Journal of the American Heart Association

ORIGINAL RESEARCH

Myocardial Infarction Across COVID-19 Pandemic Phases: Insights From the Veterans Health Affairs System

Celina M. Yong, MD, MBA, MSc; Laura Graham, PhD, MPH; Tariku J. Beyene, PhD; Shirin Sadri, MD; Juliette Hong, MSc, MEd; Tom Burdon, MD; William F. Fearon, MD; Steven M. Asch, MD, MPH; Mintu Turakhia, MD, MAS; Paul Heidenreich, MD, MS

BACKGROUND: Cardiovascular procedural treatments were deferred at scale during the COVID-19 pandemic, with unclear impact on patients presenting with non–ST-segment–elevation myocardial infarction (NSTEMI).

METHODS AND RESULTS: In a retrospective cohort study of all patients diagnosed with NSTEMI in the US Veterans Affairs Healthcare System from January 1, 2019 to October 30, 2022 (n=67 125), procedural treatments and outcomes were compared between the prepandemic period and 6 unique pandemic phases: (1) acute phase, (2) community spread, (3) first peak, (4) post vaccine, (5) second peak, and (6) recovery. Multivariable regression analysis was performed to assess the association between pandemic phases and 30-day mortality. NSTEMI volumes dropped significantly with the pandemic onset (62.7% of prepandemic peak) and did not revert to prepandemic levels in subsequent phases, even after vaccine availability. Percutaneous coronary intervention and coronary artery bypass grafting volumes declined proportionally. Compared with the prepandemic period, patients with NSTEMI experienced higher 30-day mortality during Phases 2 and 3, even after adjustment for COVID-19-positive status, demographics, baseline comorbidities, and receipt of procedural treatment (adjusted odds ratio for Phases 2 and 3 combined, 1.26 [95% CI, 1.13–1.43], $P<0.01$). Patients receiving Veterans Affairs-paid community care had a higher adjusted risk of 30-day mortality compared with those at Veterans Affairs hospitals across all 6 pandemic phases.

CONCLUSIONS: Higher mortality after NSTEMI occurred during the initial spread and first peak of the pandemic but resolved before the second, higher peak—suggesting effective adaptation of care delivery but a costly delay to implementation. Investigation into the vulnerabilities of the early pandemic spread are vital to informing future resource-constrained practices.

Key Words: acute coronary syndrome ■ acute myocardial infarction ■ COVID-19 ■ non–ST-segment–elevation myocardial infarction

In efforts to curb the spread of the novel coronavirus (SARS-CoV-2) and direct resources to address COVID-19 pandemic needs, Veterans Affairs (VA) hospitals nationwide received unprecedented mandates starting in March 2020 to postpone all elective cardiovascular procedures, while permitting only urgent, life-threatening ones.[1,2] Given that percutaneous coronary intervention (PCI) for myocardial infarction (MI) has been proven to reduce major adverse cardiac events,[3,4] impacts of this procedural triage have been unclear.[5–8] The evolving pandemic has unintentionally offered a natural experiment to demonstrate the transition from large scale deimplementation of elective cardiovascular procedural care through risk stratification to recovery. As the largest integrated health care system in the United States, the VA Healthcare System offers a unique opportunity

Correspondence to: Celina M. Yong, MD, MBA, MSc, Palo Alto Veterans Affairs Healthcare System, Stanford University, 3801 Miranda Ave, 111C, Palo Alto, CA 94304. Email: cyong@stanford.edu

Preprint posted on MedRxiv March 08, 2023. doi: https://doi.org/10.1101/2023.03.07.23286963.

This article was sent to Pamela N. Peterson, MD, Deputy Editor, for review by expert referees, editorial decision, and final disposition.

Supplemental Material is available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.123.029910

For Sources of Funding and Disclosures, see page 10.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- After the initial significant decline in non–ST-segment–elevation myocardial infarction presentations during the acute phase of the pandemic, volumes of non–ST-segment–elevation myocardial infarction presentations and procedural treatment have not reverted to prepandemic levels despite widespread availability of vaccines in the Veterans Health Administration.
- Compared with the prepandemic period, 30-day mortality after non–ST-segment–elevation myocardial infarction increased during the initial spread and first pandemic peak (Phases 2 and 3)—but resolved before the subsequent highest pandemic peak of Phase 5—suggesting a delay to implementation of adapted systems of cardiovascular care.
- The increased mortality was not significantly mediated by the decline in procedural volumes, suggesting appropriate triage of procedural care during the pandemic.

What Are the Clinical Implications?

- The COVID-19 pandemic appears to have had a lasting impact on health-seeking behaviors among patients with non–ST-segment–elevation myocardial infarction, with unclear long-term effects of this increased threshold to obtain cardiovascular care.
- Investigation into the vulnerabilities that occurred during initial phases of the pandemic is urgently needed to inform ongoing and future resource-constrained practices.

Nonstandard Abbreviations and Acronyms

VA	Veterans Affairs

to understand the impact of these adaptations. In this study, we examine how the evolving treatment paradigm during the prolonged pandemic has affected patients with non–ST-segment–elevation MI (NSTEMI).

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

We performed a retrospective cohort study of all patients diagnosed with NSTEMI between January 1, 2019 to October 30, 2022 who received inpatient care at a VA hospital or paid for by the Veterans Health Administration. Patient cohort selection is shown in Figure S1–S4. The Veterans Health Administration provides care to over 9 million veterans across the United States at more than 1200 health care facilities, including 171 VA Medical Centers.[9]

Patients requiring inpatient care for NSTEMI were identified by *International Classification of Diseases, Tenth Revision, Clinical Modification* (*ICD-10-CM*) diagnosis codes (NSTEMI: I21.4) from the VA Corporate Data Warehouse.[10,11] Additional covariates included patient demographics, socioeconomic characteristics, and comorbidity burden, including Charlson Comorbidity Index. Patient geographic information (zip code and distance to medical centers) was obtained from the VA Planning Systems Support Group data. US Census data based on patient zip code was used to include neighborhood education level, and income status. Procedures (angiograms, PCI, and coronary artery bypass grafting) performed within 30 days of incident diagnosis were identified from the VA Corporate Data Warehouse by *ICD-10* and Current Procedural Terminology procedure codes, as well as from VA controlled antegrade and retrograde tracking-PCI data (Tables S1–S4). Mortality was obtained from the VA Corporate Data Warehouse Vital Status domain.

Patients were categorized into 1 of 6 COVID-19 phases according to the date of their first NSTEMI diagnosis, with phase dates defined by epidemiological trends in the United States[12,13]:

Pre-COVID-19 Phase was defined as the year before the COVID-19 pandemic (January 1, 2019–February 15, 2020).

Phase 1 (Acute Phase, February 16, 2020–April 15, 2020) was defined as the 2-month period surrounding the initial nadir of patient NSTEMI volumes due to the pandemic, which included the initial period of national VA directives to defer nonessential procedures.

Phase 2 (Community Spread, April 16, 2020–October 27, 2020) was the initial period of rapidly rising COVID-19 infections in the United States.

Phase 3 (First Peak, October 28, 2020–February 20, 2021) was the first epidemiologic peak of COVID-19 infections in the United States.

Phase 4 (Post-Vaccine, February 21, 2021–December 10, 2021) represented the period after which all veterans who desired vaccination should have received it. By this time, most catheterization laboratories had resumed routine practices with restrictions limited to preprocedure COVID-19 testing requirements.

Phase 5 (Second Peak, December 11, 2021–February 15, 2022) represented the highest epidemiologic peak of COVID-19 infections in the United States, largely due to new variants.

Phase 6 (Recovery Phase, February 16, 2022–October 30, 2022) represented the endemic period after removal of indoor COVID-19 restrictions in most states.

Statistical Analysis

Among all patients with NSTEMI presenting to VA PCI-capable hospitals, patient demographics and comorbidities (within 1 year before first NSTEMI diagnosis) were compared across COVID-19 phases using chi-square for categorical variables and ANOVA for continuous variables. Trend line visualization was used to examine average changes in diagnoses and procedural volumes across COVID-19 phases in comparison with national daily average COVID-19-positive cases. Multivariable logistic regression was performed to evaluate 30-day mortality by COVID-19 phase (pre-COVID-19 as reference). Model covariate selection was performed with LASSO (SAS procedure hpgenselect using the Schwarz Bayes Criterion with lambda=0.8 and 25 steps), which yielded inclusion of age, Charlson Comorbidity Index, and COVID-19-positive test status at the time of admission in the final adjusted models. We also performed additional adjustment for receipt of procedural treatment to assess its potential contribution to the outcome. Kaplan–Meier curves were used to compare mortality over time across COVID-19 phases. Unlike private health insurance, VA enrollment is typically stable over the life of the patient without disenrollment. To evaluate stability of patient enrollment over time in our cohort, a separate analysis of monthly outpatient prescription volumes was performed, showing no significant changes over time (with the exception of a brief decline in Phase 1 that returned to baseline by Phase 2). Multivariate logistic regression was also used to compare 30-day mortality among patients presenting with NSTEMI to VA versus non-VA facilities across COVID-19 phases, with adjustment for demographics and comorbidities. Wald chi-square test and odds ratios (ORs) were used to compare likelihood of 30-day mortality between VA and non-VA (fee-basis) care patients in pre- versus post-COVID-19 periods. This was a complete case analysis, with no missing values for the adjusted covariates (age, Charlson Comorbidity Index, COVID-19-positive test status, or receipt of procedure). Two-sided tests were used in all scenarios. This study was approved by the Stanford Institutional Review Board. Obtaining informed consent from subjects was waived. Analyses were conducted in SAS v9.4.

