case the first week of the outbreak, 12.0 percent began with a reported resident case, and 13.1 percent began with both a reported staff and resident case.[27]

[26]Our calculation is based on data reported by nursing homes to CDC on a weekly basis. We do not take into account how many staff or residents were infected during the week, but just identify which category was reported first. Multiple contagion lines are possible for any outbreak, including contagion lines that were not detected by the testing regiment in place at the time.

[27]This is consistent with our prior reporting where we found that 66 percent of all nursing homes from May 2020 through January 2021 reported that their longest-lasting COVID-19 outbreak started with a reported staff case the first week of the outbreak. See GAO-21-367.

Nursing Homes Described a Range of Outbreak Experiences, Noting Challenges and Successes

Officials at the six nursing homes we interviewed described a range of experiences during their COVID-19 outbreaks. In describing their experiences, the nursing home officials highlighted a number of challenges as well as successes when discussing how they prevented and managed outbreaks. See table 1 for a summary of each nursing home's experience with COVID-19 outbreaks. For more information on these nursing homes' experiences during outbreaks, see Appendix III.

Table 1: Nursing Home Officials' Descriptions of COVID-19 Outbreaks

Nursing home	Nursing home officials' descriptions of COVID-19 outbreaks
Nursing home A	This nursing home's first case was a staff member in July 2020, and it was caught early. The required biweekly COVID-19 testing caught additional staff cases throughout the pandemic. The nursing home's first resident outbreak was in October 2020 and started with five residents and then spread to an additional 16 residents. The nursing home officials believed that COVID-19 entered the home from a resident who left the home regularly for dialysis. A year later, in October 2021, the home had a second major resident outbreak.
Nursing home B	This nursing home experienced its largest outbreak in December 2021 with the Omicron surge. During this time, 20 percent of its residents and staff tested positive. Officials attributed this outbreak in part to the re-opening of visitation that occurred in November 2021. Prior to the outbreak, the home had only seen a few cases at a time, and its COVID-19-positive residents had avoided severe illness.
Nursing home C	Officials from this nursing home said that it kept COVID-19 out of the facility until May 2020. The first of two resident outbreaks started with a few staff contracting COVID-19 from the community. Soon after, two residents tested positive, then two more, and so on. During the first outbreak, the virus spread slowly, but the second outbreak in late 2020 spread more rapidly—from two residents to 10 or 12 residents almost immediately.
Nursing home D	Early in 2020, a COVID-19 outbreak affected about a dozen residents. The nursing home's second outbreak in the fall of 2020 was very hard on residents and staff, with 40 residents dying. Officials believed the virus entered the facility through staff as, at the time, the home's staff and the surrounding community had low vaccination rates. In addition to the emotional toll on residents and staff, the number of resident deaths plus staff attrition resulted in the nursing home losing about 50 percent of its capacity and closing a sister nursing home.
Nursing home E	Officials from this nursing home said that it kept COVID-19 out of the facility until July 2020. The outbreak lasted about 5 weeks and culminated with 32 of about 70 residents and 12 staff infected. Eight of those residents died. After that outbreak, the nursing home did not experience any additional large outbreaks, only a few isolated cases. Officials could not trace the origin of the outbreak, but believed that COVID-19 was brought into the facility by a staff member.
Nursing home F	Early in the pandemic, this nursing home had some staff members test positive, but COVID-19 was not transferred to the residents. The first resident did not test positive until November 2020. Officials believed that it was brought into the facility by staff. The home had another outbreak in January 2021 and was able to contain COVID-19 to just one floor of their three-floor facility for a time, but eventually the virus spread.

Source: GAO interviews with officials from selected nursing homes in four states. | GAO-23-104291

While describing their experiences with COVID-19 outbreaks, officials from all six selected nursing homes highlighted a number of critical challenges their homes faced. Specifically, the challenges they described included staffing issues, physical and psychosocial effects on residents, physical space constraints, and supply issues.

- **Staffing issues.** Officials from five of the six nursing homes described challenges related to staffing, including staffing shortages and issues with maintaining staff morale. In addition, the long-term care ombudsman and state survey agency officials in all four selected states also highlighted issues around insufficient staffing, particularly how it can negatively affect resident care.[28]
    - **Staff shortages.** Officials from five of the six nursing homes described experiencing staff shortages during COVID-19 outbreaks.[29] For example, Nursing Home A officials described a staffing "crisis," noting that at one point the home lost about 25 full-time employees, an approximately 25 percent reduction in workforce. Nursing Home E officials described losing about half of its staff, which resulted in the closing of a section of the home and a reliance on traveling nurses and certified nurse assistants to replenish its workforce. Nursing Home F officials noted that, with such limited staff, they had to make difficult choices, including moving the remaining staff between COVID-19 and non-COVID-19 units, which increased the risk of spreading the virus to uninfected residents. Further, Nursing Home D officials explained that being located in a rural area meant that they had fewer

[28]For example, one long-term care state ombudsman described that, because of staffing shortages, staff were only able to address the basic needs of residents, which has resulted in reports of an increase in pressure sores and other issues of resident neglect. Another state long-term care ombudsman described resident concerns of having insufficient staff to meet their needs, where residents of one nursing home described being left on the toilet or bedpan for an hour waiting for staff assistance.

[29]In September 2020 we reported that, as of July 26, 2020, CDC data showed that 18 percent of nursing homes were reporting a shortage of aides, about 16 percent were reporting a shortage of nursing staff, about 9 percent were reporting a shortage of other staff, and 2 percent were reporting a shortage of clinical staff. These shortages persisted over time. See GAO, *COVID-19: Federal Efforts Could Be Strengthened by Timely and Concerted Actions*, GAO-20-701 (Washington, D.C.: Sept. 21, 2020), 131; *COVID-19: Urgent Actions Needed to Better Ensure an Effective Federal Response*, GAO-21-191 (Washington, D.C.: Nov. 30, 2020), 68; *COVID-19: Critical Vaccine Distribution, Supply Chain, Program Integrity, and Other Challenges Require Focused Federal Attention*, GAO-21-265 (Washington, D.C.: Jan. 28, 2021), 64; and *COVID-19: Sustained Federal Action Is Crucial as Pandemic Enters Its Second Year*, GAO-21-387 (Washington, D.C.: Mar. 31, 2021), 77.

available staff, which sometimes resulted in “scary” staffing shortages.

- **Staff morale.** Officials from three of the six nursing homes discussed the psychosocial effect the pandemic had on their staff and the difficulties in maintaining staff morale. For example, Nursing Home D officials described how the outbreaks took away from staff the joy of caregiving and felt that many staff were left traumatized. In addition, Nursing Home B officials found it difficult to find staff willing to work in the COVID-19 units due to the risk of exposure to the virus.

- **Physical and psychosocial effects on residents.** Officials from five of the six nursing homes described challenges with balancing the costs and benefits of nursing home visitation restrictions and other changes to resident rights.[30] While visitation restrictions may have helped prevent or mitigate the spread of COVID-19 in nursing homes, interviewees highlighted the physical and psychosocial harm that these restrictions caused for residents and families. For example, Nursing Home C officials noted that the home relies heavily on social interaction, so, even more than visitation, the suspension of dining facility activities resulted in declines in resident physical and mental health. Specifically, the staff began to see unplanned resident weight loss and an increased need for anti-depressant drugs. Officials told us many of the residents just “gave up.” All four selected states’ long-term care ombudsmen and two of the four states’ survey agencies also highlighted this challenge.[31]

- **Physical space constraints.** Officials from five of the six nursing homes described how the nursing homes’ physical space limited their ability to comply with COVID-19 infection control guidelines. For example, Nursing Home E officials explained that, in order to isolate COVID-19-positive residents, the home had to shuffle healthy residents from one room to another, which may have unintentionally spread the virus. In addition, Nursing Home C officials described how

[30]These challenges are consistent with our prior reporting, which found worsening mental and physical health indicators among nursing home residents during the first year of the pandemic. See GAO-22-105133.

[31]One state long-term care ombudsman said that her staff had witnessed loneliness, weight loss, and significant cognitive declines among residents they had known prior to the pandemic; the official said that residents who had previously recognized ombudsmen staff now looked at them “shell-shocked and blank.” Another state’s long-term care ombudsman said that some residents appeared to have aged 10 years over a 2- or 3-month time period.

they had to keep expanding the boundaries of the COVID-19 unit as more and more residents were diagnosed with the virus. Among the four selected states, one long-term care ombudsmen and officials from two state survey agencies also noted this challenge.[32]

- **Supply issues.** Officials from five of the six nursing homes discussed difficulty acquiring sufficient personal protective equipment early in the pandemic.[33] Officials at Nursing Home E explained that the limited supply of N95 respirators exacerbated an outbreak in July 2020, as many residents and some staff had to use regular procedure masks instead, which are not as protective against the virus. Three selected states' long-term care ombudsmen and officials at all four states' survey agencies also described this as a challenge early in the pandemic.[34]

While describing their experiences with COVID-19 outbreaks, officials from five of the six nursing homes we interviewed also noted some areas of success. For example, officials from three nursing homes described having success early in the pandemic preventing COVID-19 from entering the home. Nursing Home B officials attributed their early success to county actions that resulted in low levels of COVID-19 in the community surrounding the nursing home. Specifically, Nursing Home B is located in an isolated area and the county decided to close roads into the area to keep travelers out. Nursing Homes A and C officials discussed proactive measures that they took to prevent COVID-19, such as suspending new admissions, restricting residents to their rooms, and adopting face mask requirements. However, ultimately, all six selected nursing homes had COVID-19 outbreaks.

[32]Officials at the two state survey agencies said that the physical layout and aging infrastructure of nursing homes made it difficult to establish separate COVID-19 zones and isolation rooms.

[33]This is consistent with our prior reporting on nursing home supply shortages during the COVID-19 pandemic. For example, in September 2020 we reported that, as of July 26, 2020, CDC data showed that 22 percent of nursing homes were reporting that they did not have a 1-week supply of one or more types of personal protective equipment (N95 respirators, surgical masks, gloves, eye protection, or gowns). However, as we reported in January 2021, by December 6, 2020, this number had decreased to 10 percent of nursing homes. See GAO-20-701, 129; GAO-21-191, 67; and GAO-21-265, 63.

[34]One state long-term care ombudsman described how residents could not get the therapy they needed as providers would not come in to a home that lacked adequate personal protective equipment.

Transmission of COVID-19 in the Surrounding Community Had the Strongest Association with Outbreak Duration in Nursing Homes

Based on our analyses, we determined that transmission of COVID-19 in the community surrounding a nursing home—known as community spread—had the strongest association with the duration of an outbreak in the home, followed by the size of the nursing home, whether the nursing home reported staff shortages, and the type of nursing home ownership.[35] Specifically, prior to the introduction of COVID-19 vaccines, being a small, for-profit nursing home that did not report staffing shortages and was located in a county experiencing low community spread was associated with a higher probability of a COVID-19 outbreak ending roughly 12 days earlier when compared to a large, government-owned nursing home that reported staff shortages and was located in a county experiencing high community spread.

Using multivariate statistical models, we estimated the association of nursing home factors with the likelihood that an ongoing COVID-19 outbreak would end during a given week over two different time periods—prior to the introduction of COVID-19 vaccines in nursing homes and after

[35]These factors were statistically significant at a p-value less than 0.05 and had a significant effect on the probability of an outbreak ending in a given week, which we defined as at least plus or minus 1 day (parameter estimate of at least plus or minus 0.14) in either one of the two models. We created two models—one for prior to the introduction of COVID-19 vaccines in nursing homes and one for after the introduction of vaccines in nursing homes. Additional factors were also statistically significant at a p-value less than 0.05, but their impact on outbreak duration was smaller. See table 9 in appendix II for a list of all factors analyzed.

CDC COVID-19 community transmission levels—high, substantial, moderate, or low—describe the amount of COVID-19 spread within each county based on the total new cases per 100,000 persons within the last 7 days and the percentage of positive diagnostic and screening nucleic acid amplification tests during the last 7 days. Health care facilities use these transmission levels to determine infection control interventions. This is unique from CDC COVID-19 community levels, which the agency recommends that individuals and communities use to decide which prevention actions to take based on the latest information.

the introduction of vaccines in nursing homes.[36] Generally, the magnitude of the association of a given factor on outbreak duration was lower in the period after the introduction of vaccines compared to the period prior to the introduction of vaccines.[37] This was the case for community spread, nursing home size, and nursing home-reported staff shortages, but to varying degrees.

