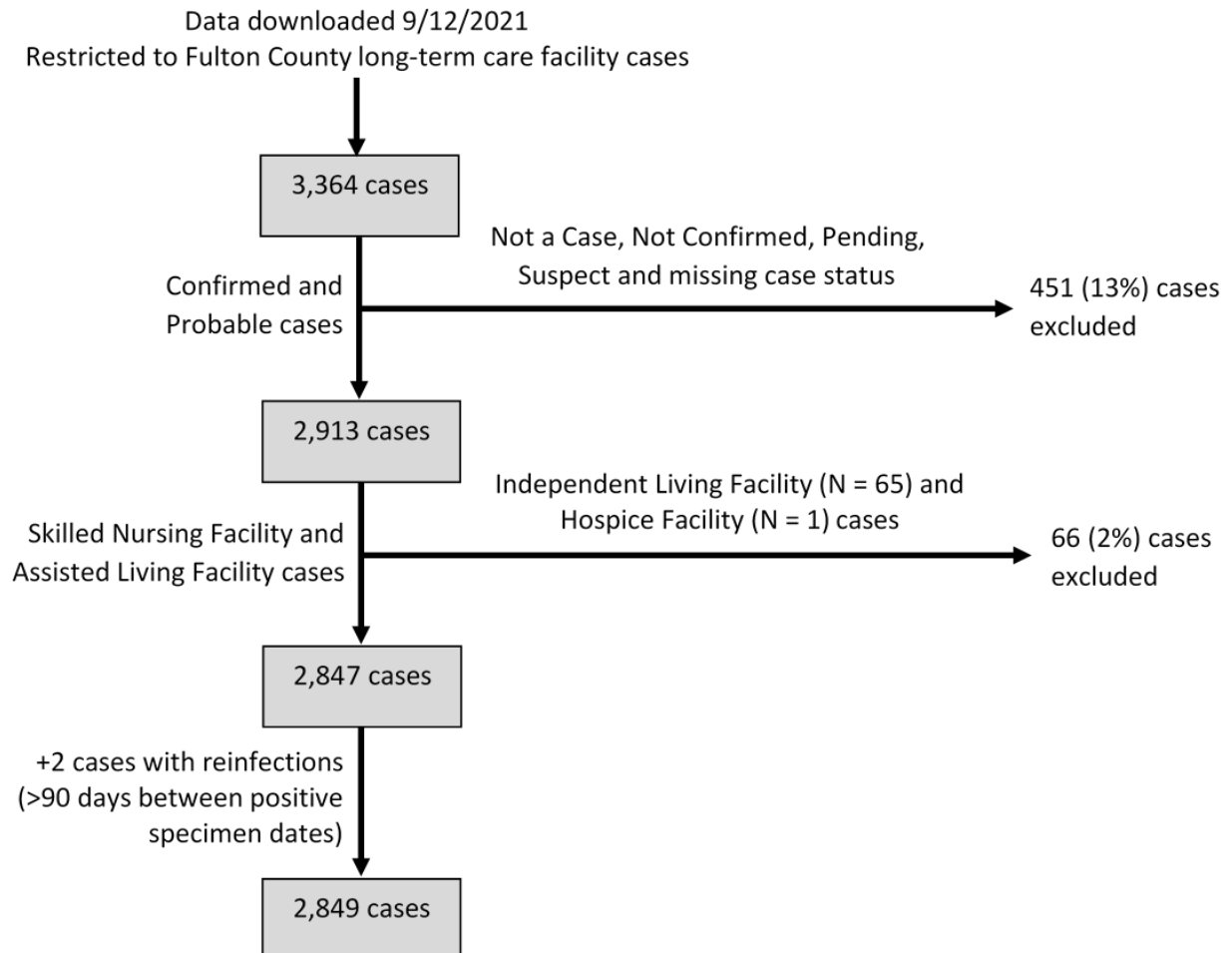
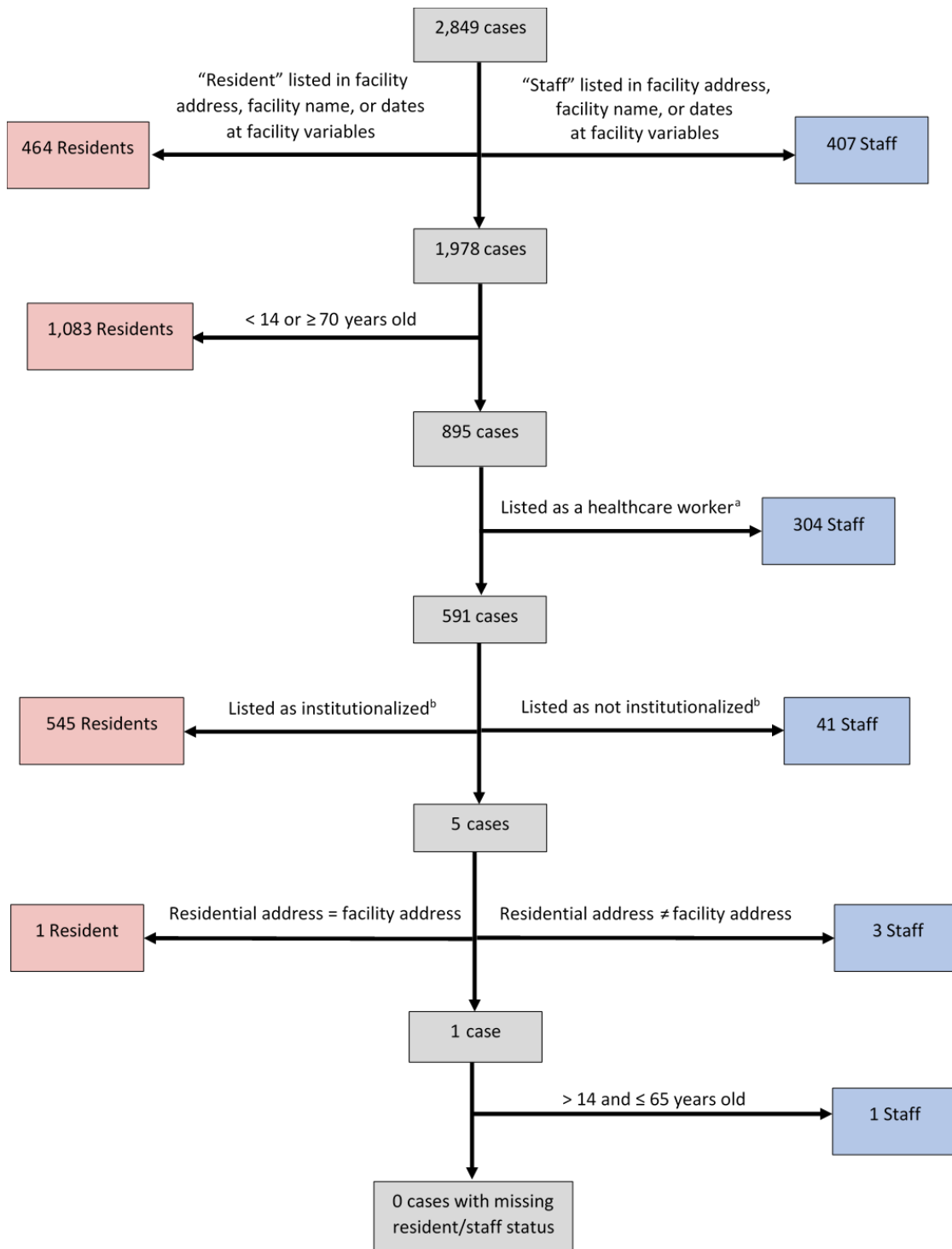