RESULTS

A total of 67 125 veterans were coded with a new NSTEMI from January 1, 2019 to October 30, 2022, of whom 27 346 presented to a PCI-capable VA hospital.

Over progressive pandemic phases, the mean age of patients presenting with NSTEMI increased (Table). Patient race or ethnicity also varied by phase (P=0.01), with the highest proportion of Black patients presenting with NSTEMI during Phase 3 (23.2%) and the highest proportion of Hispanic patients presenting with NSTEMI in Phase 1 (8.1%). Rural patients and those with lower education levels had lower NSTEMI presentations during the acute phase (Phase 1) (P=0.04 and P<0.01 respectively, across all phases). The highest proportion of patients with NSTEMI and COVID-19 infection presented during the second peak (11.3% in Phase 5, P<0.01 across all phases).

NSTEMI presentations during the acute phase (Phase 1) of the pandemic reached a nadir during the month of April 2020, with 486 NSTEMIs nationally that month, representing 62.7%, of volume at the prepandemic peak (week of January 1, 2020, Figure 1A). After the initial nadir, there was a slight uptrend in NSTEMI presentations in early Phase 2, which was followed by an overall downward trend over time that did not revert to prepandemic levels even after vaccine rollout that began in December 2020 (during Phase 3). Figure 1A demonstrates that the seasonal variation in NSTEMI volumes during the prepandemic year was no longer observed during the subsequent pandemic years. Evaluation of monthly national outpatient prescription refills showed stability over time (aside from a brief decline in Phase 1), suggesting negligible contribution to the decline in NSTEMI volumes.

Procedures performed to diagnose and treat NSTEMI (angiogram, PCI, coronary artery bypass grafting) also declined during Phase 1. The nadir of 244 procedures among patients with NSTEMI during the month of April 2020 represents 58.7% of the prepandemic peak (week of January 1, 2020, Figure 1B). Although the absolute numbers declined, the proportion of patients with NSTEMI receiving PCI or coronary artery bypass grafting did not significantly change (33.6% pre-COVID-19 versus 34.0% post-COVID-19, P=0.51, volumes by phase in Table S2). When angiogram was added to the list of procedures, there was still no significant difference in probability of receiving a procedure (55.6% pre-COVID-19 versus 56.8% post-COVID-19, P=0.09). Logistic regression also showed no significant relationship between procedural volumes and all COVID-19 phases combined (likelihood of procedural treatment compared with pre-COVID-19: adjusted OR, 1.05 [95% CI, 0.99–1.10], P=0.09). However, analysis of each individual phase showed a significantly lower likelihood of receiving a procedure during Phase 1 (adjusted OR, 0.77 [95% CI, 0.77–0.64], P=0.002), and a significantly higher likelihood of receiving a procedure during Phase 6 (adjusted OR, 1.18 [95% CI, 1.05–1.33], P=0.0005; Table S3 for other nonsignificant phase results).

Analysis of survival plots revealed that NSTEMI mortality was higher in phases 2, 3, and 5 compared with the prepandemic period (Figure 2**):** Phase 2 OR,

Table. Baseline Patient Characteristics Across COVID-19 Phases

Characteristics		COVID-19 phase						*P* value
	Pre-COVID-19	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
	January 1, 2019–February 15, 2020	February 16, 2020–April 15, 2020	April 16, 2020–October 27, 2020	October 28, 2020–February 20, 2021	February 21, 2021–December 10, 2021	December 11, 2021–February 15, 2022	February 16, 2022–October 30, 2022	
	(N=9682)	(N=1097)	(N=4155)	(N=1682)	(N=5470)	(N=1183)	(N=4077)	
Age, y, mean (SD)	71.4 (10.69)	71.4 (11.11)	71.1 (10.75)	72.0 (11.17)	71.8 (10.96)	72.4 (11.17)	72.3 (10.74)	<0.01†
Sex, n (%)								<0.01*
Female	265 (2.7%)	48 (4.4%)	124 (3.0%)	46 (2.7%)	194 (3.5%)	42 (3.6%)	141 (3.5%)	
Male	9417 (97.3%)	1049 (95.6%)	4031 (97.0%)	1636 (97.3%)	5276 (96.5%)	1141 (96.4%)	3936 (96.5%)	
Race or ethnicity, n (%)								0.013*
White	6247 (68.5%)	675 (66.0%)	2636 (67.3%)	1061 (66.7%)	3447 (67.1%)	743 (67.2%)	2490 (65.2%)	
Black	1994 (21.9%)	233 (22.8%)	896 (22.9%)	368 (23.1%)	1158 (22.5%)	253 (22.9%)	914 (23.9%)	
Hispanic	697 (7.6%)	83 (8.1%)	303 (7.7%)	120 (7.5%)	383 (7.5%)	75 (6.8%)	298 (7.8%)	
Other	187 (2.0%)	32 (3.1%)	84 (2.1%)	41 (2.6%)	150 (2.9%)	35 (3.2%)	118 (3.1%)	
Marital status, n (%)								0.08*
Married	4435 (45.9%)	504 (46.4%)	1905 (46.0%)	771 (46.0%)	2572 (47.3%)	545 (46.5%)	1987 (48.9%)	
Separated	4211 (43.6%)	461 (42.4%)	1786 (43.2%)	731 (43.6%)	2268 (41.7%)	491 (41.9%)	1623 (40.0%)	
Single	1016 (10.5%)	121 (11.1%)	448 (10.8%)	173 (10.3%)	599 (11.0%)	135 (11.5%)	450 (11.1%)	
Rurality, n (%)								0.04*
Highly rural	279 (2.9%)	30 (2.8%)	148 (3.6%)	43 (2.6%)	161 (3.0%)	29 (2.5%)	127 (3.2%)	
Rural	2591 (26.9%)	257 (23.9%)	1056 (25.8%)	412 (24.9%)	1395 (26.1%)	312 (26.9%)	965 (24.4%)	
Urban	6770 (70.2%)	788 (73.3%)	2891 (70.6%)	1201 (72.5%)	3797 (70.9%)	819 (70.6%)	2865 (72.4%)	
Education level, n %								<0.01*
<25% of high school or less	8022 (82.9%)	890 (81.1%)	3495 (84.1%)	1397 (83.1%)	4646 (84.9%)	983 (83.1%)	3484 (85.5%)	
≥25% of high school or less	1660 (17.1%)	207 (18.9%)	660 (15.9%)	285 (16.9%)	824 (15.1%)	200 (16.9%)	593 (14.5%)	
Income, % (n)								0.97*
≤25% 75K or less	7935 (82.0%)	904 (82.4%)	3407 (82.0%)	1384 (82.3%)	4501 (82.3%)	977 (82.6%)	3322 (81.5%)	
>25% 75K or less	1747 (18.0%)	193 (17.6%)	748 (18.0%)	298 (17.7%)	969 (17.7%)	206 (17.4%)	755 (18.5%)	
Comorbidities								
Charlson Comorbidity Index, mean (SD)	5.7 (3.22)	5.8 (3.28)	5.6 (3.23)	5.5 (3.14)	5.6 (3.24)	5.5 (3.16)	5.6 (3.28)	0.01†

(*Continued*)