Community Spread

Community spread of COVID-19 had the strongest association with the duration of an outbreak in a nursing home throughout our period of review. Specifically, we found that nursing homes located in counties experiencing low, moderate, or substantial levels of community spread had a higher probability of their outbreaks ending during a given week—meaning their outbreaks were shorter—when compared to nursing homes in counties with high community spread.

The magnitude of the association of community spread on outbreak duration was particularly pronounced prior to the introduction of vaccines. Specifically, in the period of time prior to the introduction of vaccines, our model estimated that the duration of a COVID-19 outbreak in a nursing home located in a county experiencing low community spread was approximately 7 days shorter than homes located in counties experiencing high community spread. Even after the introduction of COVID-19 vaccines, community spread was still associated with outbreak duration—the outbreak duration was an estimated 5 days shorter for

[36]We ran two models—one for the period of time prior to the introduction of COVID-19 vaccines (June 14, 2020, through January 3, 2021) and one for the period of time after introduction of COVID-19 vaccines in nursing homes (January 4, 2021, through January 2, 2022). The first nursing home vaccine clinics were held on December 21, 2020. According to CDC, it takes 2 weeks or more for a vaccine to reach full effectiveness, so we set the start date for the period after the introduction of vaccines as 2 weeks after the first vaccine clinics. See appendix II for a detailed description of our methodology.

[37]Throughout the pandemic there have been changes to federal, state, and local COVID-19 policies, improvements in infection prevention and control practices, increased availability of personal protective equipment, and improvements to and increased availability for COVID-19 testing. We have previously reported on the importance of infection prevention and control practices and CDC continues to emphasize the importance of rigorous infection prevention and control practices to prevent the spread of COVID-19 in nursing homes. See GAO-22-105133.

homes located in counties experiencing low community spread compared to homes located in counties experiencing high community spread.

The number of ongoing outbreaks in a given week throughout the period of review was typically much lower in nursing homes located in counties experiencing low community spread compared to nursing homes located in counties experiencing high community spread. These results could indicate that, during times of higher levels of community spread, staff have a greater likelihood of being exposed to the virus in the community and then bringing it into the nursing home.[38] As we previously noted, the first week of most outbreaks (about 75 percent) coincided with a reported staff case rather than a reported resident case. The importance of community spread in determining the probability of an outbreak ending is consistent with what we found in our literature review, with many studies finding that community spread was associated with the presence and severity of COVID-19 within a nursing home.[39]

Nursing Home Size

The size of a nursing home, as measured by the number of Medicare- or Medicaid-certified beds, was also strongly associated with the duration of a COVID-19 outbreak in a nursing home throughout our period of review. Specifically, we found that small (fewer than 50 beds) and medium (50 to 99 beds) nursing homes had a higher probability of their outbreaks ending during a given week—meaning their outbreaks were shorter—when

[38]We recognize that staff may live or visit counties outside of the one where the nursing home is located, but there are no data available to determine this. In addition, visitors, when allowed, could also bring COVID-19 into the nursing home, but there are no data available on nursing home visitors.

[39]For example, one study found that the prevalence of COVID-19 in the community was the strongest predictor of COVID-19 cases and deaths in nursing homes. See Rebecca J. Gorges and R. Tamara Konetzka, "Staffing Levels and COVID-19 Cases and Outbreaks in U.S. Nursing Homes," *Journal of the American Geriatrics Society*, vol. 68, no. 11 (2020): 2462-2466. Another study found that county-level COVID-19 rates and per-capita income were the most significant predictors of COVID-19 outbreaks within nursing homes. See Margaret M. Sugg et al., "Mapping community-level determinants of COVID-19 transmission in nursing homes: A multi-scale approach," *Science of the Total Environment*, vol. 752 (2021). And a third study identified a nursing home's county infection rate as one of the strongest predictors of COVID-19 infection. See Christopher L.F. Sun et al., "Predicting Coronavirus Disease 2019 Infection Risk and Related Risk Drivers in Nursing Homes: A Machine Learning Approach," *JAMDA*, vol. 21, no. 11 (2020): 1533-1538.

compared to large (100 to 199 beds) and very large (200 or more beds) nursing homes.

The association of nursing home size with outbreak duration remained fairly consistent both before and after the introduction of vaccines. Specifically, in the period of time prior to the introduction of vaccines, our model estimated that the duration of a COVID-19 outbreak in a small nursing home was just over 2.5 days shorter than large and very large homes and, after the introduction of vaccines, the association decreased slightly to just under an estimated 2.5 days shorter.

These findings may be a result of smaller homes simply having fewer residents and staff who can get infected by the virus, so the outbreaks do not continue for as long as in larger nursing homes. However, it could also be affected by other differences between smaller and larger nursing homes, such as fewer staff and visitors entering smaller nursing homes, which could decrease the likelihood of continued transmission of the virus. The importance of nursing home size being associated with the probability of an outbreak ending is consistent with what we found in our literature review, with multiple studies finding that larger homes were associated with the presence of COVID-19 or higher numbers of COVID-19 cases.[40]

Staff Shortages

Nursing home-reported staff shortages were also strongly associated with the duration of COVID-19 outbreaks prior to the introduction of vaccines. We found that nursing homes that reported staff shortages had a lower probability of their outbreaks ending during a given week—meaning their

[40]For example, one study found that, as of May 2020, larger nursing home size was significantly associated with both an increased probability of having a COVID-19 case and having a larger outbreak. See Hannah R. Abrams et al., "Characteristics of U.S. Nursing Homes with COVID-19 Cases," *Journal of the American Geriatrics Society*, vol. 68, no. 8 (2020): 1653-1656. Another study found that, from March to August 2020, large nursing homes (150 or more beds) reported 2.6 fewer staff COVID-19 cases per 100 beds compared with small nursing homes (less than 50 beds). See Kira L. Ryskina et al., "Characteristics of Nursing Homes by COVID-19 Cases among Staff: March to August 2020," *JAMDA*, vol. 22, no. 5 (2021): 960-965.

outbreaks were longer—when compared to homes that did not report staff shortages.[41]

Prior to the introduction of vaccines, the magnitude of the association of reported staff shortages on outbreak duration was substantial, but the association was minimal after the introduction of vaccines. Specifically, our model estimated that, prior to the introduction of vaccines, the duration of an outbreak at a nursing home reporting staff shortages was over a day longer than homes that did not report shortages. After the introduction of vaccines, the magnitude of the association of nursing home-reported staff shortages on outbreak duration decreased to less than half a day.

These findings may be due to the associated effects of staff shortages. For instance, nurse staff may need to cover more residents and rooms or temporary staff from other homes or health care settings may need to fill the vacancies, both of which could inadvertently cause the virus to be brought into the home or spread throughout more of the home. As previously noted, nursing homes, state survey agencies, and state long-term care ombudsmen we interviewed described staff shortages and associated challenges, such as adhering to CDC-recommended infection prevention and control practices, as concerns during the pandemic.

We also analyzed variables that directly measure actual nursing home staff levels, rather than perceived shortages reported by nursing home officials, and found less clear results. For instance, prior to the introduction of vaccines, the greater the percentage of new employees, the longer an outbreak lasted, but, while statistically significant, the magnitude of the association was small. After the introduction of vaccines, we found the inverse association—the greater the percentage of new employees, the shorter an outbreak lasted—and, again, the magnitude of the association was statistically significant but small. In addition, we found that the associations of other staffing variables, such

[41]A few studies analyzed the association of various factors with the likelihood of nursing homes reporting staff shortages. For example, two studies found that in mid-2020 reported shortages were greater in nursing homes with COVID-19 cases among residents and staff, as well as in homes with lower quality scores and those serving more Medicaid beneficiaries. See Diane M. Gibson and Jessica Greene, "State Actions and Shortages of Personal Protective Equipment and Staff in U.S. Nursing Homes," *Journal of the American Geriatrics Society*, vol. 68, no. 12 (2020): 2721-2726; and Brian E. McGarry et al., "Severe Staffing and Personal Protective Equipment Shortages Faced By Nursing Homes During the COVID-19 Pandemic," *Health Affairs*, vol. 39, no. 10 (2020): 1812-1821.

as average hours per employee per week and number of employees per resident, on outbreak duration were not always statistically significant.

Our literature review identified one study that analyzed a measure of outbreaks over time and it found an inverse association with nurse staffing ratings.[42] However, our nuanced results are consistent with other studies in our literature review. For example, one study found that, whereas higher staffing levels increase the probability of having at least one COVID-19 case, higher nurse aide and total nursing hours were associated with a lower probability of a larger outbreak and fewer deaths.[43] Another study found that the average number of unique staff members working in a facility on a given day was strongly associated with COVID-19 outcomes in nursing homes, but that, after staff size was controlled for, there was no clear relationship between COVID-19 outcomes and more traditional measures of staffing.[44]

Ownership

The type of nursing home ownership—whether the home is for-profit, non-profit, or government-owned—was also strongly associated with COVID-19 outbreak duration at times during our period of review. We found that nursing homes designated as non-profit or government-owned had a lower probability of their outbreaks ending during a given week—meaning their outbreaks were longer—when compared to homes designated as for-profit. For instance, our model estimated that the duration of an outbreak in a government-owned nursing home was about 1.5 days longer than in for-profit homes after the introduction of vaccines.

The studies in our literature review that found an association between COVID-19 outcomes in nursing homes and nursing home ownership

[42]The study examined the total number of weeks a nursing home was in the top decile of the national distribution of weekly confirmed resident COVID-19 incidence and found that nursing homes with lower nurse staffing ratings had 18 to 22 percent more weeks with high COVID-19 incidence than homes with the highest staffing rating. See Christianna S. Williams et al., "The Association of Nursing Home Quality Ratings and Spread of COVID-19," *Journal of the American Geriatrics Society*, vol. 69, no. 8 (2021): 2070-2078.

[43]See Rebecca J. Gorges and R. Tamara Konetzka, "Staffing Levels and COVID-19 Cases and Outbreaks in U.S. Nursing Homes," *Journal of the American Geriatrics Society*, vol. 68, no. 11 (2020): 2462-2466.

[44]See Brian E. McGarry et al., "Larger Nursing Home Staff Size Linked To Higher Number Of COVID-19 Case In 2020," *Health Affairs*, vol. 40, no. 8 (2021): 1261-1269.

generally found that non-profit homes did better than for-profit homes on the presence or severity of cases and the number of deaths. For example, one study of California nursing homes found that as of May 1, 2020, the size of COVID-19 outbreaks was 12.7 times larger in for-profit nursing homes than in their non-profit counterparts.[45] One study, however, found an inverse association—that, between March and August 2020, for-profit nursing homes were associated with fewer staff COVID-19 cases when compared to non-profit homes.[46] While our results were unexpected based on the general findings of the studies we reviewed, we analyzed a longer period of time and measured a different outcome—outbreak duration rather than the presence or severity of COVID-19 cases or deaths.

Agency Comments

We provided a draft of this report to HHS for review and comment. HHS provided technical comments, which we addressed as appropriate. HHS comments noted some considerations for potential further analysis and potential methodological limitations, and our report describes limitations. HHS comments also highlighted how critical infection prevention and control practices within nursing homes are to reducing the risk of COVID-19 transmission, a point that we and others have also made.

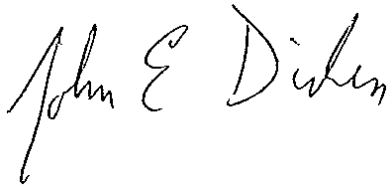
We are sending copies of this report to the appropriate congressional committees, the Secretary of HHS, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-7114 or at dickenj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on

[45]See Ram Gopal, Xu Han, and Niam Yaraghi, “Compress the Curve: A Cross-Sectional Study of Variations in COVID-19 Infections across California Nursing Homes,” *BMJ Open*, vol. 11 (2021): e042804.

[46]See Kira L. Ryskina et al., “Characteristics of Nursing Homes by COVID-19 Cases among Staff: March to August 2020,” *JAMDA*, vol. 22, no. 5 (2021): 960-965.

the last page of this report. GAO staff who made key contributions to this report are listed in Appendix IV.



John E. Dicken
Director, Health Care

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Appendix I: Literature Review—Methodology Description and Results

To understand what is known about the factors associated with COVID-19 outbreaks in nursing homes, we conducted a systematic literature review from January 1, 2020, through October 1, 2021.