ELECTRONIC SUPPLEMENTARY MATERIAL

eFigure 1. Decision tree for case inclusion and exclusion in the data analysis



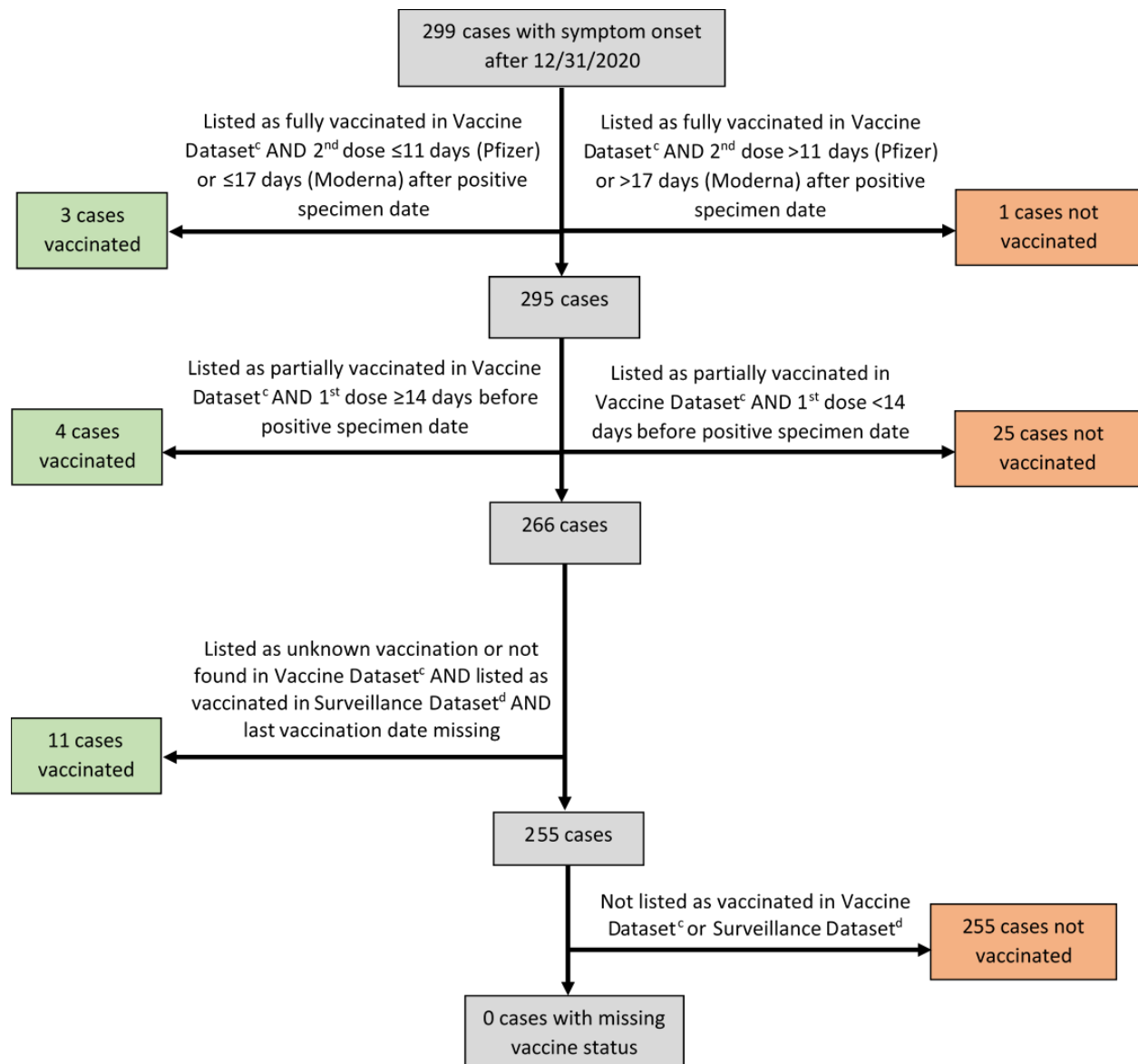
eFigure 2. Decision tree for categorizing cases as long-term care facility residents or staff



^a Cases were listed as healthcare workers (yes or no) if they worked in a healthcare setting (with or without direct patient contact).