Table. Continued

Characteristics		COVID-19 phase						*P* value
	Pre-COVID-19	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
	January 1, 2019–February 15, 2020	February 16, 2020–April 15, 2020	April 16, 2020–October 27, 2020	October 28, 2020–February 20, 2021	February 21, 2021–December 10, 2021	December 11, 2021–February 15, 2022	February 16, 2022–October 30, 2022	
	(N=9682)	(N=1097)	(N=4155)	(N=1682)	(N=5470)	(N=1183)	(N=4077)	
COVID-19-positive, n (%)	0 (0.0%)	26 (2.4%)	147 (3.5%)	139 (8.3%)	165 (3.0%)	134 (11.3%)	174 (4.3%)	<0.01*
Congestive heart failure, n (%)	5312 (54.9%)	588 (53.6%)	2252 (54.2%)	890 (52.9%)	2938 (53.7%)	626 (52.9%)	2122 (52.1%)	0.17*
Peripheral vascular disease, n (%)	3241 (33.5%)	361 (32.9%)	1287 (31.0%)	521 (31.0%)	1690 (30.9%)	355 (30.0%)	1265 (31.1%)	<0.01*
Cerebrovascular disease, n (%)	2109 (21.8%)	250 (22.8%)	850 (20.5%)	359 (21.3%)	1201 (22.0%)	263 (22.2%)	879 (21.6%)	0.54*
Chronic obstructive pulmonary disease, n (%)	3726 (38.5%)	433 (39.5%)	1482 (35.7%)	589 (35.0%)	1940 (35.5%)	401 (33.9%)	1433 (35.2%)	<0.01*
Diabetes without complications, n (%)	5212 (53.8%)	570 (52.0%)	2173 (52.3%)	873 (51.9%)	2923 (53.4%)	613 (51.8%)	2117 (52.0%)	0.26*
Diabetes with complications, n (%)	3955 (40.9%)	445 (40.6%)	1658 (39.9%)	629 (37.4%)	2228 (40.7%)	459 (38.8%)	1638 (40.2%)	0.17*
Renal disease, n (%)	4013 (41.5%)	480 (43.8%)	1713 (41.2%)	673 (40.0%)	2224 (40.7%)	506 (42.8%)	1664 (40.8%)	0.39*
Cancer, n (%)	1740 (18.0%)	208 (19.0%)	781 (18.8%)	307 (18.3%)	1016 (18.6%)	227 (19.2%)	819 (20.1%)	0.16*

*Chi-square *P* value.
†Kruskal–Wallis *P* value.

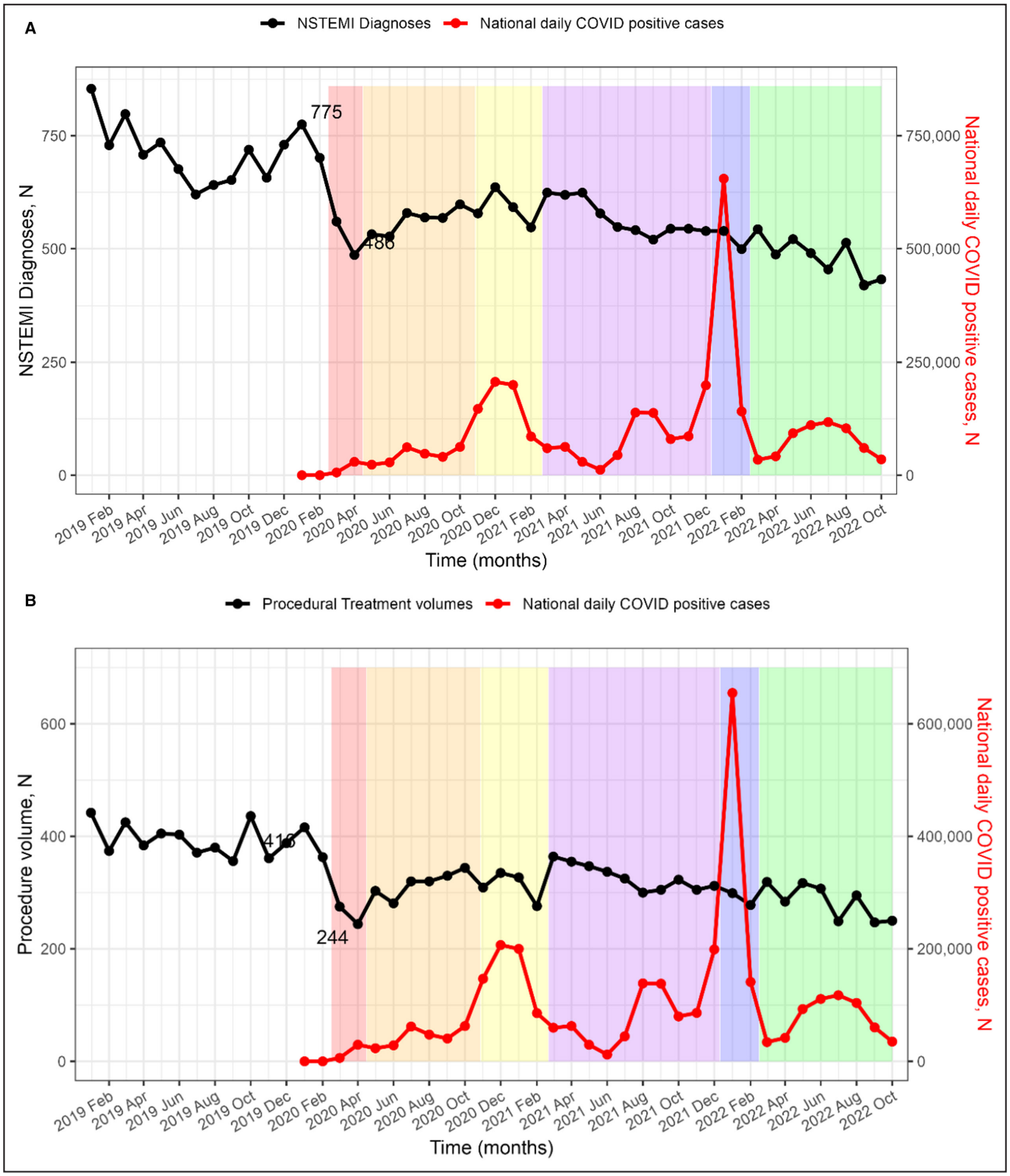


Figure 1. NSTEMI diagnoses and procedural treatment at VA facilities by COVID-19 phase.
A, NSTEMI incidence across COVID-19 phases. Volumes of NSTEMI presentations declined in Phase 1, which did not recover to pre-COVID-19 levels in subsequent phases. **B**, Procedure volumes across COVID-19 phases. Procedural treatments (angiogram/PCI/CABG) for NSTEMI underwent a decline in Phase 1, followed by steady volumes over subsequent phases. CABG indicates coronary artery bypass graft; NSTEMI, non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; and VA, Veterans Affairs.

1.13 ([95% CI, 1.04–1.23], *P*<0.01); Phase 3 OR, 1.17 ([95% CI, 1.04–1.31], *P*<0.01); Phase 5 OR, 1.15 ([95% CI, 1.01–1.31], *P*=0.04). There were no significant differences in the other phases.

Unadjusted logistic regression analysis revealed that from Phase 2 (community spread) up to Phase 5 (second peak), patients with NSTEMI had an average higher 30-day mortality compared with prepandemic levels. After adjustment for demographics, baseline comorbidities, COVID-19-positive infection status, and receipt of procedural treatment, these higher mortality findings remained significant for Phases 2 and 3 but not for the other phases (Figure 3, unadjusted results in Figure S2, with full list of demographic factors associated with NSTEMI mortality in Table S4). Note that by Phase 6 (recovery), the risk of mortality reversed to be lower than the prepandemic period. Among the 76 catheterization sites represented, procedural volume was not a significant predictor in the fully adjusted NSTEMI model (*P*=0.16).

There were 20 786 veteran patients who presented to community care facilities with NSTEMI over the study period (fee-basis care paid for by VA). The proportion of patients with NSTEMI who had 30-day mortality among fee-basis patients increased over the course of the pandemic, reaching a peak during Phase 3 (Figure 4A). Compared with those treated at VA facilities, the risk of 30-day mortality among those treated at non-VA facilities was higher across all pandemic phases. However, after adjustment for demographics and comorbidities, it remained higher only during Phases 3, 4, and 6 (Figure 4B, unadjusted results in Figure S3).