Methodology

We conducted a systematic literature review of studies using data to examine the association of any factor with COVID-19 outbreaks in U.S. nursing homes. We searched across five research platforms (EBSCO, Scopus, SSRN, ProQuest, and Dialog's 96 databases), focusing on those databases that covered health and medical issues.[1] We conducted additional targeted internet searches using the Harvard Kennedy School Think Tank Search to capture additional studies. After reviewing the initial returns from our search, we expanded and updated our search strategy to increase the relevance and breadth of our returns. We ultimately searched the original five research platforms plus PubMed and Google Scholar, covering the time period of January 1, 2020, through October 1, 2021.

We identified a total of 49 studies that met our selection criteria, and we conducted a high-level quality review to assess the reliability and methodological soundness of those studies. We considered studies to be sufficiently reliable if they had been peer-reviewed and published in an academic journal, if they were included in a federal or state government publication with similarly rigorous review processes, or if they were

[1]For instance, Embase, EMCare, HSELINE: Health and Safety, Global Health, Medline, and the New England Journal of Medicine.

prepared by or on behalf of a federal or state government entity.[2] As a result of this process, we determined that 43 studies were sufficiently reliable for our use. We excluded three of those studies because, upon further review, they did not meet our original criteria—to select studies that examined the association of one or more factors with COVID-19 outbreaks in U.S. nursing homes. This resulted in a total of 40 selected studies.

To review these selected studies, we applied a framework of three analytical categories describing the type of analysis conducted for each study: presence, severity, and duration of COVID-19 outbreaks in nursing homes. Some studies conducted more than one of these types of analyses.

- **Presence of COVID-19 outbreaks.** Studies investigating the presence of COVID-19 outbreaks assessed the association of state, county, nursing home, or resident factors with a categorical or binary outcome relating to whether or not COVID-19 affected a nursing home. For example, some studies compared nursing homes that had at least one COVID-19 case or death with homes that did not have any COVID-19 cases or deaths. Eighteen studies were categorized as assessing presence.
- **Severity of COVID-19 outbreaks.** Studies investigating the severity of COVID-19 outbreaks assessed the association of state, county, nursing home, or resident factors with a continuous outcome, such as by comparing the cumulative number of COVID-19 cases or deaths in each nursing home. Thirty-three studies were categorized as assessing severity.

[2]If studies did not meet this criterion, we considered them to be sufficiently reliable if they met all of the following three criteria: (1) the study was marked as provisional (e.g., pre-publication status) for a peer-reviewed journal or government publication with a similarly rigorous review process; (2) the study was transparent about its data sources and methods, those sources and methods appeared appropriate for the researchable questions, and the study discussed possible limitations; and (3) the study reported all relevant results, and conclusions and recommendations were adequately supported by those results.

Due to the rapidly evolving nature of the COVID-19 pandemic, we recognized that recent studies may not have had time to complete the full peer review process. We chose to include studies still pending peer review because they could cover emerging issues or use more timely and complete data than studies from earlier in the pandemic. Four of the final 40 studies were marked as provisional at the time of selection. All four of those studies were published by the time of our reporting—three in peer reviewed journals.

- **Duration of COVID-19 outbreaks.** Studies investigating the duration of COVID-19 outbreaks assessed the association of state, county, nursing home, or resident factors with the amount of time that each nursing home was experiencing COVID-19 outbreaks. One study was categorized as assessing duration.

Results

Table 2 lists the 40 studies we reviewed.

Table 2: Studies Included in GAO's Review That Focused on Factors Associated with the Presence, Severity, or Duration of COVID-19 Outbreaks in Nursing Homes, January 1, 2020, through October 1, 2021