^b Cases were listed as institutionalized (yes or no) on the case report form if they had been institutionalized (long-term care facility, skilled nursing facility, etc.) at any time during the 30 days prior to the specimen collection date.

eFigure 3. Decision tree for categorizing cases with symptom onset (imputed or empirical) after December 31, 2020^a as vaccinated^b or unvaccinated against SARS-CoV-2



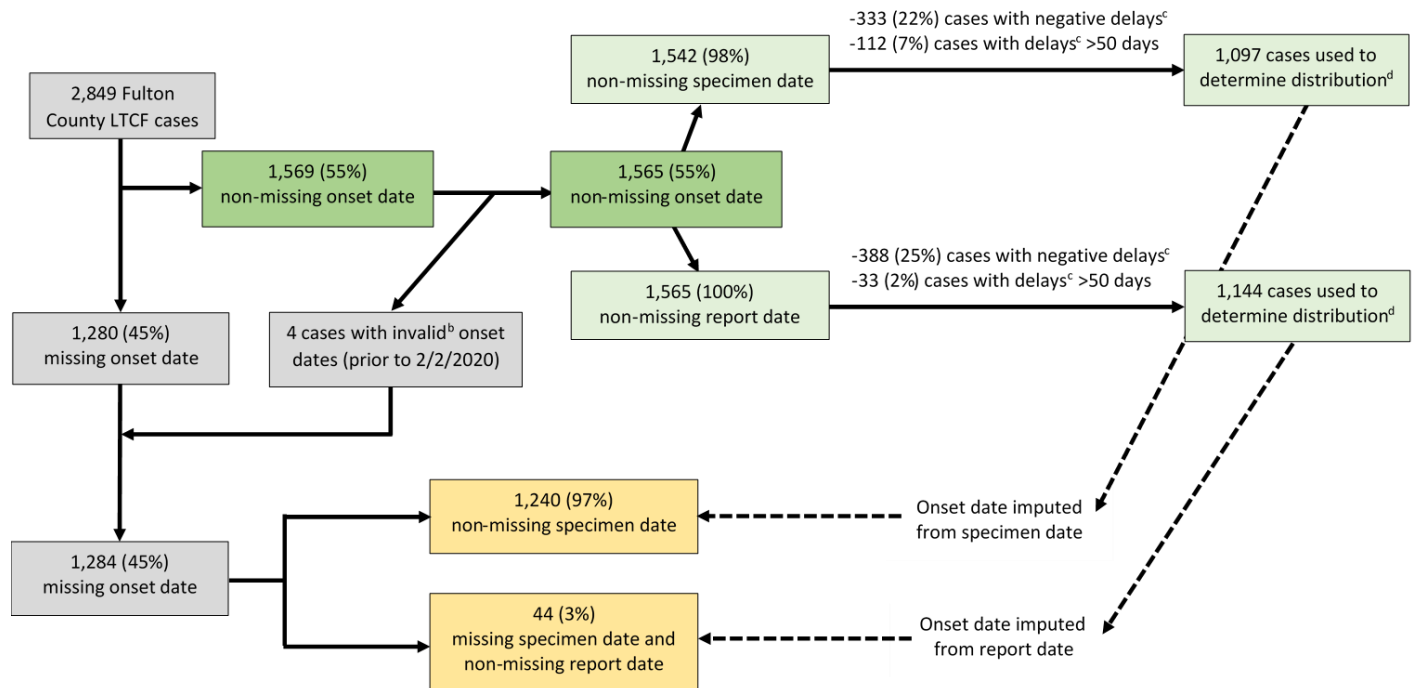
^a Shortly after vaccines were first administered to U.S. long-term care facility residents and staff.

^b Cases were considered vaccinated if they received at least one vaccine dose prior to their first positive specimen collection date. All vaccinated cases with available vaccine manufacturer information received a Pfizer-BioNTech or Moderna vaccine, both of which require two shots. Recommended dosing intervals are 17–25 days and 24–32 days for Pfizer-BioNTech and Moderna, respectively.

^c The Vaccine Dataset refers to the COVID-19 Vaccine Breakthrough Dashboard Dataset, which contains vaccination records for persons in Georgia.

^d The Surveillance Dataset refers to the Georgia COVID-19 Surveillance Dataset. In this dataset, cases were categorized as vaccinated (yes/no).

eFigure 4. Decision tree for case inclusion and exclusion in symptom onset date imputations^a



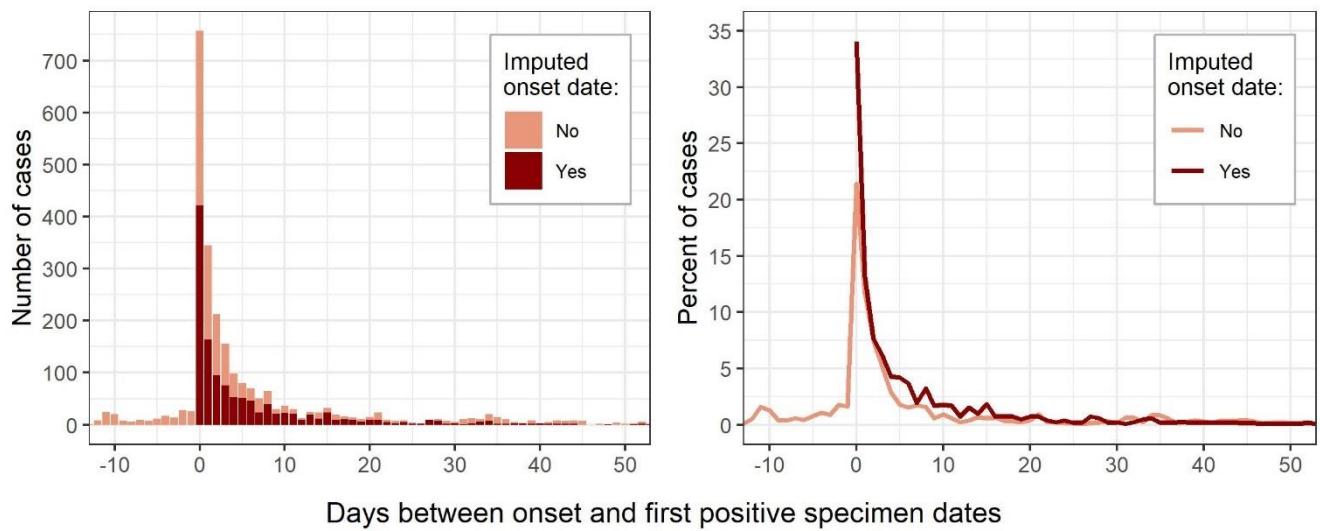
^a Symptom onset dates were imputed for cases with missing or invalid symptom onset dates using the first positive specimen collection date when available and case report date otherwise.