DISCUSSION

In this study, we report longitudinal changes in presentation, treatments, and outcomes among patients with NSTEMI over multiple phases of the COVID-19 pandemic in the VA Healthcare System. We present 3 key novel findings: (1) the availability of vaccines to veterans did not significantly change the downtrending trajectory in volumes of patients presenting with NSTEMI, which have not reverted to prepandemic levels despite resolving COVID-19 infection burden; (2) patients presenting with NSTEMI in Phases 2 and 3 had higher 30-day mortality, suggesting vulnerabilities during the initial spread and peak of COVID-19 infections that did not persist despite later, higher COVID-19 infection rates; and (3) the increased mortality was not mediated by a decline in procedural volumes, suggesting appropriate triage of procedural care during the pandemic. Notably, over the course of the pandemic, a higher

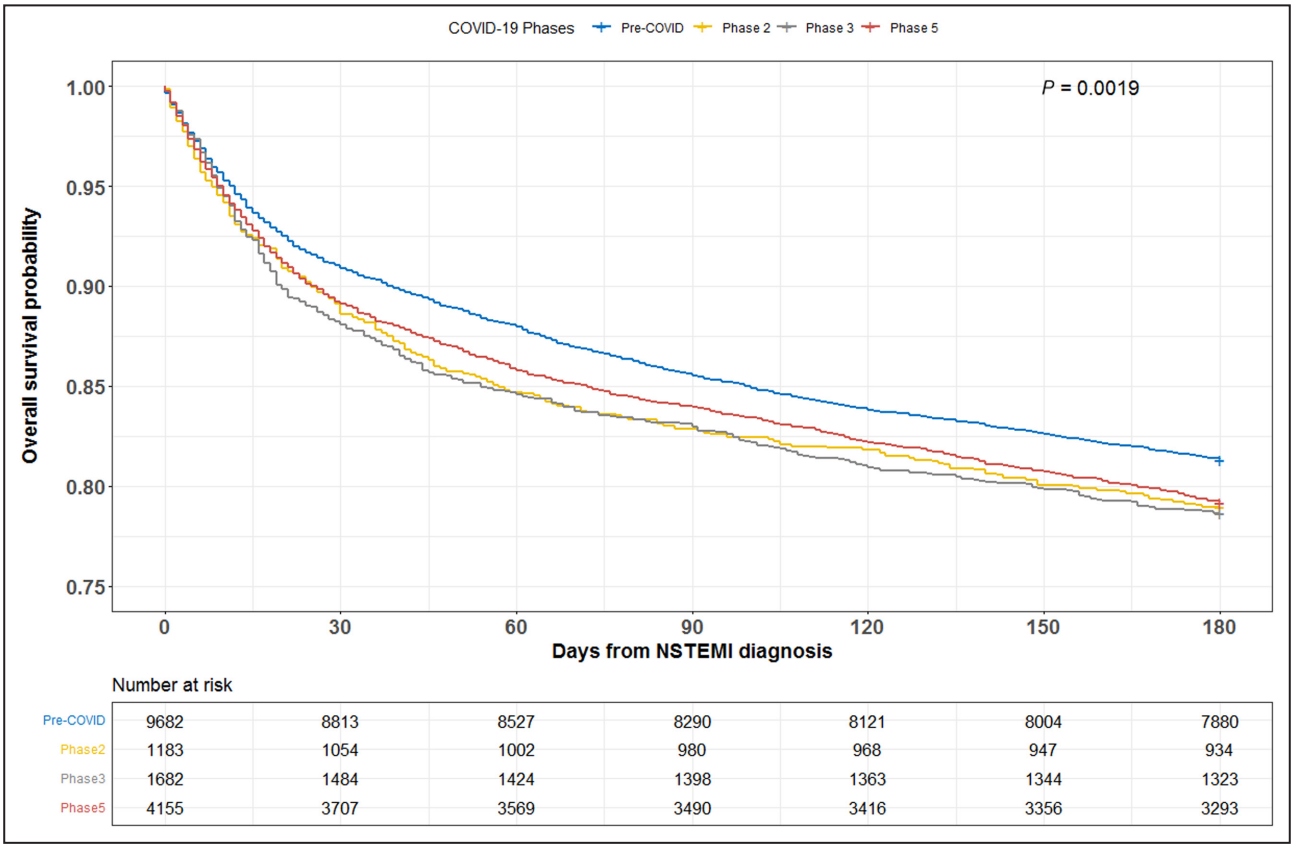


Figure 2. Kaplan–Meier survival plot by COVID-19 phases.
Phases 2, 3, and 5 showed significantly higher mortality compared with pre-COVID-19 (non-significant phases not shown).

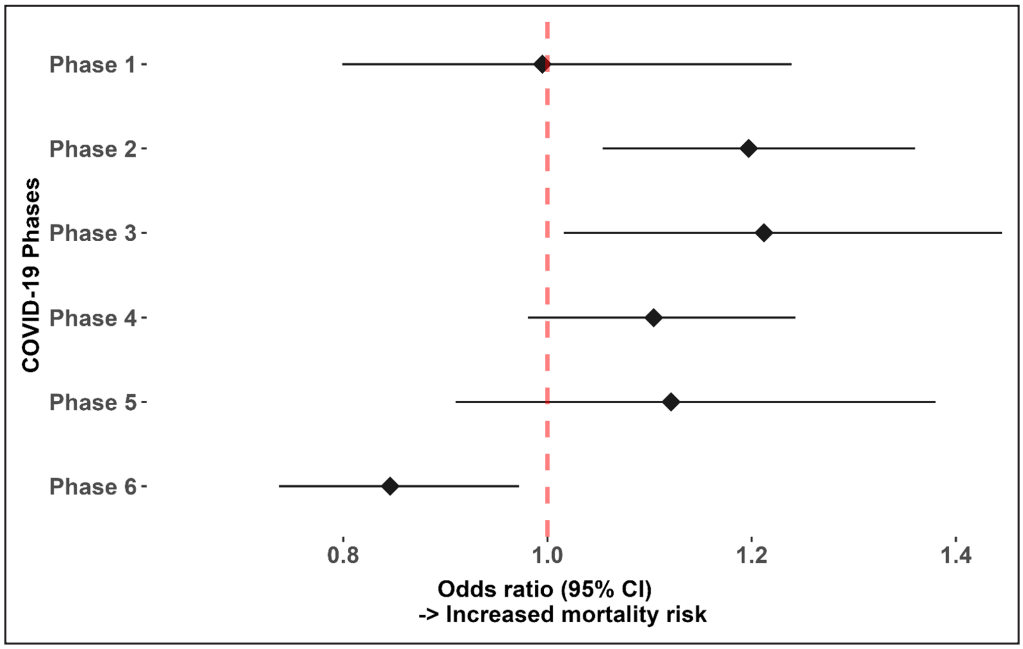


Figure 3. Adjusted 30-day mortality at VA facilities by COVID-19 phase (reference: pre-COVID-19 phase).
Compared with the pre-COVID-19 phase, higher mortality among patients with NSTEMI was found in Phase 2 and 3 (adjusted for baseline demographics, comorbidities, COVID-19 status on admission, and receipt of PCI). NSTEMI indicates non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; and VA, Veterans Affairs.

proportion of patients sought non-VA care, which was associated with higher mortality during certain phases of the pandemic even after risk adjustment.

In the Veterans Health Administration, the volume of NSTEMI presentations during Phase 1 of the pandemic dropped dramatically—as has been reported in other non-COVID-19 related disease states.[14] Given the variability of severity and symptoms within the NSTEMI diagnosis, patients who could tolerate milder symptoms may have stayed home out of fear of contagion. Steady outpatient prescription refills over time in the national VA system argue against competing risk of death due to COVID-19 infection as a major contribution to the decline. The pandemic induced exacerbation of preexisting access problems,[15–18] suggested by the decline in low-income, rural, and less educated patients during Phase 1, highlighting the importance of concerted efforts to combat worsening health inequities during the most resource-constrained times. The phases extending past vaccine availability also reveal a surprisingly persistent lag in return to prepandemic volumes, suggesting that the pandemic has had lasting impacts on patient health care seeking practices.

Interestingly, analysis of all COVID-19 phases combined showed no significant difference in likelihood of receiving a procedure after NSTEMI diagnosis, suggesting that procedural care declined proportionally to the decreased volume of NSTEMI presentations overall. However, when individual phases were analyzed, they revealed an isolated finding of a lower likelihood of procedural treatment during the acute Phase 1 and a higher likelihood during the recovery Phase 6. Although this did not appear to translate to an increase in mortality risk during Phase 1, a mortality benefit was observed in Phase 6 compared with pre-COVID-19. The improved outcomes in Phase 6 may herald a return to normalcy postpandemic, though further research is required to determine the degree to which this is due to the rise procedure use versus advancements in cardiovascular care over the 4-year period studied. On the other hand, increased procedure use in Phase 6 may also be the earliest sign of appropriate treatment for a resurgence of untreated disease that was neglected during the pandemic years.