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
1	"Is There a Link between Nursing Home Reported Quality and COVID-19 Cases? Evidence from California Skilled Nursing Facilities"	He, Mengying, Yumeng Li, and Fang Fang *JAMDA* July 2020	yes	yes	no	In California from April 23, 2020, through June 2, 2020, nursing homes with a five-star rating and a higher percentage of White residents were less likely to have COVID-19 cases and deaths compared to other nursing homes in the state, after adjusting for nursing home size, ownership, and years of operation.
2	"Nursing Home Characteristics Associated with COVID-19 Deaths in Connecticut, New Jersey, and New York"	Unruh, Mark Aaron et al. *JAMDA* July 2020	yes	no	no	As of mid-April 2020, nursing homes in Connecticut, New Jersey, and New York with the highest percentages of Medicaid patients had an 8.6 percentage point greater probability of six or more COVID-19 deaths than nursing homes with the lowest percentages of these patients in the same three states. Other characteristics associated with COVID-19 deaths included having patients with higher activities of daily living scores, more total beds, higher occupancy rates, and being for-profit.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
3	"Nurse Staffing and Coronavirus Infections in California Nursing Homes"	Harrington, Charlene et al. *Policy, Politics, & Nursing Practice* July 7, 2020	yes	no	no	Between March and May 2020, California nursing homes with total registered nurse staffing levels under 0.75 hours per resident day had a two times greater probability of having COVID-19 resident infections. Nursing homes with lower Medicare five-star ratings on total nurse and registered nurse staffing levels (adjusted for acuity), higher total health deficiencies, and more beds had a higher probability of having COVID-19 residents.
4	"Characteristics and Quality of US Nursing Homes Reporting Cases of Coronavirus Disease 2019 (COVID-19)"	Chatterjee, Paula et al. *JAMA Network Open* July 29, 2020	yes	no	no	In nursing homes from the District of Columbia and 23 states reporting COVID-19 cases from April 22, 2020, through April, 29, 2020, homes that reported COVID-19 cases had similar mean scores as those that did not on overall five-star ratings, as well as star ratings on deficiencies and staffing. Compared to homes that did not report cases, those that did had higher rates of health deficiencies, emergency preparedness deficiencies, reported incidents, and substantiated complaints. Rates of COVID-19 were nearly twice as high in counties where homes reported COVID-19 cases than in those without reported cases.
5	"Characteristics of U.S. Nursing Homes with COVID-19 Cases"	Abrams, Hannah R. et al. *Journal of the American Geriatrics Society* August 2020	yes	yes	no	In all nursing homes from 30 states with facility-level COVID-19 data as of May 11, 2020, larger facility size, urban location, greater percentage of African American residents, non-chain status, and state were significantly related to the increased probability of having a COVID-19 case. Five-star rating, prior infection violation, Medicaid dependency, and ownership were not significantly related. The size of the outbreak was significantly associated with facility size, for-profit status, and state but not with other studied characteristics.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
6	"Mapping Community-Level Determinants of COVID-19 Transmission in Nursing homes: A Multi-Scale Approach"	Sugg, Margaret M. et al. *Science of the Total Environment* August 25, 2020	yes	yes	no	As of June 30, 2020, county-level COVID-19 rates, per-capita income, average household size, population density, unemployment, and a higher percentage of African Americans, in combination with nursing home staffing levels (licensed practical nurses and total staff) and number of fines issued in 2020 were associated with an increased risk of COVID-19 cases in nursing homes. Lower overall quality rating and staffing rating increased the risk of COVID-19 cases, but the results were not statistically significant.
7	"Staffing Levels and COVID-19 Cases and Outbreaks in U.S. Nursing Homes"	Gorges, Rebecca J. and R. Tamara Konetzka *Journal of the American Geriatrics Society* August 28, 2020	yes	yes	no	As of June 14, 2020, higher registered nurse-hours were associated with a higher probability of a nursing home experiencing any COVID-19 cases. However, among nursing homes with at least one case, higher nurse aide hours and total nursing hours were associated with a lower probability of experiencing an outbreak and with fewer deaths. The strongest predictor of cases and outbreaks in nursing homes was per capita cases in the county.
8	"COVID-19 Infections and Deaths among Connecticut Nursing Home Residents: Facility Correlates"	Li, Yue et al. *Journal of the American Geriatrics Society* September 2020	yes	yes	no	Among Connecticut nursing homes with at least one confirmed COVID-19 case, as of April 16, 2020, every 20-minute increase in registered nurse staffing (per resident day) was associated with 22 percent fewer confirmed cases. Compared with one- to three-star facilities, four- or five-star facilities had 13 percent fewer confirmed cases, and facilities with a high concentration of Medicaid residents or racial/ethnic minority residents had 16 percent and 15 percent more confirmed cases, respectively, than their counterparts. Among nursing homes with at least one COVID-19 death, every 20-minute increase in registered nurse staffing significantly predicted 26 percent fewer COVID-19 deaths. Other characteristics did not show statistically significant associations with COVID-19 deaths.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
9	"Association of Nursing Home Ratings on Health Inspections, Quality of Care, and Nurse Staffing with COVID-19 Cases"	Figueroa, Jose F. et al. *JAMA* September 15, 2020	no	yes	no	For 4,254 nursing homes across eight states from January 1, 2020, through June 30, 2020, nursing homes with high ratings on nurse staffing had fewer COVID-19 cases than nursing homes with low ratings on nurse staffing. There was no significant association between high- and low-performing nursing homes in the health inspections or quality measures domains with COVID-19 cases.
10	"Association Between CMS Quality Ratings and COVID-19 Outbreaks in Nursing Homes—West Virginia, March 17-June 11, 2020"	Bui, David P. et al. *Morbidity and Mortality Weekly Report* September 18, 2020	yes	no	no	During March through June 2020, 14 (11 percent) of 123 West Virginia nursing homes experienced COVID-19 outbreaks. Compared with one-starnorated (lowest rating) nursing homes, the odds of a COVID-19 outbreak were 87 percent lower among two- to three-starnorated facilities and 94 percent lower among four- to five-starnorated facilities.
11	"A Study of the COVID-19 Outbreak and Response in Connecticut Long-Term Care Facilities"	Rowan, Patricia et al. *Connecticut Department of Public Health* September 30, 2020	no	yes	no	Through July 22, 2020, nursing homes in Connecticut with a high staffing rating had significantly fewer COVID-19 cases and deaths per licensed bed than nursing homes with a lower staffing rating. Nursing homes in Connecticut located in communities with a greater incidence of COVID-19 were more likely to experience higher numbers of cases and deaths. Nursing homes in Connecticut with a larger share of residents that received dialysis and cancer treatments, which tend to be delivered off site, had more cases per licensed bed. The total number of residents and the share of the licensed beds that were filled also significantly predicted greater COVID-19 spread.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
12	"Variation in SARS-CoV-2 Prevalence in U.S. Skilled Nursing Facilities"	White, Elizabeth M. et al. *Journal of the American Geriatrics Society* October 2020	yes	yes	no	As of late April and early May 2020, a difference in county prevalence of 1,000 COVID-19 cases per 100,000 (1 percent) was associated with a 33.6 percentage point difference in the probability of an outbreak for Genesis HealthCare-owned nursing homes (sample of 341 nursing homes in 25 states) and non-Genesis nursing homes (sample of 3,016 nursing homes in 12 states) combined, and a difference of 12.5 cases per facility for Genesis nursing homes. A 10-bed difference in facility size was associated with a 0.9 percentage point difference in the probability of outbreak. No consistent relationship was found between nursing home Five-Star ratings or past infection control deficiency citations and probability or severity of outbreak.
13	"Prevalence of COVID-19 in Ohio Nursing Homes: What's Quality Got to Do with It?"	Bowblis, John and Robert Applebaum *Journal of Aging & Social Policy* October 11, 2020	yes	yes	no	Through mid-June 2020, just under one-third of nursing homes in Ohio had at least one resident with COVID-19, with over 82 percent of all cases in the state coming from 37 percent of nursing homes. Overall findings on the association between facility quality and the prevalence of COVID-19 showed that having any resident case of the virus or even having a high caseload of residents with the virus is not more likely in nursing homes with lower quality ratings.
14	"Comparative Performance of Private Equity-Owned US Nursing Homes During the COVID-19 Pandemic"	Braun, Robert Tyler et al. *JAMA Network Open* October 28, 2020	no	yes	no	From May 17, 2020, through July 2, 2020, there were no statistically significant differences in staffing levels, COVID-19 cases or deaths, or deaths by any cause between private equity-owned nursing homes and for-profit, nonprofit, and government-owned facilities. For-profit, nonprofit, and government-owned nursing homes were more likely to have at least a 1-week supply of N95 masks and a 1-week supply of medical gowns than private equity-owned nursing homes.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
15	"Mortality Rates from COVID-19 Are Lower in Unionized Nursing Homes"	Dean, Adam, Atheendar Venkataramani, and Simeon Kimmel *Health Affairs* November 2020	no	yes	no	In 355 New York nursing homes with available data from March 1, 2020, through May 31, 2020, health care worker unions were associated with a 1.29 percentage point decrease in the COVID-19 mortality when compared with nursing homes without these unions. Unions were also associated with greater access to personal protective equipment.
16	"Racial and Ethnic Disparities in COVID-19 Infections and Deaths Across U.S. Nursing Homes"	Li, Yue et al. *Journal of the American Geriatrics Society* November 2020	yes	yes	no	For COVID-19 data reported the week of May 25, 2020, nursing homes with a high-proportion of racial and ethnic minorities were 76 percent more likely to have at least one new resident case compared to nursing homes with a low-proportion of racial and ethnic minorities. In addition, similar across-facility disparities were found for the weekly count of new COVID-19 deaths among residents and in the weekly count of new COVID-19 confirmed cases among staff. No substantial disparities in self-reported shortages of staff or personal protective equipment were found.
17	"Stemming the Tide of COVID-19 Infections in Massachusetts Nursing Homes"	Lipsitz, Lewis A. et al. *Journal of the American Geriatrics Society* November 2020	no	yes	no	In response to the COVID-19 pandemic, a statewide effort in Massachusetts offered all 360 nursing homes in the state weekly webinars and answers to questions regarding infection control procedures. The effort also targeted a subset of 123 nursing homes with previous infection control deficiencies for intervention, which included on-site and virtual consultations. During the 9-week intervention period from May 10, 2020, through July 5, 2020, both resident and staff COVID-19 infection rates started higher in the targeted subset of nursing homes, then rapidly declined to the same low level as other nursing homes. Adherence to infection control processes, especially proper wearing of personal protective equipment and cohorting, was significantly associated with declines in weekly infection and mortality rates.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
18	"Predicting Coronavirus Disease 2019 Infection Risk and Related Risk Drivers in Nursing Homes: A Machine Learning Approach"	Sun, Christopher L.F. et al. *JAMDA* November 2020	yes	no	no	As of April 20, 2020, the strongest predictors of COVID-19 cases in 1,146 nursing homes in Massachusetts, Georgia, and New Jersey were the nursing home's county's infection rate and the number of separate units in the nursing home; other predictors included the county's population density, the nursing home's historical health deficiency citations, and the nursing home's resident density (in persons per 1,000 square feet). In addition, the nursing home's historical percentage of non-Hispanic White residents was identified as a protective factor.
19	"The Role of the Social Vulnerability Index in Personal Protective Equipment Shortages, Number of Cases, and Associated Mortality During the Coronavirus Disease 2019 (COVID-19) Pandemic in Michigan Skilled Nursing Facilities"	LeRose, Jennifer J. et al. *Infection Control & Hospital Epidemiology* November 13, 2020	no	yes	no	In May 2020, Michigan nursing homes located in the most vulnerable areas of the state, which was determined using the Centers for Disease Control and Prevention's social vulnerability index, were 2.3 times more likely to experience personal protective equipment shortages than homes located in the least vulnerable areas. In addition, nursing homes located in the most vulnerable areas had 1.6 times the number of COVID-19 cases and 1.9 times the mortality rate compared to nursing homes located in the least vulnerable areas.
20	"Nursing Home Staff Networks and COVID-19"	Chen, M. Keith, Judith A. Chevalier, and Elisa F. Long *Proceedings of the National Academy of Sciences* December 28, 2020	no	yes	no	During the 11-week period from March 13, 2020, to May 31, 2020, 5.1 percent of 50 million smartphone users who visited a nursing home for at least one hour also visited another nursing home and nursing homes, on average, shared connections with an estimated 7.1 other homes. Comparing demographically and geographically situated nursing homes of similar quality suggested that 49 percent of nursing home COVID-19 cases were attributable to shared staff transmitting the virus across multiple nursing homes.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
21	"Compress the Curve: A Cross-Sectional Study of Variations in COVID-19 Infections across California Nursing Homes"	Gopal, Ram, Xu Han, and Niam Yaraghi *BMJ Open* January 6, 2021	yes	yes	no	For California nursing homes as of May 1, 2020, the size of COVID-19 outbreaks among residents in for-profit nursing homes was 12.7 times larger than their non-profit counterparts. Higher star ratings for health inspections were associated with a lower number of infections among both staff and residents and higher star ratings for staffing were associated with a lower number of infections among residents. Conversely, higher star ratings for quality measures were associated with a higher number of infections among staff and residents.
22	"Factors Associated with Racial Differences in Deaths Among Nursing Home Residents with COVID-19 Infection in the U.S."	Gorges, Rebecca J. and R. Tamara Konetzka *JAMA Network Open* February 10, 2021	no	yes	no	As of September 13, 2020, nursing homes in which more than 40 percent of residents were non-White experienced case and death counts that were 3.3-fold higher than those of nursing homes with low proportions of non-White residents. These differences in resident deaths by race were associated with nursing home size and community-level outbreak severity, but not with aggregate health status of residents or other nursing home characteristics.
23	"Nontraditional Small House Nursing Homes Have Fewer COVID-19 Cases and Deaths"	Zimmerman, Sheryl et al. *JAMDA* March 2021	no	yes	no	Green House and other small nursing home models are considered nontraditional due to their size (10-12 beds), universal caregivers, and other home-like features. From January 20, 2020, through July 31, 2020, 219 Green House and other similar small nursing homes located in 20 states had lower COVID-19 incidence and mortality rates compared to 392 geographically proximate traditional nursing homes, especially among the higher and extreme values.
24	"Predicting COVID-19 at Skilled Nursing Facilities in California: Do the Stars Align?"	Poltavskiy, Eduard et al. *BMJ Open Quality* March 3, 2021	yes	no	no	As of May 31, 2020, publicly reported nursing home metrics were associated with COVID-19 presence in California nursing homes. Specifically, nursing home health inspection star ratings, emergency room visits, and short-stay hospitalizations were significantly associated with nursing homes reporting COVID-19 cases.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
25	"High-Minority Nursing Homes Disproportionately Affected by COVID-19 Deaths"	Weech-Maldonado, Robert et al. *Frontiers in Public Health* March 22, 2021	no	yes	no	As of October 25, 2020, nursing homes with a high percentage of minority residents reported 6.5 COVID-19 deaths as compared to 2.6 deaths for nursing homes that had no racial or ethnic minorities. After controlling for interstate differences, facility-level resident characteristics, resource availability, and organizational characteristics, nursing homes with a high percentage of minority residents had 61 percent more COVID-19 deaths as compared to nursing homes with no minorities.
26	"Assessment of Coronavirus Disease 2019 Infection and Mortality Rates among Nursing Homes with Different Proportions of Black Residents"	Travers, Jasmine L. et al. *JAMDA* April 2021	no	yes	no	From January 20, 2020, through July 19, 2020, nursing homes with any Black residents showed significantly more COVID-19 infections and deaths than nursing homes with no Black residents. There were 13.6 percentage points more infections and 3.5 percentage points more deaths in nursing homes with 50 percent or greater Black residents than in nursing homes with no Black residents. Although facility characteristics explained some of the differences found in multivariable analyses, county-level factors and rurality explained more of the differences.
27	"Short-Term Impact of Nursing Home SARS-CoV-2 Vaccinations on New Infections, Hospitalizations, and Deaths"	Mor, Vincent et al. *Journal of the American Geriatrics Society* April 16, 2021	no	yes	no	Two hundred and eighty nursing homes in 21 states owned and operated by Genesis Healthcare were divided into two COVID-19 vaccination groups based on the date the nursing home had its initial vaccine clinic—early vaccination group (December 18, 2020, through January 2, 2021) and late vaccination group (January 3, 2021, through January 18, 2021). After 1 week, early vaccinated nursing homes had a predicted 2.5 fewer incident COVID-19 infections per 100 at-risk residents per week compared with what would have been expected based on the experience of the late vaccinated nursing homes. The rates remained significantly lower for several weeks.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
28	"SARS-CoV-2 in Nursing Homes after 3 Months of Serial, Faciltywide Point Prevalence Testing, Connecticut, USA"	Ehrlich, Hanna Y. et al. *Emerging Infectious Diseases* May 2021	no	yes	no	The Connecticut Department of Public Health began point prevalence survey testing in nursing homes in early May 2020, and this type of testing was formally recommended on May 11, 2020, and mandated weekly in staff effective June 14, 2020. The state initially prioritized a subset of 34 Connecticut nursing homes to receive test kits and these nursing homes performed their first round of testing on or before May 20, 2020. After adjusting for community incidence of COVID-19, the implementation of serial point prevalence survey testing in the 34 nursing homes was associated with a significant decrease in nursing home COVID-19 incidence rates compared to the pre-implementation period.
29	"Shifting US Patterns of COVID-19 Mortality by Race and Ethnicity from June-December 2020"	Kumar, Amit et al. *JAMDA* May 2021	no	yes	no	During the first 6 weeks of a 30-week study period, which started on June 1, 2020, nursing homes with a higher proportion of Black residents reported more COVID-19 deaths per 1,000 followed by nursing homes with a higher proportion of Hispanic residents. Between 7 and 12 weeks, nursing homes with a higher proportion of Hispanic residents reported more deaths per 1,000, followed by nursing homes with a higher proportion of Black residents. However, after 23 weeks (mid-November 2020), nursing homes serving a higher proportion of White residents reported more deaths per 1,000 than nursing homes serving a high proportion of Black and Hispanic residents.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
30	"Characteristics of Nursing Homes by COVID-19 Cases Among Staff: March to August 2020"	Ryskina, Kira L. et al. *JAMDA* May 2021	no	yes	no	From March to August 2020, after accounting for local COVID-19 prevalence, nursing homes in the highest quartile of confirmed resident cases reported 18.9 more staff cases per 100 beds compared with nursing homes that had no resident cases. Large nursing homes (150 or more beds) reported 2.6 fewer staff cases per 100 beds compared with small nursing homes (<50 beds) and for-profit nursing homes reported 0.8 fewer staff cases per 100 beds compared with nonprofit nursing homes. Higher occupancy and more direct-care hours per day were associated with more staff cases. Estimates associated with resident demographics, payer mix, or regional socioeconomic characteristics were not statistically significant.
31	"The BNT162b2 Vaccine Is Associated with Lower New COVID-19 Cases in Nursing Home Residents and Staff"	Domi, Marsida et al. *Journal of the American Geriatrics Society* May 6, 2021	no	yes	no	Dividing the 2,501 nursing homes from the first 17 states to hold vaccine clinics into three groups—vaccine clinic ending the week of December 27, 2020 (cohort 1), January 3, 2021 (cohort 2), or January 10, 2021 (cohort 3)—found that resident and staff cases trended downward in all three cohorts following the vaccine clinic. Time following the first clinic at 5 and 6 weeks was consistently associated with fewer resident cases, resident deaths, and staff cases. Other factors associated with fewer resident and staff cases included facilities with less than 50 beds and high nurse staffing per resident day. Higher Hispanic non-White resident census was associated with fewer resident cases and deaths.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
32	"Trends in COVID-19 Death Rates by Racial Composition of Nursing Homes"	Gilman, Matlin and Mary T. Bassett *Journal of the American Geriatrics Society* May 15, 2021	no	yes	no	From May 25, 2020 to April 18, 2021, death rates in nursing homes categorized into the highest and lowest quintiles of White residents varied over time. Specifically, high-White quintile nursing homes initially had a lower death rate than low-White quintile nursing homes. However, by late December 2020, high-White quintile nursing homes had experienced 3 months of higher community spread and its death rate had increased to nearly three times that of low-White quintile nursing homes. Through the first few months of 2021, death rates declined substantially for both groups of nursing homes, but, overall, high-White quintile nursing homes had more total deaths than low-White quintile nursing homes despite having fewer beds and higher star ratings.
33	"The Association of Nursing Home Quality Ratings and Spread of COVID-19"	Williams, Christianna S. et al. *Journal of the American Geriatrics Society* May 31, 2021	no	yes	yes	As of January 10, 2021, higher nursing home quality ratings were associated with COVID-19 incidence and mortality, as well as with fewer high-incidence weeks, after controlling for local community COVID-19 spread and relevant facility-level factors. For example, nursing homes with a lower overall rating (one- to three-stars) had about 10 percent more weeks with high COVID-19 incidence than the highest (five-star) rated homes, and nursing homes with an overall star rating of one- to three-stars also had about 13 to 16 percent higher incidence and 8 to 10 percent higher cumulative COVID-19 mortality than five-star homes. Higher county COVID-19 incidence was also strongly and consistently associated with higher nursing home COVID-19 incidence and mortality, as well as number of high-incidence weeks.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
34	"Trends in Racial and Ethnic Disparities in Coronavirus Disease 2019 (COVID-19) Outcomes among Nursing Home Residents"	Li, Yue et al. *Infection Control & Hospital Epidemiology* June 16, 2021	no	yes	no	From April 13, 2020, through June 19, 2020, Connecticut nursing homes caring for predominately racial and ethnic minority residents tended to have higher COVID-19 incidence and fatality rates. Specifically, compared to nursing homes with a low proportion of racial and ethnic minority residents, the adjusted COVID-19 incidence rate ratios for the nursing homes with a high proportion of racial and ethnic minority residents were 1.18 in week 1 of the study period and 1.54 in week 10, showing a 30 percent relative increase. Adjusted disparities in COVID-19 fatalities similarly increased over time.
35	"COVID-19 Cases and Death in Nursing Homes: The Role of Racial and Ethnic Composition of Facilities and Their Communities"	Cai, Shubing, Di Yan, and Orna Intrator *JAMDA* July 2021	yes	no	no	From June 7, 2020, through August 23, 2020, the racial and ethnic composition of nursing homes and their communities were both associated with the likelihood of having COVID-19 cases and death in nursing homes. The racial and ethnic composition of the community played an independent role in the likelihood of COVID-19 cases and death in nursing homes, even after accounting for the COVID-19 infection rate in the community. In addition, the relationship between nursing home characteristics and the probability of COVID-19 cases or death varied with the racial and ethnic composition of the community. For example, although an hour increase in registered nurse hours per resident per day was associated with 2.8 percentage point reduction in the probability of COVID-19 cases in nursing homes located in high-minority communities, such relationship was smaller in low-minority communities.