^b Invalid symptom onset dates were those >1 month prior to the first case report date in Georgia.

^c Delays are the time in days between symptom onset and first positive specimen collection date or case report date.

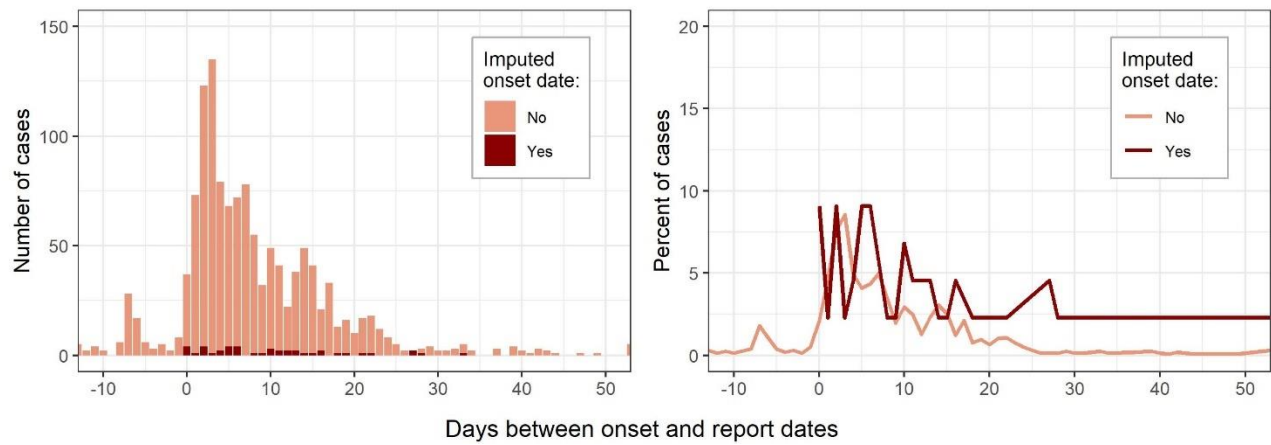
^d Negative binomial distributions were used. The number of days between symptom onset date and first positive specimen collection date or report date was modeled using negative binomial regression with the first positive specimen collection date or report date as the predictor.

eFigure 5. Comparison of days between symptom onset and first positive specimen collection dates for cases with imputed^a and non-imputed symptom onset dates



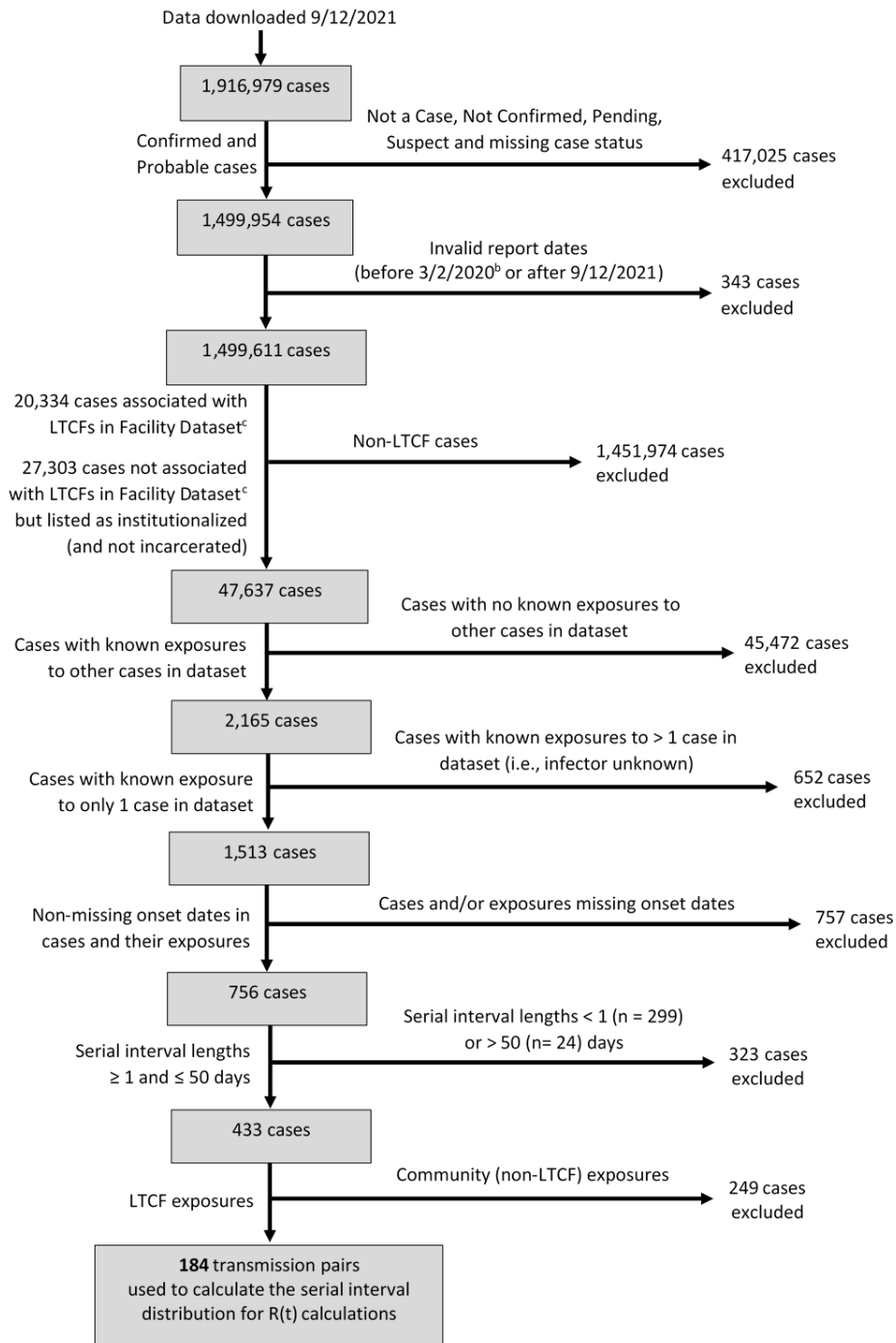
^a Only cases with imputed symptom onset dates based on first positive specimen collection dates (and not report dates) are shown.