Examination of Kaplan–Meier survival curves reveals that mortality after NSTEMI was worse across Phases 2 (community spread), 3 (first peak), and 5 (second peak) compared with pre-pandemic levels. Adjusted regression analyses of 30-day mortality show that patients in Phases 2 and 3 experienced worse outcomes, but these were no longer significant by Phase 5—almost 2 years into the pandemic—suggesting that cardiovascular systems adapted over time to the new

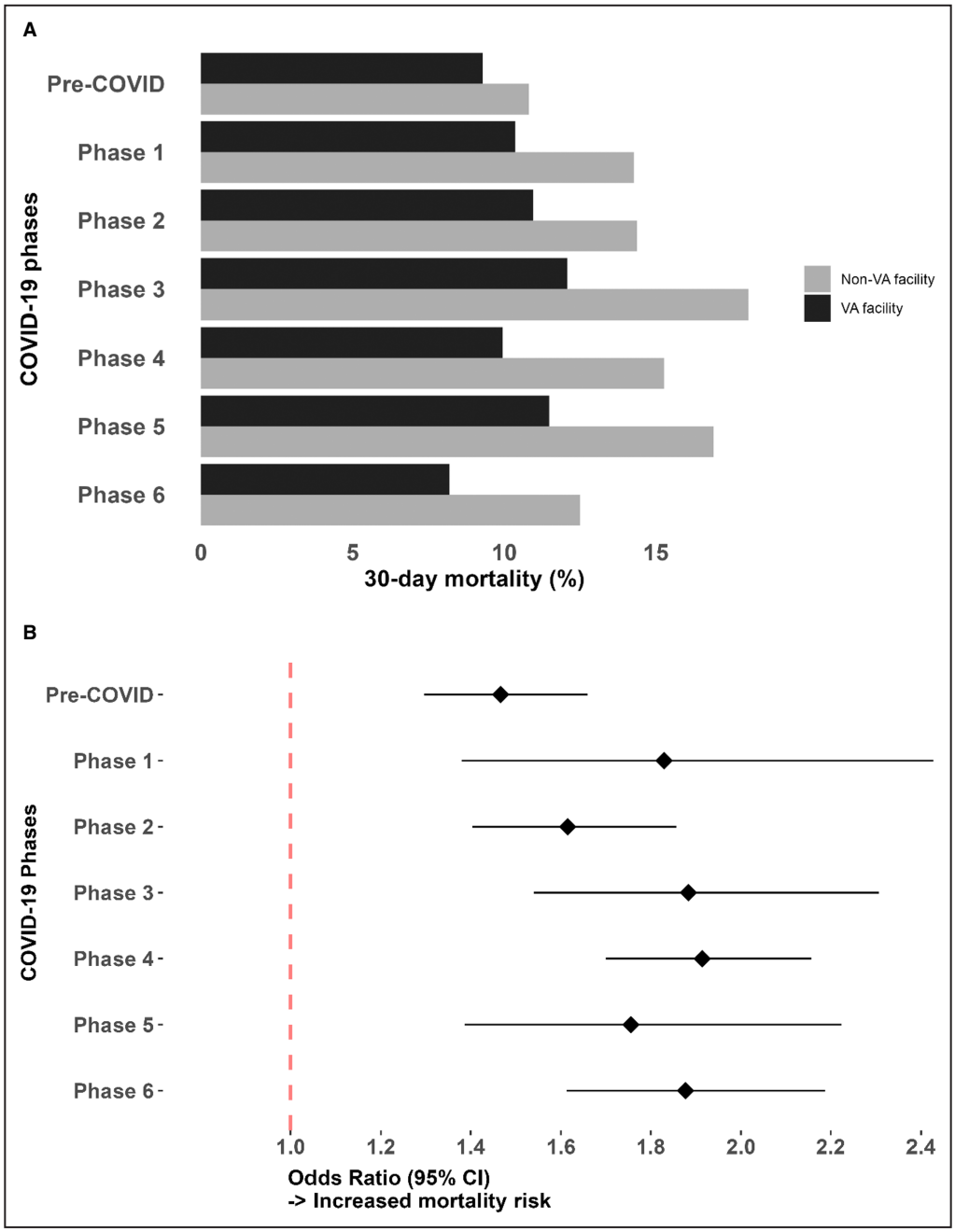


Figure 4. Comparison of 30-day NSTEMI mortality at VA vs non-VA facilities across COVID-19 pandemic phases.
A, Unadjusted 30-day NSTEMI mortality at VA vs non-VA facilities by COVID-19 pandemic phase. Non-VA facility use peaked during Phases 3 and 5, corresponding to the first and second pandemic peaks. **B**, Adjusted risk of 30-day NSTEMI mortality at non-VA facilities by COVID-19 phase (reference: VA facilities). Fee-basis care outside the VA was associated with higher mortality during multiple pandemic phases compared with treatment within the VA (adjustment for demographics and comorbidities). NSTEMI indicates non–ST-segment–elevation myocardial infarction; and VA, Veterans Affairs.

paradigm of pandemic care, despite the much higher burden of COVID-19 infections during this time.

Closer examination of the circumstances of Phases 2 and 3 reveal the unique vulnerabilities during this time period. As rapid early growth in COVID-19 infections climbed, this was a time of great uncertainty, during which strict national mandates limiting elective care started to be repealed and providers had few prior data to guide decisions on how to resume care.[19,20] Analysis of the mortality outcomes after adjustment for

receipt of PCI in these phases showed negligible effect, suggesting appropriate triage of procedural care. This points to the need to examine other potential contributing factors, such as inpatient care practices, outpatient follow-up, transition to telehealth, and medication compliance.

Our findings that veterans increased their use of non-VA care during the pandemic likely stem from multiple causes. First, progressive implementation of the Mission Act over the course of the pandemic may have affected fee-basis usage.[21] However, recovery of VA prescription volumes in early Phase 2 of the pandemic argues against an overall decline in VA use as the sole cause. Contagion concern may have led patients to seek the closest care possible or limited patient capacity to travel if the VA was not the nearest hospital. Severe VA bed shortages and strict VA rules limiting nonessential procedures may have also driven care to non-VA hospitals.[22] Prepandemic studies have suggested improved outcomes for MI care within the VA,[22,23] and we similarly found lower unadjusted risk of mortality among patients treated at VA facilities compared with non-VA facilities across all pre- and postpandemic phases. After adjustment however, the differences became no longer significant in the prepandemic period, as well as Phases 1, 2, and 5, leaving only Phases 3, 4, and 6 with significantly higher mortality risk at non-VA facilities. Interestingly, the higher non-VA facility mortality found in Phase 3 overlaps with the higher mortality observed within the VA alone in Phase 3 compared with prepandemic levels—suggesting possible health care systemwide vulnerabilities during this phase.

This study has limitations. Although *ICD* coding for STEMI and NSTEMI has been previously validated,[24] non-COVID-19 coding reliability during the pandemic has not been specifically addressed. One of the advantages of VA data is that they avoid bias from voluntary reporting or insurance status[25]; however, this is a predominantly male population. We adjusted our analyses for multiple patient characteristics, though additional confounders may exist. These data do not capture patients who did not present to a health care facility.

In conclusion, we found that the VA health care system responded to the COVID-19 pandemic with reductions in procedural treatment for NSTEMI that were proportional to the lower numbers of patients presenting with NSTEMI, yet the community spread and first peak of the pandemic was still affected with higher mortality. These resolved by the second, higher pandemic peak but reveal the vulnerabilities that occurred during earlier abrupt changes in operational capacity and serve as a guide to direct preparations for future threats.

ARTICLE INFORMATION

Received February 21, 2023; accepted March 28, 2023.

Affiliations

Veterans Affairs Palo Alto Healthcare System, Palo Alto, CA (C.M.Y., T.J.B., J.H., T.B., W.F.F., S.M.A., M.T., P.H.); Division of Cardiovascular Medicine, Stanford University School of Medicine, and Cardiovascular Institute, Stanford, CA (C.M.Y., W.F.F., M.T., P.H.); Health Economics Resource Center (HERC), VA Palo Alto Healthcare System, Palo Alto, CA (L.G.); Stanford-Surgery Policy Improvement Research & Education Center (S-SPIRE), Stanford Medicine, Palo Alto, CA (L.G.); Department of Medicine, Stanford School of Medicine, Stanford, CA (S.S., S.M.A.); and Center for Digital Health, Stanford University, Stanford, CA (M.T.).

Sources of Funding

C.M.Y. is funded by a Career Development Award from the US Department of Veterans Affairs Health Services Research & Development Service of the VA Office of Research and Development. This work was also funded by a VA Rapid Response COVID-19 grant.

Disclosures

W.F. receives research support from Abbott, Boston Scientific, Edwards LifeSciences, and Medtronic. He has a consulting relationship with CathWorks and Siemens and stock options with HeartFlow. The remaining authors have no disclosures to report.