			Methodological focus of study			
	Title	Authors Journal Publication date	Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
36	"Larger Nursing Home Staff Size Linked to Higher Number of COVID-19 Cases in 2020"	McGarry, Brian E. et al. *Health Affairs* August 2021	no	yes	no	From June 7, 2020, through September 27, 2020, sample nursing homes (7,154 nursing homes without resident COVID-19 cases by the start of the study period) in the lowest quartile of staff size had 6.2 resident cases and 0.9 deaths per 100 beds, compared with 11.9 resident cases and 2.1 deaths per 100 beds among nursing homes in the highest quartile. Staff size, including staff members not involved in resident care, was strongly associated with COVID-19 outcomes, even after nursing home size was accounted for. Staffing quality measures, including direct care staff-to-resident ratios and skill mix, were not significant predictors of COVID-19 cases or deaths.
37	"Interpreting COVID-19 Deaths among Nursing Home Residents in the US: The Changing Role of Facility Quality Over Time"	Das Gupta, Debasree et al. *PLOS ONE* September 1, 2021	yes	yes	no	From June 1, 2020, through January 31, 2021, nursing homes with a higher overall quality rating were associated with lower rates of COVID-19 deaths. However, this association diminished over the study period. In addition, the duration of self-reported staff shortages by nursing homes were associated with COVID-19 mortality rates and the adverse role of staff shortages did not change over the study period. Nursing home ownership and shortage of personal protective equipment were not associated with COVID-19 mortality at any point during the study period, but community level variables (such as local COVID-19 death rate) were significant determinants of nursing home mortality outcomes.
38	"State Social Distancing Restrictions and Nursing Home Outcomes"	Li, Yue et al. *Scientific Reports* January 20, 2022	yes	yes	no	From June to August 2020, stronger state social distancing measures were associated with lower weekly rates of new COVID-19 confirmed cases and related deaths among nursing home residents, as well as lower weekly COVID-19 new confirmed case rate among nursing home staff. The magnitude of these associations was larger for nursing homes serving disproportionately more racial and ethnic minority residents.

	Title	Authors Journal Publication date	Methodological focus of study: Factors associated with the presence of COVID-19 outbreaks in nursing homes	Factors associated with the severity of COVID-19 outbreaks in nursing homes	Factors associated with the duration of COVID-19 outbreaks in nursing homes	Summary of key findings
39	"Nursing Home Quality, COVID-19 Deaths, and Excess Mortality"	Cronin, Christopher J. and William N. Evans *Journal of Health Economics* January 21, 2022	no	yes	no	From the start of the pandemic through September 13, 2020, a nursing home's overall five-star rating was highly predictive of COVID-19 mortality, with five-star nursing homes having 15 percent fewer resident COVID-19 deaths than one-star nursing homes. This relationship between quality and COVID-19 deaths did not continue after September 13, 2020, through April 25, 2021. Conversely, higher-quality nursing homes had much higher non-COVID-19 mortality, with five-star nursing homes experiencing 11.4 percent more non-COVID-19 deaths than one-star homes as of September 13, 2020. This relationship strengthened over time through April 2021.
40	"Firm Finances and the Spread of COVID-19: Evidence from Nursing Homes"	Begley, Taylor A., and Daniel Weagley *SSRN* July 28, 2022	no	yes	no	For a sample of 7,045 nursing homes, as of October 18, 2020, those nursing homes with less liquidity and those experiencing more severe cash flow shocks had more cases of COVID-19. For example, increased Medicaid nursing home reimbursement rates was associated with much lower rates of COVID-19 and the difference was largest for nursing homes with the highest share of Medicaid residents.

Source: Studies GAO reviewed. | GAO-23-104291

Notes: We selected studies for inclusion in our review if they used data to examine the association of any factor with COVID-19 outbreaks in U.S. nursing homes.

Studies listed in the table used nationwide data except where specific states are indicated in the summary.

Appendix II: Detailed Description of Methodology for Multivariate Statistical Models

This appendix describes our methods for analyzing how certain nursing home factors were associated with the duration of COVID-19 outbreaks. To do this, we used Centers for Disease Control and Prevention (CDC), Centers for Medicare & Medicaid Services (CMS), and Health Resources and Services Administration data to develop Cox proportional hazard statistical models, which simultaneously evaluate the association between many factors on the probability of a specified outcome and the significance of the relationship. Specifically, our models estimated the probability of an outbreak ending at any given week from June 14, 2020, through January 2, 2022, controlling for a host of factors, such as nursing home characteristics and levels of COVID-19 in the surrounding community, among others. The following describes our definitions, data sources, and methodology.

CDC COVID-19 Nursing Home Data

We used CDC's COVID-19 nursing home data as the foundation for our statistical model. CDC collects weekly nursing home-level COVID-19 information, including cases, deaths, and shortages of staff and supplies, from all Medicare- or Medicaid-certified nursing homes.[1] We analyzed the data for the week ending June 14, 2020, through the week ending January 2, 2022, the last full week of the 2021 calendar year. CMS began requiring nursing homes to report COVID-19 data to CDC in May 2020. Reporting information retroactively to the beginning of the pandemic was voluntary and the data do not clearly distinguish between nursing homes that opted to report information prior to this time and those that did not. Therefore, we started our analysis with data for the week ending June 14, 2020, and excluded data from the first 3 weeks of reporting because

[1]The CDC data on COVID-19 in nursing homes were accessed on May 12, 2022, for the week ending May 1, 2022, from https://data.cms.gov/covid-19/covid-19-nursing-home-data. Nursing homes report aggregate data to CDC on a weekly basis. According to CDC, data used in this analysis are part of a live data set, meaning that facilities can correct the data at any time.

these data contained information from multiple weeks dating back to February 2020.

COVID-19 Outbreaks in Nursing Homes

According to CDC, a COVID-19 outbreak starts the week a nursing home reports a new COVID-19 case in a resident or staff member and ends when the nursing home has 2 consecutive weeks (not included in the outbreak duration) where they report no new staff or resident cases.[2] Using this definition of an outbreak, we analyzed CDC's COVID-19 nursing home data for descriptive statistics, including the number and duration of nursing home outbreaks each nursing home experienced.

From June 14, 2020, through January 2, 2022, 15,281 nursing homes reported data to CDC and we found that those homes had a total of 102,992 outbreaks. Nursing homes had an average of 7.6 outbreaks and a median of eight outbreaks (2,435 nursing homes) over the review period, ranging from zero (25 nursing homes) to 16 (one nursing home) outbreaks. Forty-two percent of the outbreaks (43,753 of 102,992 outbreaks) lasted 1 week, with outbreak duration averaging 4 weeks (6,316 outbreaks) and ranging to 53 weeks (one outbreak).

Other Data Sources

We used additional data sources to create measures of independent variables for the regression analysis. In order to understand our universe of nursing homes, we examined the descriptive information for each variable.

Nursing Home Characteristics

CMS's publicly available nursing home provider information file contains information on a number of characteristics, such as number of beds and non-profit or for-profit status, of nursing homes certified to participate in Medicare or Medicaid.[3] This file contained information on 15,622 nursing

[2]See Centers for Disease Control and Prevention, *Interim Infection Prevention and Control Recommendations to Prevent SARS-CoV-2 Spread in Nursing Homes*, accessed September 7, 2022, https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care.html.

[3]The CMS publicly available nursing home provider information files were accessed on July 22, 2022, from https://data.cms.gov/provider-data/dataset/4pq5-n9py.

homes during our period of review. To determine whether a nursing home was located in a metropolitan or micropolitan core based statistical area, or neither, we merged the provider information file with Health Resources and Services Administration's publicly available county-level Area Health Resources Files.[4] Using the merged file, we examined the breakdown of all Medicare- and Medicaid-certified nursing homes by facility characteristic for all categorical variables. (See table 3). In addition, for two continuous variables, we calculated the average across all nursing homes, finding that nursing homes had an average of 106 beds and an average of 78 residents during our period of review.

Table 3: Nursing Home Facility Characteristics, Categorical Variables, June 14, 2020, through January 2, 2022

Nursing home facility characteristics	Number of nursing homes (n = 15,622)	Percentage of nursing homes
Ownership type		
For-profit	10,651	68.2
Nonprofit	3,384	21.7
Government-owned	834	5.3
Mixed ownership[a]	753	4.8
Certification type		
Medicare-only	667	4.3
Medicaid-only	348	2.2
Medicare and Medicaid	14,606	93.5
Facility type		
Hospital-based	699	4.5
Freestanding	14,923	95.6
Location type[b]		
Metropolitan	11,297	72.3
Micropolitan	2,144	13.7

[4]The Health Resources and Services Administration publicly available 2020 and 2021 Area Health Resources Files (county-level data) were accessed on July 22, 2022, from https://data.hrsa.gov/data/download.

The Health Resources and Services Administration defines core based statistical areas as the following: (a) Metropolitan—at least one urbanized area of 50,000 or more population plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties; and (b) Micropolitan—at least one urban cluster of at least 10,000 but less than 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. We categorized all counties that did not meet the prior two criteria as rural.

Nursing home facility characteristics	Number of nursing homes (n = 15,622)	Percentage of nursing homes
Rural	2,173	13.9
Transitioning area	5	0
Change of ownership in last 12 months		
Home had a change of ownership	1,128	7.2
Home did not have a change of ownership	14,494	92.8
Average number of Medicare- and Medicaid-certified beds		
Less than 50 beds	1,946	12.5
50 to 99 beds	5,948	38.1
100 to 199 beds	6,834	43.8
200 or more beds	894	5.7
Special Focus Facility status[c]		
Special Focus Facility	68	0.4
Special Focus Facility candidate	975	6.2
Both Special Focus Facility home and candidate	101	0.6
Not a Special Focus Facility or candidate	14,478	92.7
Continuing care residential community[d]		
Continuing care residential community	1,872	12.0
Not a continuing care residential community	13,750	88.0
Resident and family councils[e]		
Resident council only	11,601	74.3
Family council only	28	0.2
Both resident and family councils	3,481	22.3
Separate resident council and family council	18	0.1
No resident or family councils	494	3.2
Overall Five-Star rating[f]		
Average rating of four or five stars	5,420	34.7
Average rating of three stars	3,308	21.2
Average rating of one or two stars	6,894	44.1
Health inspections Five-Star rating[f]		
Average rating of four or five stars	3,739	23.9
Average rating of three stars	3,645	23.3
Average rating of one or two stars	8,238	52.7

Nursing home facility characteristics	Number of nursing homes (n = 15,622)	Percentage of nursing homes
Staffing Five-Star rating[f]		
Average rating of four or five stars	3,571	22.9
Average rating of three stars	4,326	27.7
Average rating of one or two stars	7,725	49.5
Quality measure Five-Star rating[f]		
Average rating of four or five stars	7,371	47.2
Average rating of three stars	4,096	26.2
Average rating of one or two stars	4,155	26.6

Source: GAO analysis of Centers for Medicare & Medicaid Services data and the Health Resources and Services Administrations' Area Health Resources Files. | GAO-23-104291

Notes: Percentages do not always add to 100 due to missing data and rounding. The percentage of nursing homes with missing data, if any, was less than 1 percent for each category.