eFigure 6. Comparison of days between symptom onset and case report dates for cases with imputed^a and non-imputed symptom onset dates



^a Only cases with imputed symptom onset dates based on report dates (and not first positive specimen collection dates) are shown.

eFigure 7. Decision tree for case inclusion and exclusion in COVID-19 serial interval^a calculations for Georgia long-term care facilities



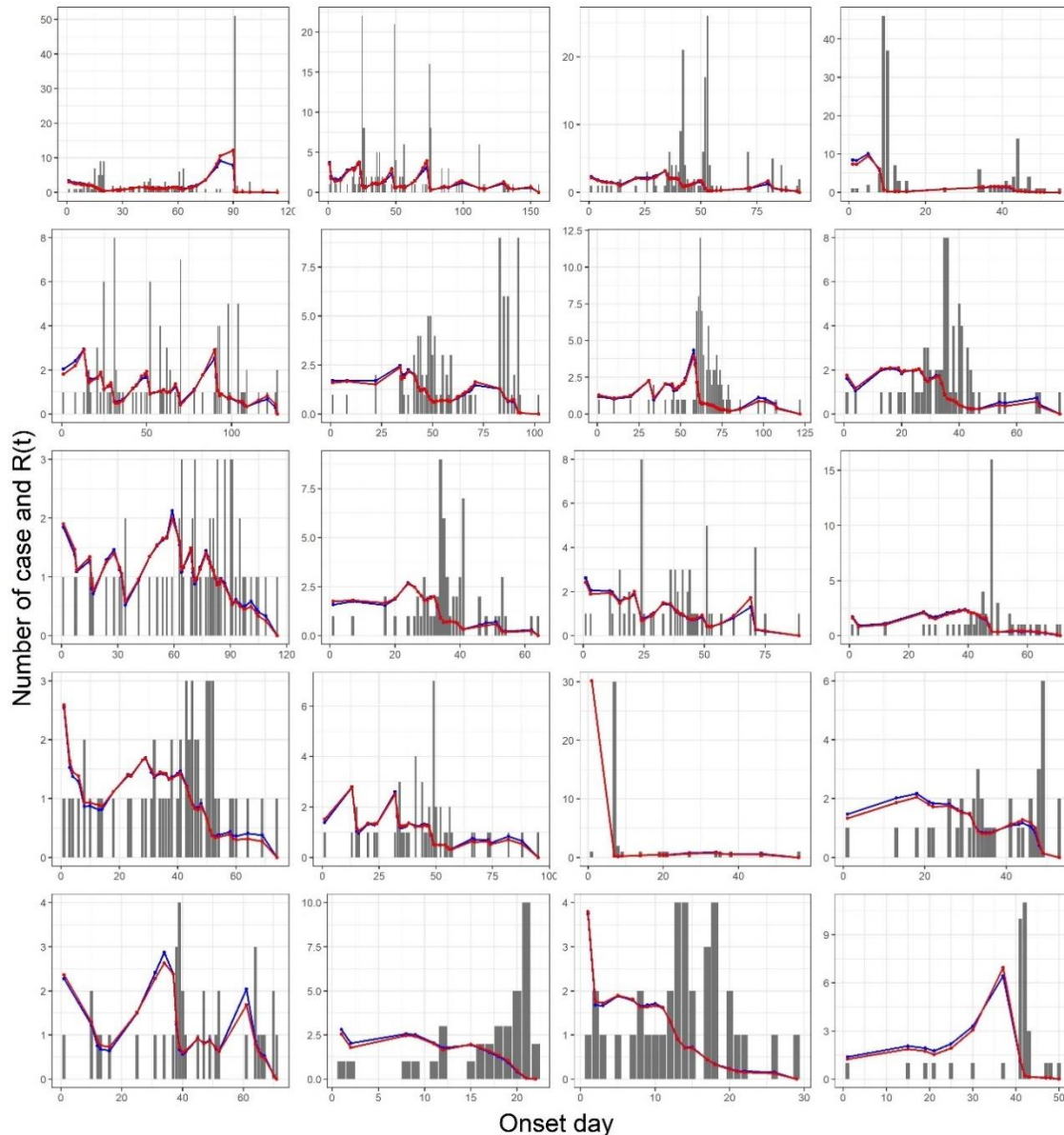
Abbreviations: LTCF, long-term care facility; R(t), time-varying reproduction number; n, number

^a The serial interval is defined as the time, in days, between symptom onset in a primary case (infector) and a secondary case (infectee).

^b The first COVID-19 case in Georgia was reported 3/2/2020.

^c The Facility Dataset is a separate surveillance dataset that includes cases associated with facilities, including LTCFs, and the type and name of facilities with which they are associated.

eFigure 8. Comparison^a of time-varying reproduction numbers, $R(t)$, calculated using one serial interval distribution^b for the entire study period (in red) and three separate serial interval distributions for different time periods^c (in blue) with case counts by symptom onset day^d shown by gray bars