Supplemental Material

Tables S1–S4
Figures S1–S3

REFERENCES

1. Veterans Health Administration–Office of Emergency Management. COVID-19 Response Plan. Accessed June 2, 2020. https://www.va.gov/opa/docs/VHA_COVID_19_03232020_vF_1.pdf.
2. Centers for Disease Control and Prevention. Managing Healthcare Operations during COVID-19. Accessed January 12, 2022. https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/guidance-hcf.html.
3. Amsterdam EA, Wenger NK, Brindis RG, Casey DE Jr, Ganiats TG, Holmes DR Jr, Jaffe AS, Jneid H, Kelly RF, Kontos MC, et al. 2014 AHA/ACC guideline for the management of patients with non–ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2014;130:344–426. doi: 10.1161/CIR.0000000000000134
4. O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, de Lemos JA, Ettinger SM, Fang JC, Fesmire FM, Franklin BA, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2013;127:362–425. doi: 10.1161/CIR.0b013e3182742c84
5. Mohamed MO, Banerjee A, Clarke S, de Belder M, Patwala A, Goodwin AT, Kwok CS, Rashid M, Gale CP, Curzen N, et al. Impact of COVID-19 on cardiac procedure activity in England and associated 30-day mortality. *Eur Heart J Qual Care Clin Outcomes.* 2021;7:247–256. doi: 10.1093/ehjqcco/qcaa079
6. Kwok CS, Gale CP, Kinnaird T, Curzen N, Ludman P, Kontopantelis E, Wu J, Denwood T, Fazal N, Deanfield J, et al. Impact of COVID-19 on percutaneous coronary intervention for ST-elevation myocardial infarction. *Heart.* 2020;106:1805–1811. doi: 10.1136/heartjnl-2020-317650
7. Yong CM, Ang L, Welt FG, Gummidipundi S, Henry TD, Pinto DS, Cox D, Wang P, Asch S, Mahmud E, et al. Society for Cardiovascular Angiography and Interventions (SCAI) and the American College of Cardiology (ACC) interventional council. Cardiac procedural deferral during the coronavirus (COVID-19) pandemic. *Catheter Cardiovasc Interv.* 2020;96:1080–1086. doi: 10.1002/ccd.29262
8. Fox DK, Waken RJ, Johnson DY, Hammond G, Yu J, Fanous E, Maddox TM, Joynt Maddox KE. Impact of the COVID-19 pandemic on patients without COVID-19 with acute myocardial infarction and heart failure. *J Am Heart Assoc.* 2022;11:e022625. doi: 10.1161/JAHA.121.022625

9. Veterans Health Administration. About VHA. Accessed May 10, 2022. https://www.va.gov/health/aboutvha.asp#:~:text=The%20Veterans%20Health%20Administration%20(VHA,Veterans%20enrolled%20in%20the%20VA).
10. US Department of Veterans Affairs, VA Information Resource Center (VIReC). VIReC research user guide: VHA pharmacy prescription data, 2nd edition. Accessed March 1, 2022. http://www.virec.research.va.gov/References/RUG/RUG.htm.
11. Sohn MW, Arnold N, Maynard C, Hynes DM. Accuracy and completeness of data in the Department of Veterans Affairs. *Popul Health Metr.* 2006;4:2. doi: 10.1186/1478-7954-4-2
12. Yong CM. "COVID-19 phase dating in the VHA" presentation at VHA Disrupted Care Big Tent Virtual Meeting. 2022.
13. New York Times. Coronavirus in the U.S. Latest Map and Case Count. Accessed January 23, 2023. https://www.nytimes.com/interactive/2021/us/covid-cases.html.
14. Kwok CS, Gale CP, Curzen N, de Belder MA, Ludman P, Lüscher TF, Kontopantelis E, Roebuck C, Denwood T, Burton T, et al. Impact of the COVID-19 pandemic on percutaneous coronary intervention in England: insights from the British Cardiovascular Intervention Society PCI database cohort. *Circ Cardiovasc Interv.* 2020;13:e009654. doi: 10.1161/CIRCINTERVENTIONS.120.009654
15. Spalluto LB, Lewis JA, Samuels LR, Callaway-Lane C, Matheny ME, Denton J, Robles JA, Dittus RS, Yankelevitz DF, Henschke CI, et al. Association of rurality with annual repeat lung cancer screening in the veterans health administration. *J Am Coll Radiol.* 2022;19:131–138. doi: 10.1016/j.jacr.2021.08.027
16. Cheney AM, Koenig CJ, Miller CJ, Zamora K, Wright P, Stanley R, Fortney J, Burgess JF, Pyne JM. Veteran-centered barriers to VA mental healthcare services use. *BMC Health Serv Res.* 2018;18:591. doi: 10.1186/s12913-018-3346-9
17. Vogt D, Bergeron A, Salgado D, Daley J, Ouimette P, Wolfe J. Barriers to veterans health administration care in a nationally representative sample of women veterans. *J Gen Intern Med.* 2006;21:S19–S25. doi: 10.1111/j.1525-1497.2006.00370.x
18. Schooley BL, Horan TA, Lee PW, West PA. Rural veteran access to healthcare services: investigating the role of information and communication technologies in overcoming spatial barriers. *Perspect Health Inf Manag.* 2010;7:1f.
19. Fanaroff AC, Peterson ED, Chen AY, Thomas L, Doll JA, Fordyce CB, Newby LK, Amsterdam EA, Kosiborod MN, de Lemos JA, et al. Intensive care unit utilization and mortality among Medicare patients hospitalized with non–ST-segment elevation myocardial infarction. *JAMA Cardiol.* 2017;2:36–44. doi: 10.1001/jamacardio.2016.3855
20. Yong C. COVID-19: the isolation that has brought us together. *J Am Coll Cardiol.* 2020;75:2639–2641. doi: 10.1016/j.jacc.2020.04.014
21. VA Office of Public and Intergovernmental Affairs. VA Launches new healthcare options under MISSION Act. Accessed January 14, 2022. https://www.va.gov/opa/pressrel/pressrelease.cfm?id=5264.
22. Nuti SV, Qin L, Rumsfeld JS, Ross JS, Masoudi FA, Normand SL, Murugiah K, Bernheim SM, Suter LG, Krumholz HM. Association of admission to veterans affairs hospitals vs non–veterans affairs hospitals with mortality and readmission rates among older men hospitalized with acute myocardial infarction, heart failure, or pneumonia. *JAMA.* 2016;315:582–592. doi: 10.1001/jama.2016.0278
23. Hess PL, Gunzburger EC, Kini V, Liu CF, Jones J, Matlock D, Heidenreich PA, Levy CR, Maddox TM, Grunwald GK, et al. National trends of hospital performance in acute myocardial infarction care: Department of Veterans Affairs, 2011-2014. *Circ Cardiovasc Qual Outcomes.* 2018;11:e004282. doi: 10.1161/CIRCOUTCOMES.117.004282
24. Patel AB, Quan H, Welsh RC, Deckert-Sookram J, Tymchak W, Sookram S, Surdhar I, Kaul P. Validity and utility of ICD-10 administrative health data for identifying ST- and non-ST-elevation myocardial infarction based on physician chart review. *CMAJ Open.* 2015;3:E413–E418. doi: 10.9778/cmajo.20150060
25. Yong CM, Spinelli KJ, Chiu ST, Jones B, Penny B, Gummidipundi S, Beach S, Perino A, Turakhia M, Heidenreich P, et al. Cardiovascular procedural deferral and outcomes over COVID-19 pandemic phases: a multi-center study. *Am Heart J.* 2021;241:14–25. doi: 10.1016/j.ahj.2021.06.011