[a]"Mixed ownership" refers to nursing homes that changed their ownership type at any point over the period of review.

[b]The Health Resources and Services Administration defines core based statistical areas as the following: (a) Metropolitan—at least one urbanized area of 50,000 or more population plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties; and (b) Micropolitan—at least one urban cluster of at least 10,000 but less than 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. We categorized all counties that did not meet the prior two criteria as rural. In addition, we considered a "transitioning area" to be a county where the statistical area designation changed at some point during the period of review.

[c]Nursing homes with chronic noncompliance with federal standards can be selected for the Special Focus Facility program, which requires state survey agencies to conduct more frequent oversight and the nursing homes to improve performance or risk termination from the Medicare and Medicaid programs.

[d]Continuing care resident communities offer multiple housing options and levels of care. A nursing home is typically the most service-intensive housing option. Residents may move from one level to another based on their particular needs, while typically still remaining in the community.

[e]Resident and family councils are usually organized and managed by nursing home residents or the residents' families to address concerns and improve the quality of care and life for the resident.

[f]The Five-Star Quality Rating System assigns each nursing home participating in the Medicare or Medicaid programs an overall "star" rating, ranging from one to five. Nursing homes with five stars are considered to have much above average quality, while nursing homes receiving one star are considered to have much below average quality. Calculation of the overall star rating is based on separate ratings that nursing homes receive for each of three components: health inspections, staffing, and quality measures. We calculated the average overall and component ratings for each nursing home during our period of review.

Nursing Home History of Infection Prevention and Control Deficiencies

CMS maintains data on nursing home surveys and deficiencies, including the dates of surveys and the number and type of deficiencies cited.[5] To determine the number of infection prevention and control deficiencies each nursing home received and the average number of these deficiencies cited per nursing home, we merged three different CMS datasets—the Certification and Survey Provider Enhanced Reports system data, the publicly available nursing home inspection dates file, and the publicly available nursing home health citations file.[6] (See table 4.) These files contained information on 13,614 nursing homes with deficiencies in 2017 and 12,343 nursing homes with deficiencies in 2021.

Table 4: Infection Prevention and Control Deficiencies Cited in Nursing Homes, by Year, 2017 through 2021

Year	Number of surveyed nursing homes	Total number of infection prevention and control deficiencies	Average infection prevention and control deficiencies per surveyed nursing home
2017	14,184	6,527	0.5
2018	14,594	6,874	0.5

[5]In general, CMS requires that state survey agencies conduct standard surveys, or evaluations, approximately once each year of the state's nursing homes and investigate both complaints from the public and facility-reported incidents regarding resident care or safety. Beginning in March 2020, CMS required state survey agencies to conduct focused infection control surveys, a new type of survey in response to the pandemic with a narrower scope than a standard survey. State survey agencies are required to perform focused infection control surveys for 20 percent of nursing homes in their state annually, prioritizing those facilities that report new COVID-19 cases and low vaccination rates. If a surveyor from a state survey agency determines that a nursing home violated a federal standard during a survey or investigation, a nursing home receives a deficiency code specific to that standard, known as a deficiency.

[6]For this analysis, we analyzed the deficiency code F-880 for nursing homes that were cited for not meeting federal standards for establishing and maintaining an infection prevention and control program. This code went into effect as part of CMS's restructuring of its deficiency codes on November 28, 2017, replacing a prior deficiency code that had been in effect for several years. For infection prevention and control deficiencies cited in 2017 prior to this restructuring, we used the prior code.

The CMS publicly available nursing home survey dates files were accessed on March 28, 2022, from https://data.cms.gov/provider-data/dataset/svdt-c123. The publicly available nursing home health citations files were accessed on April 12, 2022, from https://data.cms.gov/provider-data/dataset/r5ix-sfxw.

Year	Number of surveyed nursing homes	Total number of infection prevention and control deficiencies	Average infection prevention and control deficiencies per surveyed nursing home
2019	14,776	6,913	0.5
2020	15,406	9,775	0.6
2021	14,128	6,738	0.5

Source: GAO analysis of Centers for Medicare & Medicaid Services data. | GAO-23-104291

Nursing Home Staffing

CMS's payroll-based journal collects employee-level payroll information for various types of nursing home staff, including registered nurses, licensed practical nurses, and nurse aides, from all Medicare- or Medicaid-certified nursing homes. This dataset included information from 15,419 nursing homes during our period of review.[7] Using the payroll-based journal data, we determined the daily staffing levels during our period of review for the 32 types of staff CMS requires nursing homes to report.[8] (See table 5.)

Table 5: Nursing Home Average Daily Staffing Levels, June 14, 2020, through January 2, 2022

Type of staff	Minimum hours worked per day	Average hours worked per day	Maximum hours worked per day
Administrator	7.6	7.7	7.8
Medical director	2.6	2.9	3.3

[7]According to CMS officials, 878 nursing homes had data issues outside of their control from December 11, 2021, through December 31, 2021, possibly resulting in missing payroll data for that time period. CMS provided us with a list of the affected nursing homes, and 874 were in our database. We checked to see if those homes had staffing levels consistent with projections based on prior month and prior year data and we excluded any outbreaks that had incomplete data.

[8]Nursing homes must submit accurate information on direct-care staffing to CMS's payroll-based journal each quarter. This information must be based on payroll and other verifiable and auditable data. CMS allows nursing homes to submit staffing information for 40 different types of staff, including both nurse staff and non-nurse staff. However, the agency only requires reporting for the 32 types of direct-care staff. According to CMS, the remaining eight types of staff (dentist, podiatrist, vocational service worker, clinical laboratory service worker, diagnostic x-ray service worker, blood service worker, housekeeping service worker, other service worker) are voluntary for nursing homes to report because they either do not meet the definition of direct-care or are not paid by nursing homes, so CMS could not audit their data. Due to concerns with the reliability of the data for these eight types of staff, we did not include them in our analysis.

Type of staff	Minimum hours worked per day	Average hours worked per day	Maximum hours worked per day
Other physician	4.4	4.9	5.1
Physician assistant	5.2	5.9	6.3
Registered nurse director of nursing	7.8	7.9	8.0
Registered nurse with administrative duties	7.7	7.7	7.8
Registered nurse	8.3	8.4	8.5
Licensed practical nurse with administrative duties	7.9	8.0	8.1
Licensed practical nurse	8.5	8.6	8.7
Certified nurse aide	7.8	7.9	8.0
Nurse aide in training	7.3	7.6	7.8
Medication aide/technician	8.3	8.5	8.6
Nurse practitioner	5.7	6.0	6.1
Clinical nurse specialist	7.1	7.5	7.8
Pharmacist	3.4	3.8	4.2
Dietitian	6.7	6.8	7.0
Paid feeding assistant	6.9	7.1	7.3
Occupational therapist	6.0	6.2	6.3
Occupational therapy assistant	6.2	6.4	6.5
Occupational therapy aide	6.7	6.9	7.1
Physical therapist	5.9	6.2	6.4
Physical therapy assistant	6.2	6.4	6.5
Physical therapy aide	6.6	6.7	6.8
Respiratory therapist	8.1	8.4	8.5
Respiratory therapy technician	8.1	8.5	8.8
Speech/language pathologist	5.1	5.5	5.7
Therapeutic recreation specialist	7.2	7.4	7.5
Qualified activities professional	7.4	7.6	7.7
Other activities staff	7.0	7.1	7.2
Qualified social worker	7.6	7.7	7.8
Other social worker	7.5	7.6	7.7
Mental health service worker	7.0	7.2	7.4

Source: GAO analysis of Centers for Medicare & Medicaid Services data. | GAO-23-104291

Note: The 32 staff types listed in the table are those CMS requires nursing homes to report to its payroll-based journal.

Reported Nursing Home Staff Shortages during the COVID-19 Pandemic

Using CDC's COVID-19 nursing home data, discussed above, we determined the average number of weeks during our period of review that nursing homes reported facing staff shortages. (See table 6.) The dataset included information reported from 15,466 nursing homes during our period of review.

Table 6: Reported Nursing Home Staff Shortages during the COVID-19 Pandemic, June 14, 2020, through January 2, 2022

Types of reported staffing shortages	Average number of weeks nursing homes reported shortage
Shortage of nursing staff	14.1
Shortage of clinical staff	1.8
Shortage of aides	15.8
Shortage of other staff	8.0

Source: GAO analysis of Centers for Disease Control and Prevention data. | GAO-23-104291

Resident Demographics

CMS's Minimum Data Set collects information on each resident's strengths and needs, as well as resident demographic information, through regular comprehensive assessments conducted by all nursing homes certified to participate in Medicare or Medicaid.[9] The dataset included information for 15,416 nursing homes during our period of review. Using admission, quarterly, and annual assessments in the Minimum Data Set, we determined the average demographic makeup of all Medicare- and Medicaid-certified nursing homes during our period of review. (See table 7.) We also determined each nursing home's case-mix—that is, a numeric representation of the acuity of residents within a

[9]The CMS Minimum Data Set is reported by nursing homes, which are required to complete resident assessments at regular intervals as part of federal requirements to participate in the Medicare and Medicaid programs. Nursing homes are required to conduct resident assessments at entry, quarterly, at discharge, and if there are any significant changes or corrections. During standard surveys, surveyors can evaluate whether a nursing home's assessments meet federal standards for accuracy.

nursing home—using CMS's methodology.[10] We found that the total average case-mix score in nursing homes was 43.8, ranging from 0.5 to 568.9.

Table 7: Nursing Home Resident Demographics, June 14, 2020, through January 2, 2022

Nursing home resident demographics	Percentage of residents within a nursing home
Resident age	
Less than 50	3.1
50 to less than 65	13.7
65 to less than 75	22.4
75 to less than 85	30.0
Greater than 85	30.8
Resident gender	
Male	40.9
Female	59.1
Resident race and ethnicity	
White	75.1
Black or African American	12.7
Hispanic or Latino	5.1
Asian	1.8
Native Hawaiian or Other Pacific Islander	0.2
American Indian or Alaska Native	0.4
Mixed ethnicity	0.4
Unknown	4.7

Source: GAO analysis of Centers for Medicare & Medicaid Services data. | GAO-23-104291

Note: Percentages do not always add to 100 due to rounding.

Community Conditions during the COVID-19 Pandemic

CDC county-level COVID-19 community transmission data contain the daily levels of community transmission by county, known as community spread. The dataset included information on 3,222 counties. Using this

[10]We used CMS's methodology to calculate the numeric case-mix index value associated with the resource utilization group obtained from non-therapy index maximizing classification.

data, we analyzed the number of weeks during our period of review that the level of COVID-19 community spread in each county was categorized by CDC as high, substantial, moderate, or low.[11] (See table 8.)

Table 8: Number of Weeks Counties Were Designated by CDC as Having High, Substantial, Moderate, or Low Levels of Community Transmission of COVID-19, June 14, 2020, through January 2, 2022

CDC levels of community spread	Minimum number of weeks	Average number of weeks	Maximum number of weeks
High	0	50.0	80.4
Substantial	0	11.9	37.0
Moderate	0	13.4	41.7
Low	0	6.7	82.0

Source: GAO analysis of Centers for Disease Control and Prevention (CDC) data. | GAO-23-104291

Note: CDC calculated the level of community transmission using two indicators: (1) the total new cases per 100,000 persons within the last 7 days and (2) the percentage of positive diagnostic and screening nucleic acid amplification tests during the last 7 days. If the two indicators suggest different transmission levels, the higher level is selected. Possible transmission categories are high (counties with 100 or more cumulative cases per 100,000 population or a cumulative test positivity result of 10.0 percent or higher in the past 7 days), substantial (counties with 50-99 cumulative cases per 100,000 population or a cumulative test positivity result between 8.0-9.9 percent in the past 7 days), moderate (counties with 10-49 cumulative cases per 100,000 population or a cumulative test positivity result between 5.0-7.9 percent in the past 7 days), or low (counties with fewer than 10 cumulative cases per 100,000 population in the past 7 days and a cumulative percent test positivity result below 5 percent in the past 7 days).