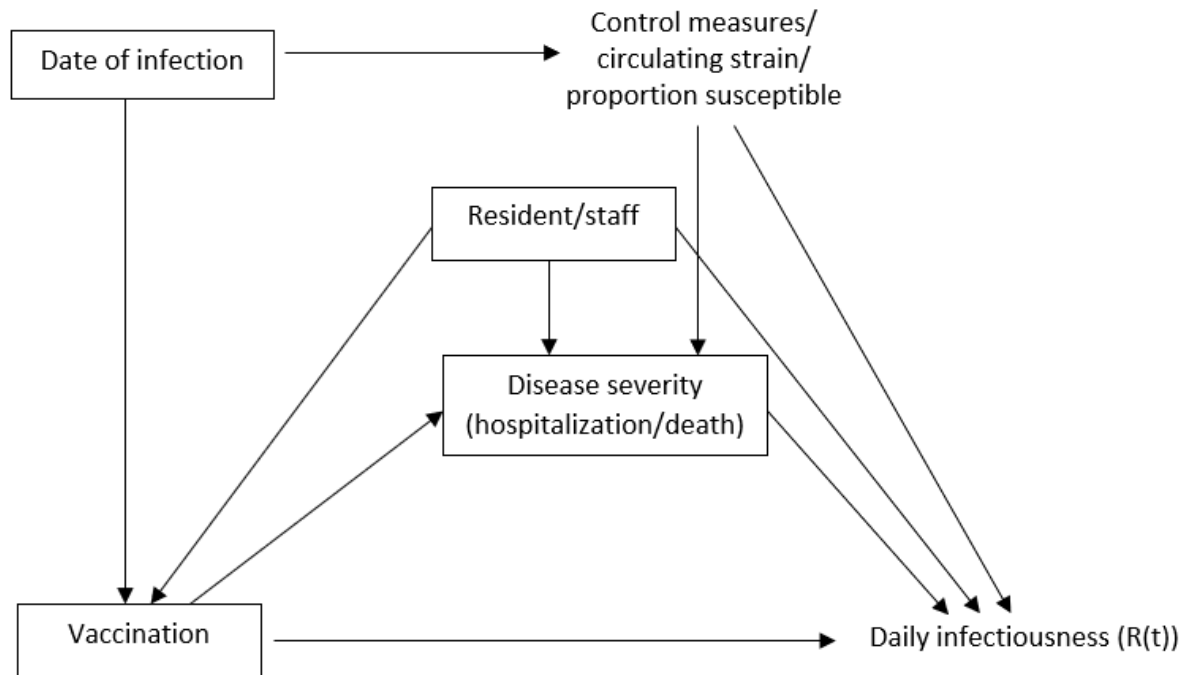
^a Plots for 20 skilled nursing facility outbreaks lasting 15 days or longer are shown. Plots for other skilled nursing facility outbreaks and assisted living facility outbreaks showed similar $R(t)$ estimates for the different serial interval distributions.

^b The serial interval is defined as the time, in days, between symptom onset in a primary case (infector) and a secondary case (infectee).

^c Serial interval distributions were calculated for the following time periods: February to May, 2020, June to December, 2020, and January to August, 2021 (there were no symptom onset dates after August 2021). Time periods were selected based on the numbers of available cases from which to calculate distributions and important long-term care facility pandemic response changes.

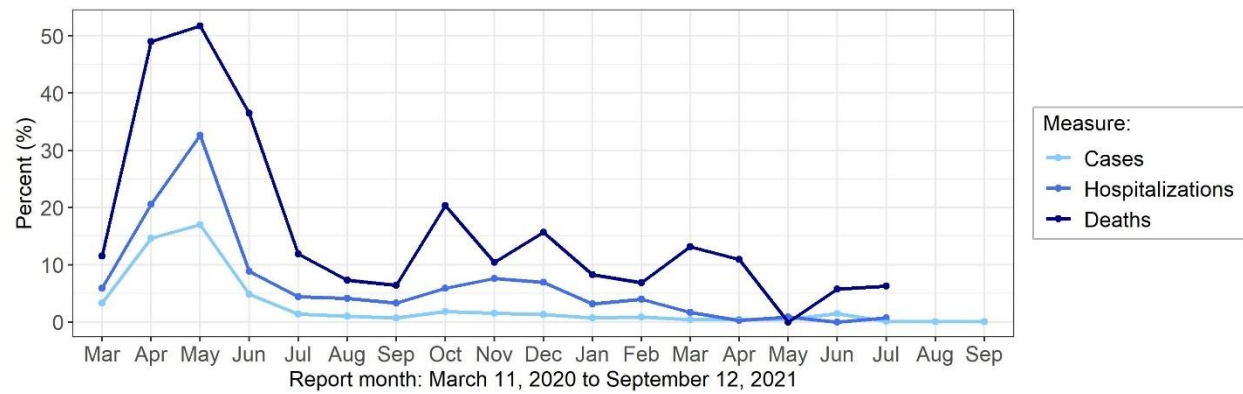
^d Symptom onset day is the day of the outbreak, with outbreaks beginning on the first day one or more cases had symptom onset.

eFigure 9. Directional Acyclic Graph (DAG) for associations between daily infectiousness, quantified by the time-varying reproduction number ($R(t)$), and case characteristics^a



^a Variables surrounded by black boxes indicate variables included in regression models.

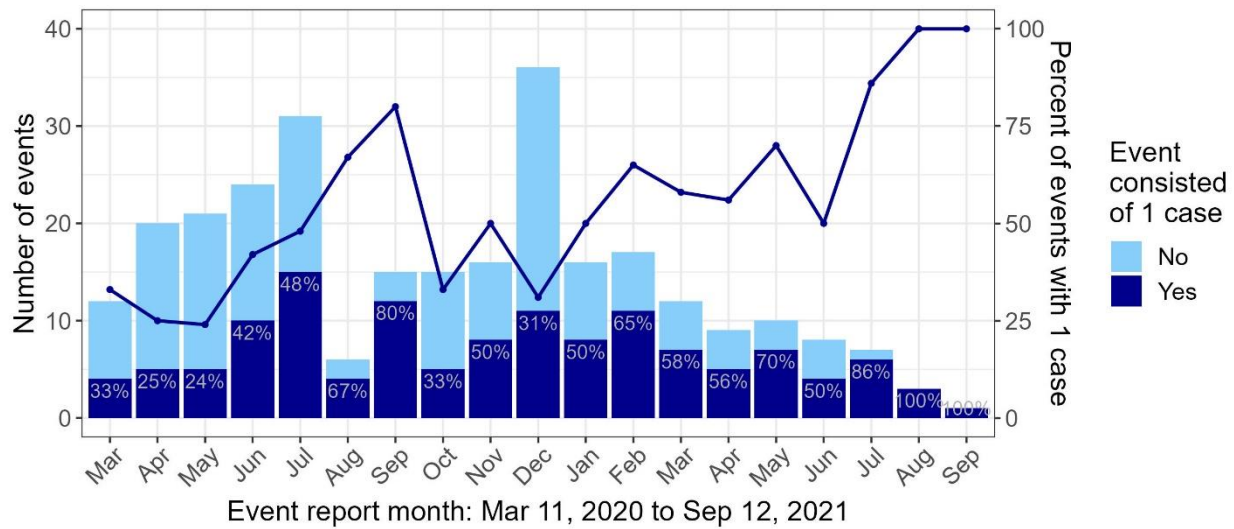
eFigure 10. Percentages of COVID-19 cases, hospitalizations and deaths in Fulton County that occurred among LTCF residents and staff by report month: March 11, 2020 to September 12, 2021^a