Supplemental Material

Table S1. ICD-10 Procedure Codes and CPT Codes

PCI	**ICD10:** '0270346' , '027034Z' , '270356' , '027035Z' , '270366' , '027036Z' , '270376' , '027037Z' , '02703D6' , '02703DZ' , '02703EZ' , '02703F6' , '02703FZ' , '02703G6' , '02703GZ' , '02703T6' , '02703TZ' , '02703Z6' , '02703ZZ' , '271346' , '027134Z' ,'271356' , '027135Z' , '271366' , '027136Z' , '271376' , '027137Z' , '02713D6' , '02713DZ' , '02713EZ' , '02713F6' , '02713FZ' , '02713G6' ,'02713GZ' , '02713T6' , '02713TZ' , '02713Z6' , '02713ZZ' , '272346' , '027234Z' , '272356' , '027235Z' , '272366' , '027236Z' , '272376' , '027237Z' , '02723D6' , '02723DZ' , '02723EZ' , '02723F6' , '02723FZ' , '02723G6' , '02723GZ' , '02723T6' , '02723TZ' , '02723Z6' , '02723ZZ' , '273346' , '027334Z' ,'273356' , '027335Z' , '273366' , '027336Z' , '273376' , '027337Z' , '02733D6' , '02733DZ' , '02733EZ' , '02733F6' , '02733FZ' , '02733G6' , '02733GZ' , '02733T6' , '02733TZ' , '02733Z6' , '02733ZZ' , '02C03Z6' , '02C03ZZ' , '02C13Z6' , '02C13ZZ' , '02C23Z6' , '02C23ZZ' , '02C33Z6' , '02C33ZZ'
	CPT: '92920' , '92921' , '92924' , '92925' , '92928' , '92929' , '92933' , '92934' , '92937' , '92938' , '92941' , '92943' , '92944' , '92973' , '92974' , '92980' , '92981' , '92982' , '92984' , '92995' , '92996' , 'C9600' , 'C9601' , 'C9602' ,'C9603' , 'C9604' , 'C9605' , 'C9606' , 'C9607' , 'C9608' , 'G0290' , 'G0291'
CABG	**ICD10:** '210083' , '210088' , '210089' , '021008C' , '021008F' , '021008W' , '210093' , '210098' , '210099' , '021009C' , '021009F' , '021009W' , '02100A3' , '02100A8' , '02100A9' , '02100AC' , '02100AF' , '02100AW' , '02100J3' , '02100J8' , '02100J9' , '02100JC' , '02100JF' , '02100JW' , '02100K3' , '02100K8' , '02100K9' , '02100KC' , '02100KF' , '02100KW' , '02100Z3' , '02100Z8/ 02100Z9' , '02100ZC' , '02100ZF' , '210344' , '02103D4' , '210444' , '210483' , '210488' , '210489' , '021048C' , '021048F' , '021048W' , '210493' , '210498' , '210499' , '021049C' , '021049F' , '021049W' , '02104A3' , '02104A8/ 02104A9' , '02104AC' , '02104AF' , '02104AW' , '02104D4' , '02104J3' , '02104J8' , '02104J9' , '02104JC' , '02104JF' ,'02104JW' , '02104K3' , '02104K8' , '02104K9' , '02104KC' , '02104KF' , '02104KW' , '02104Z3' , '02104Z8' , '02104Z9' , '02104ZC' , '02104ZF' , '211083' ,'211088' , '211089' , '021108C' , '021108F' , '021108W' , '211093' , '211098' , '211099' , '021109C' , '021109F' , '021109W' , '02110A3' , '02110A8' ,'02110A9' , '02110AC' , '02110AF' , '02110AW' , '02110J3' , '02110J8' , '02110J9' , '02110JC' , '02110JF' , '02110JW' , '02110K3' , '02110K8' , '02110K9' ,'02110KC' , '02110KF' , '02110KW' , '02110Z3' , '02110Z8' , '02110Z9' , '02110ZC' , '02110ZF' , '211344' , '02113D4' , '211444' , '211483' , '211488' , '211489' , '021148C' , '021148F' , '021148W' , '211493' , '211498' , '211499' , '021149C' , '021149F' , '021149W' , '02114A3' , '02114A8' , '02114A9' , '02114AC' , '02114AF' , '02114AW' , '02114D4' , '02114J3' , '02114J8' , '02114J9' , '02114JC' , '02114JF' , '02114JW' , '02114K3' , '02114K8' , '02114K9' , '02114KC' , '02114KF' , '02114KW', '02114Z3' , '02114Z8' , '02114Z9' , '02114ZC' , '02114ZF' , '212083' , '212088' , '212089' , '021208C' , '021208F' , '021208W' , '212093' , '212098' , '212099' , '021209C' , '021209F' , '021209W' , '02120A3' , '02120A8' , '02120A9' , '02120AC' , '02120AF' , '02120AW' , '02120J3' , '02120J8' , '02120J9' , '02120JC' , '02120JF' , '02120JW' , '02120K3' , '02120K8' , '02120K9' , '02120KC' , '02120KF' , '02120KW' , '02120Z3' , '02120Z8' , '02120Z9' , '02120ZC' , '02120ZF' , '212344' , '02123D4' , '212444' , '212483' , '212488' , '212489' , '021248C' , '021248F' , '021248W' , '212493' , '212498' , '212499' , '021249C' , '021249F' , '021249W' , '02124A3' , '02124A8' , '02124A9' , '02124AC' , '02124AF' , '02124AW' , '02124D4' , '02124J3' , '02124J8' , '02124J9' , '02124JC' , '02124JF' , '02124JW' , '02124K3' , '02124K8' , '02124K9' , '02124KC' , '02124KF' , '02124KW' ,'02124Z3' , '02124Z8' , '02124Z9' , '02124ZC' , '02124ZF' , '213083' , '213088' , '213089' , '021308C' , '021308F' , '021308W' , '213093' , '213098' ,

	'213099' , '021309C' , '021309F' , '021309W' , '02130A3' , '02130A8' , '02130A9' , '02130AC' , '02130AF' , '02130AW' , '02130J3' , '02130J8' , '02130J9' ,'02130JC' , '02130JF' , '02130JW' , '02130K3' , '02130K8' , '02130K9' , '02130KC' , '02130KF' , '02130KW' , '02130Z3' , '02130Z8' , '02130Z9' , '02130ZC' , '02130ZF' , '213344' , '02133D4' , '213444' , '213483' , '213488' , '213489' , '021348C' , '021348F' , '021348W' , '213493' , '213498' , '213499' , '021349C' ,'021349F' , '021349W' , '02134A3' , '02134A8' , '02134A9' , '02134AC' , '02134AF' , '02134AW' , '02134D4' , '02134J3' , '02134J8' , '02134J9' , '02134JC' , '02134JF' , '02134JW' , '02134K3' , '02134K8' , '02134K9' , '02134KC' , '02134KF' , '02134KW' , '02134Z3' , '02134Z8' , '02134Z9' , '02134ZC' , '02134ZF'
	CPT: '33510' , '33511' , '33512' , '33513' , '33514' , '33516' , '33517' , '33518' , '33519' , '33521' , '33522' ,'33523' , '33533' , '33534' , '33535' , '33536' , '33572' , '4110F' , 'S2205' , 'S2206' ,'S2207' , 'S2208' , 'S2209
Coronary Angiography	**ICD10:** 'B2100ZZ','B2101ZZ','B210YZZ','B211YZZ' 'B210010' , 'B2100ZZ' , 'B210110' , 'B2101ZZ' , 'B210Y10' , 'B210YZZ' , 'B211010' , 'B2110ZZ' , 'B211110' , 'B2111ZZ' , 'B211Y10' , 'B211YZZ' , 'B212010' , 'B2120ZZ', 'B212110' , 'B2121ZZ' , 'B212Y10' , 'B212YZZ' , 'B213010', 'B2130ZZ' , 'B213110' , 'B2131ZZ' , 'B213Y10' , 'B213YZZ' , 'B2170ZZ' , 'B2171ZZ' , 'B217YZZ' ,'B2180ZZ', 'B2181ZZ' , 'B218YZZ' , 'B21F0ZZ' , 'B21F1ZZ' , 'B21FYZZ'
	CPT: '8855' , '8856' , '8857' , '3E073KZ'
CPT= Current Procedural Terminology, ICD= International Classification of Diseases, PCI= percutaneous coronary intervention, CABG= coronary artery bypass graft.	

Table S2. Procedural Volumes by COVID-19 Phase , N (% of NSTEMI patients)

	Pre-COVID	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	P-value
PCI	2811 (29.0%)	296 (27.0%)	1226 (29.5%)	467 (27.8%)	1647 (30.1%)	342 (28.9%)	1184 (29.0%)	0.33
CABG	472 (4.9%)	39 (3.6%)	216 (5.2%)	85 (5.1%)	271 (5.0%)	69 (5.8%)	213 (5.2%)	0.26
Coronary Angiogram	5220 (53.9%)	526 (48.0%)	2254 (54.3%)	882 (52.4%)	3070 (56.1%)	652 (55.1%)	2328 (57.1)	<0.01

NSTEMI= Non-ST-segment-elevation myocardial infarction, PCI= percutaneous coronary intervention, CABG= coronary artery bypass graft.

Table S3. Adjusted Likelihood of Receiving Procedural Treatment for NSTEMI by Phase (reference: Pre-COVID).

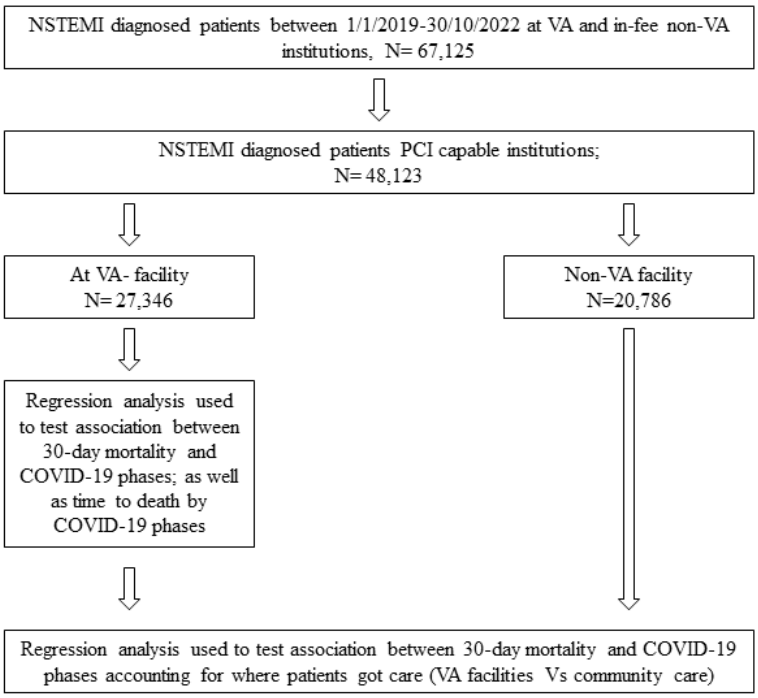
	Adjusted OR	Lower	Upper	P-value
Phase 1	0.773	0.635	0.940	0.002
Phase 2	0.987	0.880	1.106	1.000
Phase 3	0.916	0.779	1.078	0.694
Phase 4	1.104	0.994	1.226	0.081
Phase 5	1.057	0.874	1.279	0.978
Phase 6	1.180	1.051	1.325	0.001
NSTEMI= Non-ST-segment-elevation myocardial infarction, OR= Odds Ratio.				