Analyzing the Data

We merged the CDC COVID-19 nursing home data with the data sets described in the sections above, creating a single analytic data file for our study period of June 14, 2020, through January 2, 2022.

[11]CDC calculated the level of community transmission using two indicators: (1) the total new cases per 100,000 persons within the last 7 days and (2) the percentage of positive diagnostic and screening nucleic acid amplification tests during the last 7 days. If the two indicators suggest different transmission levels, the higher level is selected. Possible transmission categories are high (counties with 100 or more cumulative cases per 100,000 population or a cumulative test positivity result of 10.0 percent or higher in the past 7 days), substantial (counties with 50-99 cumulative cases per 100,000 population or a cumulative test positivity result between 8.0-9.9 percent in the past 7 days), moderate (counties with 10-49 cumulative cases per 100,000 population or a cumulative test positivity result between 5.0-7.9 percent in the past 7 days), or low (counties with fewer than 10 cumulative cases per 100,000 population in the past 7 days and a cumulative percent test positivity result below 5 percent in the past 7 days).

Exclusions

We merged the data using weekly COVID-19 outbreaks as our unit of analysis. First, we excluded 117 nursing homes that had 50 weeks or more of CDC COVID-19 nursing home data that was missing or did not pass quality control. Second, we excluded 24 nursing homes that did not have data in CMS's publicly available data files. This resulted in a total of 15,322 nursing homes with 100,780 outbreaks. Third, we excluded 4,632 outbreaks due to missing data in CMS's Minimum Data Set, CMS's payroll-based journal, or both. All other data files were complete and did not result in any exclusions. After these exclusions, our analytic file included 15,091 nursing homes that had a total of 96,148 COVID-19 outbreaks.

Factors Not Included in Analysis

We could not control for all factors that may be associated with COVID-19 outbreak duration in nursing homes, often due to inconsistent data, incomplete data, or a lack of data entirely. Some examples include the following.

- **Equipment shortages.** We have reported on the lack of COVID-19 tests and personal protective equipment in nursing homes, particularly during the first year of the pandemic.[12] However, while CDC collected information from nursing homes on these types of shortages in its COVID-19 nursing home data, these variables were inconsistent across our period of review. For example, after the week ending on March 7, 2021, CDC removed questions related to whether nursing homes had any supply or a one week supply of personal protective equipment and added in similar, but slightly different questions, making it difficult to track consistently over time.
- **Vaccination rates.** The development and subsequent availability of COVID-19 vaccines for nursing home residents and staff at the end of 2020 was an important milestone in the pandemic, which corresponded with dramatic decreases in nursing home cases and deaths through the first part of 2021. However, nationwide data on the rate of vaccinations within each nursing home is incomplete—reporting was not required until May 2021—so we could not include these data as a variable in our regression. Instead, we ran two separate models to account for the time period before the introduction

[12]See GAO-20-701, 129; GAO-21-191, 67; and GAO-21-265, 63.

of vaccines and the time period after the introduction of vaccines. This is explained further in the following section.

- **State and local policies.** States and localities varied throughout the pandemic on what, if any, COVID-19 policies, such as masking requirements or the closure of non-essential businesses, they had in place. However, even when policies were in place, we could not quantify how well communities surrounding a nursing home enforced or complied with the policies. Therefore, rather than assess the reliability of data on state and local COVID-19 policies, we assumed that analyzing the effect of transmission of COVID-19 in the county where each nursing home is located would reflect both the local policies and the community's compliance with the policies.
- **Adherence to infection prevention and control practices.** We have previously reported on the importance of infection prevention and control practices and CDC continues to emphasize the importance of rigorous infection prevention and control to prevent the spread of COVID-19 in nursing homes.[13] Because CMS collects data on nursing home deficiencies, we were able to control for a nursing home's history of infection prevention and control deficiencies; however, we could not account for the day-to-day adherence by nursing home staff and residents to infection prevention and control practices.

Multivariate Regression Model

We conducted a series of multivariate Cox proportional hazard regression models. The purpose of the model is to evaluate simultaneously the effect of several factors on outbreak duration. A hazard regression model allows us to examine how specified factors may be associated with the rate of a particular event happening (e.g., outbreak ending) at a particular point in time and allows time-varying covariates to capture the effects of changes in independent variables over time.[14] The rate is commonly referred to as the hazard rate. Predictor variables (or independent factors) are usually termed covariates in the survival-analysis literature. The Cox model is expressed by the hazard function denoted by λ(t). Briefly, the hazard

[13]See GAO-22-105133.

[14]We did not use a hierarchical model on top of an already complex model. A hierarchical model would help to account for potential correlation between outbreak durations within the same nursing home. When we checked for this potential correlation in an hierarchical model with no other factors included, we found there was no significant correlation between outbreak durations within the same nursing home.

function can be interpreted as the probability of the outbreak ending at time t. It can be estimated as follow:

$$\lambda_k (t; Z_{ki}) = \lambda_{k0} \exp\{\beta'_k Z_{ki}(t)\}$$

where

- k is the event, which in our case is the outbreak ($k = 1, \ldots, K$).
- i is the subject, which in our case is the nursing home ($i = 1, \ldots, n$).
- Z represents the set of covariates. Z_{ki} represents the specific covariate associated with ki.
- $\lambda_{k0}(t)$ is the baseline hazard function (hazard rate at time t).
- $\exp\{\beta'_k Z_{ki}(t)\}$ is the expected hazard ratio of covariates at time (t).

The value of exp(β) is the hazard ratio. A value of β greater than zero, or equivalently a hazard ratio greater than one, indicates that as the value of the covariate increases, the hazard increases and thus the duration of the outbreak decreases.

Multivariate regression modeling is a statistical method that examines multiple variables simultaneously to estimate whether each of these variables are more likely or less likely to be associated with a certain outcome, controlling for the other variables. A multivariate regression analyzes the statistical influence of each individual factor with the outcome. This type of modeling allowed us to test the association between nursing home factors, such as nursing home size or nursing home ownership, and the probability (hazard rate) of the COVID-19 outbreak ending, while holding other nursing home information constant (such as staffing levels and resident demographics as independent variables).

A Cox proportional hazard model provides an estimated hazard ratio for each independent variable, where a value greater than one indicates a higher likelihood of the COVID-19 outbreak ending (the dependent, or outcome, variable) and an estimated hazard ratio less than one indicates lower probability of the outbreak ending, controlling for all the other independent variables. For example, an overall staffing level with an estimated hazard ratio of 2.0 would indicate a higher probability of an outbreak ending. In contrast, an overall staffing level with an estimated staffing ratio of 0.5 would indicate a higher probability that the outbreak continues.

The statistical significance of the results for each variable is determined by a p-value of less than 0.05. As a result, in our report, we state that hazard ratios that are statistically significant and greater than 1.00 or lower than 1.00 indicate that nursing homes with that characteristic (e.g., rural location) are more likely or less likely, respectively, to have their COVID-19 outbreak end at that point in time, relative to their corresponding reference category. In cases where the p-value was greater than 0.05, we report that we could not identify any statistically significant differences, which means that we could not conclude that there was an association between that attribute and the likelihood of the outbreak ending.

We developed multivariate Cox proportional hazard models to test the extent of association with outcome and statistical significance of all independent factors presented in table 9.[15] We ran two models—one for the period of time prior to the introduction of COVID-19 vaccines (June 14, 2020, through January 2, 2021) and one for the period of time after introduction of COVID-19 vaccines in nursing homes (January 3, 2021, through January 2, 2022).[16] Hazard ratios from the multivariate model represent simultaneous relationships of all independent factors specified in the model with the outcome. Therefore, there is a reference category for each categorical factor specified in the multivariate model. As an example, for nursing home size, small and medium nursing homes are compared against large and very large nursing homes as the reference category in the model. Based on the results in Table 9, in the pre-vaccine time period, small nursing homes had a statistically significant hazard ratio of 1.444, indicating that small homes were distinct from large and very large homes and that the small homes had shorter outbreaks than larger homes. Further, the parameter estimate of 0.367 indicates that an outbreak was likely to end approximately 2.5 days earlier in small homes than in large and very large homes.

[15]The model results presented are right-censored.

[16]We initially ran a single model with a dummy variable for the time period that COVID-19 vaccinations were available but found that this dummy variable was overly dominate. Therefore, by running two separate models we were able to tease out the effects of other independent variables.

Table 9: Multivariate Regression Results from Cox Proportional Hazard Model, COVID-19 Outbreak Duration by Vaccination Time Period, June 14, 2020, through January 2, 2022

	Hazard ratio (parameter estimate)	
Independent factors	**Pre-vaccine time period (June 14, 2020, through January 2, 2021)**	**Post-vaccine time period (January 3, 2021, through January 2, 2022)**
Categorical variables		
Reference category: High community spread		
Low community spread	2.784** (1.024)	1.999** (0.692)
Moderate community spread	2.382** (0.868)	1.920** (0.652)
Substantial community spread	2.014** (0.700)	1.703** (0.533)
Reference category: Metropolitan		
Rural	1.023 (0.023)	1.042* (0.041)
Micropolitan	0.978 (-0.022)	0.990 (-0.010)
Reference category: Large (100 no 199 beds) or very large (200 or more beds)		
Medium (50 to <100 beds)	1.177** (0.163)	1.167** (0.155)
Small (<50 beds)	1.444** (0.367)	1.414** (0.346)
Reference category: For-profit		
Non-profit	0.882** (-0.125)	0.884** (-0.124)
Government-owned	0.903** (-0.102)	0.799** (-0.225)
Reference category: No reported staff shortages		
Reported staff shortages	0.843** (-0.170)	0.944** (-0.058)
Reference category: Lower overall star rating (one- to three-stars)		
Higher overall star rating (four- and five-stars)	0.933** (-0.070)	0.956** (-0.045)
Reference category: Lower health inspection star rating (one- to three-stars)		
Higher health inspection star rating (four- and five-stars)	1.004 (0.004)	1.006 (0.006)
Continuous variables		
Number of prior outbreaks	0.959** (-0.042)	1.074** (0.072)
Percentage of new employees[a]	0.987** (-0.013)	1.003** (0.003)
Average hours per employee per week	0.996 (-0.004)	1.000 (0.000)
Number of employees per resident	0.984 (-0.016)	0.969** (-0.031)
Nursing home case-mix	0.995** (-0.005)	0.995** (-0.005)
Percentage of occupied beds	1.001 (0.001)	0.999** (-0.001)
Number of infection prevention and control deficiencies cited in the last year	0.955** (-0.046)	1.006 (0.006)
Percentage of residents over 75	1.001 (0.001)	1.001 (0.001)

Independent factors	Hazard ratio (parameter estimate)	
	Pre-vaccine time period (June 14, 2020, through January 2, 2021)	Post-vaccine time period (January 3, 2021, through January 2, 2022)
Percentage of residents less than 65	1.005* (0.005)	1.006** (0.006)
Percentage of female residents	1.001 (0.001)	1.002** (0.002)
Percentage of minority residents	1.001** (0.001)	1.001* (0.001)

Legend:

"*" indicates that this variable is statistically significant at p-value <0.05.

"**" indicates that this variable is statistically significant at p-value <0.001.

Source: GAO analysis of Centers for Disease Control and Prevention, Centers for Medicare & Medicaid Services (CMS), and Health Resources and Services Administration data. | GAO-23-104291

Notes: Multivariate Cox Proportional Hazard models are used to test the extent of association with outcome and statistical significance of all independent factors.

The hazard ratio is the probability of an outbreak ending for the given factor relative to its reference category. In our report, we state that hazard ratios that are statistically significant and greater than 1.00 or lower than 1.00 indicate that nursing homes with that characteristic are more likely or less likely, respectively, to have their COVID-19 outbreak end at that point in time.

The parameter estimate is the measure of the direction and size of the effect that a single unit change in the independent variable has on the dependent variable. The parameter estimate is based on weekly data (parameter estimate of 1.00 equals 1 week); therefore, a parameter estimate of approximately +/- 0.143 is equivalent to one day.

[a]New employees were defined as any employee at a specific nursing home without a record in CMS's payroll-based journal in the prior 6 weeks.