Abbreviations: LTCF, long-term care facility

^a Data for hospitalizations and deaths were restricted to cases reported prior to August 1, 2021 (6 weeks prior to data download) to account for lags in hospitalization and death.

eFigure 11. Number and percent^a of COVID-19 events^b, as defined by report date, consisting of a single case by event report month^c



^a Numbers of events are shown by bars and percentages of events consisting of 1 case are shown by the line and text in bars

^b COVID-19 events were defined as 1 or more cases reported in the same facility. If no new cases were reported in more than 14 days, the event was considered over and any cases reported after 14 days were considered part of a separate event.

^c Event report month was determined by the first case report date for each event.

eTable 1. Number and percent of cases with missing information by variable

Variable	Missingness [N (%)] (n = 2,849)
Report date	0 (0)
Gender	2 (0)
Age	12 (0)
First positive specimen collection date	67 (2)
Race/ethnicity	126 (4)
Hospitalized ^a	611 (21)
Asymptomatic ^a	1,086 (38)
Symptom onset date ^b	1,284 (45)
COVID-19 death ^{a,c}	1,371 (48)
Underlying condition(s) ^a	2,106 (74)
Vaccinated ^{a,d}	241 (81)

^a These are dichotomous (Yes/No) variables.

^b Missing symptom onset dates were imputed, after which no cases were missing symptom onset dates.

^c Cases missing COVID-19 death information were assumed to not have died from COVID-19. After making this assumption, 70 (2%) cases with COVID-19 death “Under Review” were still categorized as missing.

^d Missingness for vaccination status was only examined for cases with symptom onset after December 31, 2020 (n=299). Cases were categorized as vaccinated or unvaccinated using information from the COVID-19 Surveillance Dataset, the COVID-19 Vaccine Breakthrough Dashboard Dataset, and a decision tree, after which no cases were missing vaccination status.

eTable 2. Comparison of gamma serial interval distributions^a for the entire study period and three different time periods^b

Time period^b	Number of cases^c	Shape parameter	Scale parameter	Mean (in days)	Standard deviation
Total	184	1.4	5.9	8.0	6.9
Feb-May 2020	89	1.4	6.9	9.4	8.0
Jun-Dec 2020	59	1.6	4.4	7.0	5.5
Jan-Aug 2021	36	1.2	5.3	6.4	5.9

^a The serial interval is defined as the time, in days, between symptom onset in a primary case (infector) and a secondary case (infectee). Serial interval distributions were used to calculate time-varying reproduction numbers, $R(t)$.

^b Time periods were selected based on the numbers of available cases from which to calculate distributions and important long-term care facility pandemic response changes.

^c Serial interval distributions were calculated from long-term care facility (LTCF) cases in Georgia exposed to one known LTCF case with non-missing symptom onset dates.

eTable 3. Sensitivity analysis for associations^a between the COVID-19 time-varying reproduction number, $R(t)$, and long-term care facility (LTCF) role (resident or staff) in Fulton County, Georgia LTCFs for cases reported March 11, 2020 to September 12, 2021

Days included ^b	LTCF role	Main analysis ^c	Sensitivity analysis ^d
		R_i (95% CI)	R_i (95% CI)
All	Staff	0.6 (0.4, 0.7)	0.6 (0.2, 1.0)
	Resident	0.1 (0.1, 0.2)	0.2 (0.0, 0.5)
Pre-vaccination	Staff	0.6 (0.5, 0.7)	0.6 (0.2, 1.1)
	Resident	0.1 (0.0, 0.1)	0.2 (0.0, 0.5)

Abbreviations: R_i , individual reproduction number; CI, confidence interval; LTCF, long-term care facility

^a Associations between case characteristics and $R(t)$ were examined using linear mixed regression models. Regression coefficients can be interpreted as the average individual reproduction number, R_i , (i.e., the number of secondary cases infected by a single case) for cases with different characteristics.

^b The analysis was stratified by the following symptom onset days: 1) all days during the study period, and 2) days prior to vaccine administration (January 1, 2021).

^c LTCF role for the main analysis was determined using a decision tree that incorporated a number of variables in the dataset, including whether “Resident” or “Staff” was entered into free-text fields and age of cases

^d LTCF role for the sensitivity analysis was determined based on whether “Resident” or “Staff” was entered into free-text fields. If “Staff” was not entered into free text fields, cases were assumed to be residents.

eTable 4. Results from main analysis and sensitivity analyses for associations^a between the COVID-19 time-varying reproduction number, R(t), and case characteristics in Fulton County, Georgia long-term care facilities for cases reported March 11, 2020 to September 12, 2021