Table S4. Factors Associated with 30-day Mortality

Characteristics	NSTEMI Patients (N=2674)	P-value
Demographics		
Age, years, mean (SD)	77.7 (10.23)	<0.01†
Sex, n (%)		<0.01*
F	49 (5.7%)	
M	2625 (10.0%)	
Race/Ethnicity, n (%)		<0.01*
Black Non-Hispanic	427 (7.3%)	
Hispanic	220 (11.2%)	
Other	86 (13.3%)	
White Non-Hispanic	1792 (10.4%)	
Rurality by Zip code, n (%)		<0.01*
Highly rural	71 (8.7%)	
Rural	759 (10.9%)	
Urban	1793 (9.4%)	
Census Tract Education Level, n (%)		0.54*
<25% of HS Education	2230 (9.7%)	
>=25% of HS Education	444 (10.0%)	
Census Tract Income, n (%)		0.05*
<=25% 75K or less income	2230 (9.9%)	
>25% 75K or less income	444 (9.0%)	
DRIVE DISTANCE, mile, mean (SD)		
To Primary Care Center	14.7 (14.21)	0.37†
To Secondary Care Center	29.8 (31.86)	0.80†
To Tertiary Care Center	61.2 (66.49)	0.95†
Comorbidities		
Charlson Comorbidity Index, mean (SD)	7.4 (3.39)	<.01†
Congestive Heart Failure, n (%)	1850 (12.6%)	<.01*
Peripheral Vascular Disease, n (%)	1056 (12.1%)	<.01*
Cerebrovascular Disease, n (%)	783 (13.2%)	<.01*
Chronic Pulmonary Disease, n(%)	1203 (12.0%)	<.01*
Diabetes without complications, n(%)	1409 (9.7%)	0.76*
Diabetes with complications, n(%)	1184 (10.8%)	<.01*
Renal Disease, n (%)	1503 (13.3%)	<.01*
Cancer, n (%)	813 (15.9%)	<.01*
Metastatic Carcinoma, n (%)	307 (27.7%)	<.01*

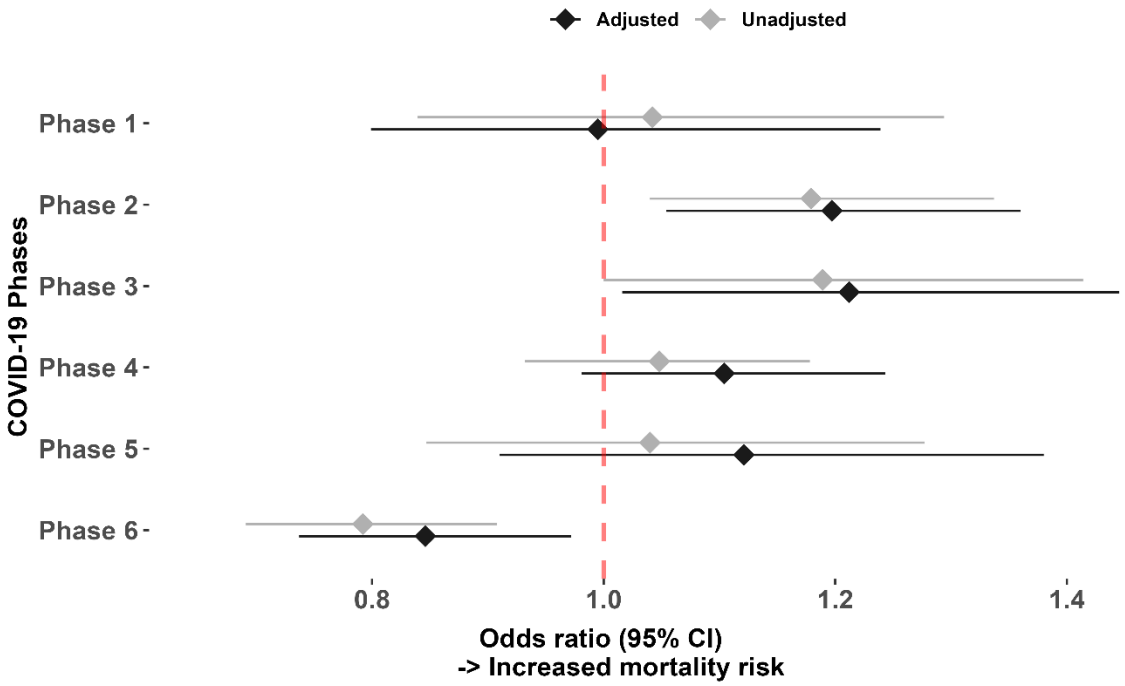
*Chi-Square p-value; †Kruskal-Wallis p-value; NSTEMI= Non-ST-segment-elevation myocardial infarction, SD= standard deviation, HS= high school.

Figure S1. Patient cohort selection flowchart



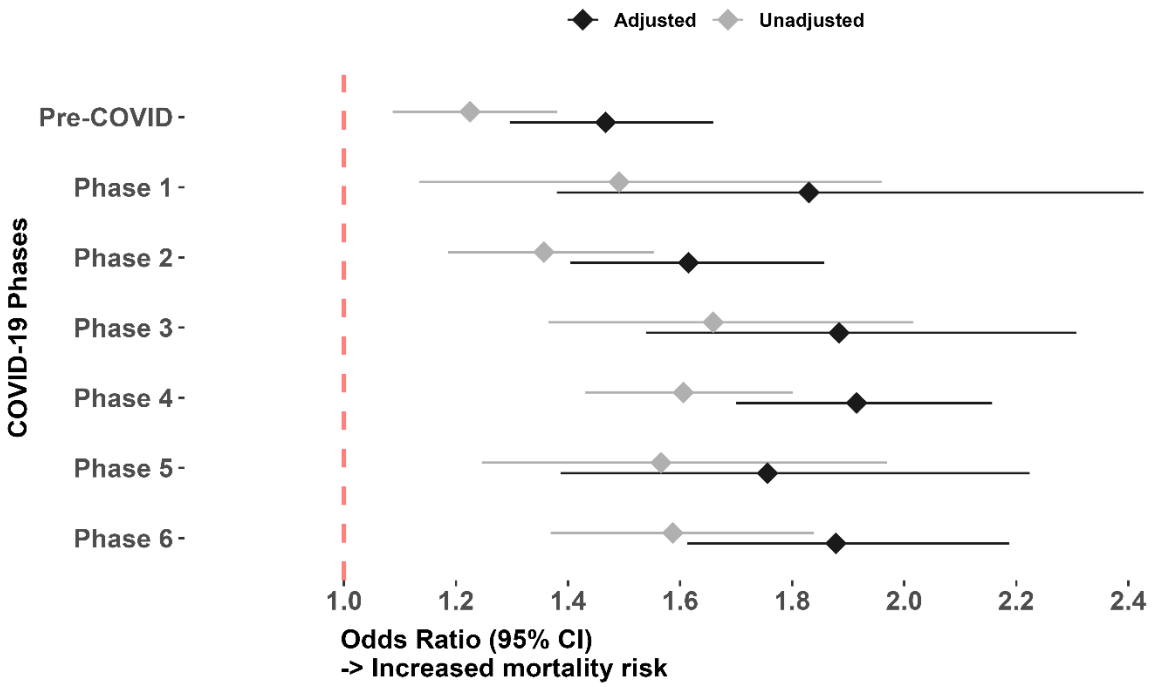
NSTEMI= Non-ST-segment-elevation myocardial infarction, PCI= percutaneous coronary intervention, VA= Veterans Affairs.

Figure S2. Unadjusted and Adjusted 30-day Mortality by COVID-19 phase (reference: pre-COVID phase)



Compared to the pre-COVID phase, higher mortality among NSTEMI patients was found in Phase 2 and 3, which persisted after adjustment for baseline demographics, comorbidities, COVID status on admission, and receipt of PCI. NSTEMI= Non-ST-segment-elevation myocardial infarction, PCI= percutaneous coronary intervention.

Figure S3. Unadjusted and Adjusted Risk of 30-day Mortality at Non-VA Facilities by COVID-19 Phase (reference: VA Facilities).



Fee-Basis care outside the VA was associated with higher mortality during multiple pandemic phases compared to treatment within the VA, and persisted after adjustment for demographics and comorbidities. VA= Veterans Affairs.