Data and Model Limitations

Although the data quality is sufficiently reliable for the purposes of our objective, there are some limitations to note. The CDC COVID-19 nursing home data, which forms the backbone of the COVID-19 outbreak variable and other variables, is self-reported weekly by nursing homes. The number of COVID-19 cases is based on the testing technology and infrastructure available to homes at the time the data were reported; the availability and accuracy of the tests may have changed over time, but there is no reason to believe that any bias in testing occurred between homes at the time. In addition, according to CDC officials, the agency's definition of a COVID-19 outbreak is an epidemiologic one and has been used during the pandemic to trigger the implementation of additional infection prevention and control practices, such as screening testing for residents and staff to determine if unrecognized cases were in the nursing home. Therefore, an individual outbreak in our analysis does not necessarily imply that all of the COVID-19 cases reported during that outbreak were related to a single introduction of COVID-19 into the facility.

CDC officials also noted that the inclusion of staff COVID-19 cases in our analysis of outbreaks may inflate the total number and duration of

outbreaks because routine screening testing of asymptomatic nursing home staff could have identified infected staff who may have never entered the facility. This situation would reflect COVID-19 transmission in the community rather than transmission in the nursing home.

Other variables in the COVID-19 nursing home data weekly reports, such as the availability of staffing and personal protective equipment, are also self-reported. While noting the staffing shortages are self-reported, we also included CMS payroll-based journal data that provide an objective measure of staffing. In the case of personal protective equipment and infection containment supplies (such as hand sanitizer), CDC altered the questions at different periods during the pandemic. This resulted in data that could not be tracked over time and thus we did not include variables on personal protective equipment shortages in the final models. The vaccination of staff and residents posed a slightly different problem, in that CMS did not require nursing homes to report data to CDC on the number and percent of staff and residents vaccinated until about 5 months into the vaccination program. To account for the possible role that the presence of the vaccine played in COVID-19 outbreaks, we first created a dummy variable to acknowledge the availability of the vaccine. When this proved to be an overwhelmingly significant variable, we split the model into two time periods, as described above.

Other datasets also had limitations. In its payroll-based journal CMS allows nursing homes to submit staffing information for 40 different types of staff, including both nurse and non-nurse staff. While CMS has instituted checks and audits to ensure that nurse staffing data reported in the payroll-based journal are accurate, CMS does not have a process to ensure the accuracy and completeness of staffing information for non-nurse staff.[17] Based on interviews with CMS officials, we determined that, despite this limitation, we could still use most of the non-nurse payroll-based journal data for the purposes of our analysis. However, CMS only requires reporting for 32 of the 40 types of staff. Data for the remaining eight types of non-nurse staff—which include housekeepers and others

[17]The Department of Health and Human Services' Office of Inspector General has recommended that CMS take steps to ensure the accuracy of payroll-based journal data for non-nurse staff that it chooses to include on its Care Compare website. For example, CMS may consider adding physical therapists—the only type of non-nurse staff with data currently found on Care Compare—to its audits of payroll-based journal data. See Department of Health and Human Services Office of Inspector General, *CMS Use of Data on Nursing Home Staffing: Progress and Opportunities To Do More*, OEI-04-18-00451 (Washington, D.C.: March 2021).

who may not care for residents in a therapeutic manner but still may come into close contact with residents—are neither required to be reported nor audited for accuracy.[18] As a result, we decided to exclude these eight types of staff from our analysis. Therefore, we do not know if these types of staff were associated with the duration of outbreaks.

When using staffing variables created based on data in the payroll-based journal, we were generally not able to separate out the influence of certain staff roles (e.g., registered nurses and nurse aides) to our satisfaction. While many of the homes we interviewed pointed to staffing as an issue, the actual employment data, despite several different iterations using different breakouts of staffing roles, did not indicate a significant role by particular kinds of staff.

CDC data on community spread is based on test results. While there is no imputation that accounts for cases that exist but for which no test was done or tests were done at home and not reported, we used CDC's categorization of community spread, which is based, in part, on the percentage of positive diagnostic and screening nucleic acid amplification tests, which are required to be reported. CDC data is assumed to be reliable for our purposes because we can assume that there was no systematic bias with respect to the duration of outbreaks in nursing homes.

In general, CMS data on nursing home surveys and investigations and their resulting deficiencies is considered reliable. We should note that for a number of months during the first year of the pandemic, regular standard surveys of nursing homes and low priority investigations were temporarily suspended, replaced by focused infection control surveys, which evaluated compliance with CMS infection prevention and control policies. Based on this and findings in prior reports we focused on a home's history of infection prevention and control deficiencies rather than on their overall number and severity of deficiencies.

The CMS Minimum Data Set was used to determine the case-mix of the residents in a home as well as the demographics of each home's

[18]According to CMS, these eight types of staff (dentist, podiatrist, vocational service worker, clinical laboratory service worker, diagnostic x-ray service worker, blood service worker, housekeeping service worker, other service worker) are voluntary for nursing homes to report because they either do not meet the definition of direct-care or are not paid by nursing homes, so their data would not be able to be audited by CMS.

population. Many variables within the Minimum Data Set are self-reported by the resident, the family, or a staff member on behalf of a resident, and we acknowledge this can raise some questions of data reliability, some of which have been reported in the literature.[19] We determined that the demographic data are sufficiently reliable. Further, we determined that case-mix data are sufficiently reliable given that any bias in case-mix is likely to exist in all nursing homes, so comparison of homes is not particularly problematic.

[19]Some studies have found that the Minimum Data Set data reported by nursing homes underreports anti-psychotic use and falls. For examples, see HHS Office of Inspector General, *CMS Could Improve the Data It Uses to Monitor Antipsychotic Drugs in Nursing Homes*, OEI-07-19-00490 (Washington, D.C.: May 3, 2021), and J. Mintz et al., "Validation of the Minimum Data Set Items on Falls and Injury in Two Long-Stay Facilities," *Journal of the American Geriatrics Society*, vol. 69, no. 4 (April 2021).

Appendix III: Nursing Home Officials' Descriptions of COVID-19 Outbreaks, including Challenges and Successes

Table 10: Nursing Home Officials' Descriptions of COVID-19 Outbreaks, including Challenges and Successes

Nursing home	Description of COVID-19 outbreaks, including challenges and successes
Nursing home A *Non-profit* *Large (100-199 beds)*	This nursing home kept COVID-19 out of the facility until July 2020, which was likely due to the proactive steps it took to restrict residents to their rooms and adopt face mask requirements. Their first case was a staff member, and it was caught early. The required biweekly COVID-19 testing caught additional staff cases throughout the pandemic. The challenges posed by the reduction in staff due to quarantine or symptoms was "manageable although not optimal." However, the home reached a staffing "crisis" as the pandemic continued, noting that they were down 25 full-time employees. The nursing home's first resident outbreak was in October 2020 and started with five residents and then spread to an additional 16 residents. The nursing home officials believed that COVID-19 entered the home from a dialysis patient. The COVID-positive residents were able to be isolated in one ward of the nursing home and staff who already had tested positive and had returned from their quarantine were willing to work in the COVID-19 unit. A year later, in October 2021, the home had a second "major" resident outbreak.
Nursing home B *For-profit* *Large (100-199 beds)*	This nursing home experienced its largest outbreak in December 2021 with the Omicron surge. During this time, 20 percent of its residents and staff tested positive. Officials attributed this outbreak in part to the re-opening of visitation that occurred in November 2021. Prior to the outbreak, the home had only seen a few cases at a time, and its COVID-19-positive residents had avoided severe illness. A lot of the home's prior success in keeping COVID-19 out of the facility was due to community decisions that resulted in low levels of COVID-19. Located in an isolated area, the county was able to close a road into the community during the worst of the pandemic in 2020 to keep travelers out. However, these community policies were discontinued by winter of 2021, and the nursing home could no longer restrict visitation. Officials also discussed staffing shortages and staff fatigue as challenges experienced during outbreaks. For example, at one point the home was down five working staff members as COVID-19-positive staff had to quarantine. In addition, the home had to staff a separate COVID-19 unit for just a few COVID-19-positive residents during a smaller outbreak, requiring more staff. It was also difficult to find staff willing to work the COVID-19 unit due to the risk of exposure.

Nursing home	Description of COVID-19 outbreaks, including challenges and successes
Nursing home C *For-profit* *Very large (200+ beds)*	This nursing home kept COVID-19 out of the facility until May 2020, which the home attributed to having enough personal protective equipment, suspending new admissions, and adopting face mask requirements. But mitigation measures only worked for a while. The first of two resident outbreaks started with a few staff contracting COVID-19 from the community. Soon after, two residents tested positive, then two more, and so on. During the first outbreak, the virus spread slowly, but the second outbreak in late 2020 spread more rapidly—from two residents to 10 or 12 residents almost immediately. During the first outbreak, the boundaries of the COVID-19 unit never changed, but during the second outbreak the home had to keep expanding the boundaries. Throughout the outbreaks, the nursing home was able to maintain its staffing levels—even when staff were out sick with COVID-19. However, the psychosocial toll had significant negative effects on residents. The suspension not only of visitation but also dining facility activities resulted in declines in resident physical and mental health. The staff began to see residents with weight loss and an increased need for anti-depressant drugs. Many of the residents just "gave up."
Nursing home D *Non-profit* *Very large (200+ beds)*	This nursing home was hit "like a brick" in the fall of 2020. Earlier in 2020, a COVID-19 outbreak affected about a dozen residents, but cases in its outbreak in the fall of 2020 "wreaked havoc" on residents and staff, with 40 residents dying. The loss of so many residents took a heavy emotional toll on staff and fellow residents. Officials believed the virus entered the facility through staff as, at the time, the home's staff and the surrounding community had low vaccination rates. In addition to the emotional toll on residents and staff, the number of resident deaths plus staff attrition resulted in the nursing home losing about 50 percent of its capacity and closing a sister nursing home. The home learned a lot about the importance of communication during the second outbreak. For example, to facilitate communication within the home, task force teams met twice a week, and to facilitate communication to families, a hotline was created and a weekly newsletter was developed to provide relevant COVID-19 information. However, the psychosocial toll during that time took the joy away from caregiving and left many staff with trauma. Further, the fact that the home is located in a rural area with limited available staff, made maintaining staffing levels very difficult, with officials noting "scary" staffing shortages.
Nursing home E *For-profit* *Medium (50-99 beds)*	This nursing home kept COVID-19 out of the facility until July 2020 and used its outbreak-free time learning to adapt to infection control procedures that very few staff were doing correctly before the pandemic. The July 2020 outbreak lasted about 5 weeks and culminated with 32 of about 70 residents and 12 staff infected. Eight of those residents died. After that outbreak, the nursing home did not experience any additional large outbreaks, only a few isolated cases. Officials could not trace the origin of the outbreak, but believed that COVID-19 was brought into the facility by a staff member. Further exacerbating the outbreak was a limited supply of N95 masks, so many residents and some staff were using regular procedure masks instead, as well as physical space constraints. Officials said that to isolate COVID-19-positive residents, the home had to "shuffle" healthy residents from one room to another, which may have accidentally spread the virus. In addition, the nursing home's resident population and nurse staff decreased significantly. Specifically, the nursing home lost 23 residents and about half of its staff left. This resulted in closing a section of the home in December 2020 and having to rely on traveling nurses and aides for the home's staffing needs.
Nursing home F *For-profit* *Large (100-199 beds)*	Early in the pandemic, this nursing home had some staff members test positive, but COVID-19 was not transferred to the residents. The first resident did not test positive until November 2020. Officials believed that the virus was brought into the facility by staff. The home had another outbreak in January 2021 and was able to contain COVID to just one floor of their three-floor facility for a time, but eventually the virus spread. Staff were out sick with COVID-19 during these outbreaks. With limited staff and the building's physical space constraints, officials had to make difficult choices. For example, there were times where nursing home officials felt they had no choice but to move staff between COVID-19 and non-COVID-19 units. As the pandemic wore on, staff had a hard time adjusting to the re-opening of visitation in November 2021. Officials said that they believed their staff were exposed to trauma as a result of their early experiences with COVID-19.

Source: GAO interviews with officials from selected nursing homes in four states. | GAO-23-104291

Appendix IV: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

In addition to the contact named above, key contributors to this report were Karin Wallestad (Assistant Director), Kathryn Richter (Analyst-in-Charge), Julianne Flowers, Isabella Guyott, Sarah-Lynn McGrath, Elise Pressma, and Elaina Stephenson. Also contributing to the report were Laurie Pachter, Vikki Porter, Patricia Powell, Bryan Ricciardi, Ravi Sharma, Anna Beth Smith, Roxanna Sun, Jeff Tamburello, Jennifer Whitworth, and Sirin Yaemsiri.

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