Days included ^b	Characteristic		Main Analysis R _i (95% CI)	Sensitivity Analysis ^c		
				Serial Interval 1 R _i (95% CI)	Serial Interval 2 R _i (95% CI)	SNFs R _i (95% CI)
All	Vaccinated ^d	Yes	0.2 (0.0, 0.8)	0.3 (0.0, 0.9)	0.2 (0.0, 0.8)	0.1 (0.0, 0.8)
		No	0.4 (0.3, 0.5)	0.4 (0.3, 0.5)	0.5 (0.4, 0.5)	0.4 (0.3, 0.5)
	LTCF role	Staff	0.6 (0.4, 0.7)	0.5 (0.4, 0.7)	0.5 (0.4, 0.6)	0.5 (0.4, 0.7)
		Resident	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.1 (0.0, 0.1)
	Hospitalized ^e	Yes	0.4 (0.2, 0.5)	0.3 (0.2, 0.4)	0.3 (0.2, 0.4)	0.5 (0.2, 0.8)
		No	0.4 (0.3, 0.5)	0.4 (0.3, 0.5)	0.4 (0.3, 0.4)	0.3 (0.2, 0.4)
	COVID-19 death ^e	Yes	0.3 (0.2, 0.5)	0.3 (0.1, 0.5)	0.3 (0.1, 0.5)	0.6 (0.3, 0.9)
		No	0.3 (0.2, 0.4)	0.3 (0.2, 0.3)	0.2 (0.1, 0.3)	0.0 (0.0, 0.1)
Residents only	Vaccinated ^d	Yes	0.1 (0.0, 0.7)	0.1 (0.0, 0.7)	0.1 (0.0, 0.7)	0.1 (0.0, 1.2)
		No	0.5 (0.4, 0.6)	0.5 (0.4, 0.7)	0.6 (0.4, 0.7)	0.5 (0.3, 0.7)
	LTCF role	Staff	—	—	—	—
		Resident	—	—	—	—
	Hospitalized ^e	Yes	0.6 (0.4, 0.8)	0.5 (0.4, 0.7)	0.6 (0.4, 0.8)	0.9 (0.5, 1.2)
		No	0.4 (0.3, 0.6)	0.4 (0.3, 0.6)	0.4 (0.3, 0.6)	0.2 (0.0, 0.3)
	COVID-19 death ^e	Yes	0.8 (0.6, 1.1)	0.7 (0.5, 1.0)	0.8 (0.5, 1.0)	1.1 (0.7, 1.6)
		No	0.4 (0.3, 0.5)	0.3 (0.2, 0.5)	0.4 (0.2, 0.5)	0.2 (0.0, 0.4)
Pre-vaccination	Vaccinated ^d	Yes	—	—	—	—
		No	—	—	—	—
	LTCF role	Staff	0.6 (0.5, 0.7)	0.6 (0.4, 0.7)	0.6 (0.4, 0.7)	0.6 (0.4, 0.8)
		Resident	0.1 (0.0, 0.1)	0.1 (0.0, 0.1)	0.1 (0.0, 0.1)	0.0 (0.0, 0.1)
	Hospitalized ^e	Yes	0.4 (0.2, 0.5)	0.3 (0.2, 0.4)	0.3 (0.2, 0.5)	0.5 (0.1, 0.8)
		No	0.4 (0.3, 0.5)	0.4 (0.3, 0.5)	0.4 (0.3, 0.4)	0.2 (0.0, 0.4)
	COVID-19 death ^e	Yes	0.4 (0.2, 0.6)	0.3 (0.1, 0.6)	0.4 (0.1, 0.6)	0.6 (0.3, 1.0)
		No	0.3 (0.2, 0.4)	0.2 (0.1, 0.3)	0.2 (0.1, 0.3)	0.0 (0.0, 0.1)
Wave 1 ^f	Vaccinated ^d	Yes	—	—	—	—
		No	—	—	—	—
	LTCF role	Staff	0.6 (0.5, 0.8)	0.6 (0.4, 0.8)	0.6 (0.4, 0.7)	0.7 (0.5, 0.9)

Wave 2 ^f	Hospitalized^e	Resident	0.1 (0.0, 0.1)	0.1 (0.0, 0.1)	0.1 (0.0, 0.1)	0.0 (0.0, 0.1)
		Yes	0.6 (0.4, 0.9)	0.6 (0.3, 0.8)	0.6 (0.3, 0.8)	0.8 (0.3, 1.4)
	COVID-19 death^e	No	0.1 (0.0, 0.3)	0.1 (0.0, 0.2)	0.1 (0.0, 0.2)	0.1 (0.0, 0.2)
		Yes	0.8 (0.5, 1.2)	0.7 (0.3, 1.1)	0.8 (0.5, 1.1)	1.2 (0.5, 1.9)
	Vaccinated^d	No	0.2 (0.0, 0.4)	0.1 (0.0, 0.3)	0.1 (0.0, 0.2)	0.1 (0.0, 0.2)
		Yes	—	—	—	—
	LTCF role	No	—	—	—	—
		Staff	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)	0.6 (0.4, 0.8)
	Hospitalized^e	Resident	0.4 (0.3, 0.5)	0.4 (0.3, 0.5)	0.4 (0.4, 0.5)	0.4 (0.3, 0.5)
		Yes	0.6 (0.4, 0.8)	0.6 (0.4, 0.8)	0.6 (0.4, 0.8)	0.7 (0.4, 1.1)
	COVID-19 death^e	No	0.6 (0.4, 0.8)	0.5 (0.3, 0.8)	0.6 (0.4, 0.8)	0.4 (0.2, 0.6)
		Yes	0.6 (0.4, 0.9)	0.6 (0.4, 0.9)	0.6 (0.4, 0.9)	0.7 (0.3, 1.1)
	COVID-19 death^e	No	0.6 (0.4, 0.7)	0.6 (0.4, 0.7)	0.6 (0.5, 0.7)	0.5 (0.3, 0.6)

Abbreviations: R_i, individual reproduction number; CI, confidence interval; LTCF, long-term care facility; SNFs, skilled nursing facilities

^a Associations between case characteristics and R(t) were examined using linear mixed regression models. Regression coefficients can be interpreted as the average individual reproduction number, R_i (i.e., the number of secondary cases infected by a single case) for cases with different characteristics.

^b The analysis was stratified by the following symptom onset days: 1) all days during the study period, 2) days on which only resident cases had symptom onset, 3) days prior to vaccine administration (January 1, 2021), 4) days in the first pandemic wave (prior to September 27, 2020), and 5) days in the second pandemic wave (September 27, 2020 to March 21, 2021).

^c Sensitivity analyses included the following: 1) R(t) estimates from a serial interval distribution calculated by Zhang, et al. (Serial Interval 1), 2) R(t) estimates from a serial interval calculated by Wang, et al. (Serial Interval 2), and 3) results for skilled nursing facilities only (i.e., excluding assisted living facilities).

^d Associations between vaccination and R(t) were restricted to symptom onset dates after December 31, 2020, the approximate date when COVID-19 vaccines were first administered to U.S. nursing home residents and staff.

^e Associations between hospitalizations and deaths and R(t) were restricted to symptom onset dates prior to August 1, 2021 (6 weeks prior to data download) to account for lags in hospitalization and death.

^f For variables Hospitalized and COVID-19 death, includes days in the first and second pandemic waves on which only resident cases had symptom onset.