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ORIGINAL RESEARCH

Increased Inpatient Mortality for Cardiovascular Patients During the First Wave of the COVID-19 Epidemic in New York

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BACKGROUND: The acuity and magnitude of the first wave of the COVID-19 epidemic in New York mandated a drastic change in healthcare access and delivery of care.

METHODS AND RESULTS: We retrospectively studied patients admitted with an acute cardiovascular syndrome as their principal diagnosis to 13 hospitals across Northwell Health during March 11 through May 26, 2020 (first COVID-19 epidemic wave) and the same period in 2019. Three thousand sixteen patients (242 COVID-19 positive) were admitted for an acute cardiovascular syndrome during the first COVID-19 wave compared with 9422 patients 1 year prior (decrease of 68.0%, $P<0.001$). During this time, patients with cardiovascular disease presented later to the hospital (360 versus 120 minutes for acute myocardial infarction), underwent fewer procedures (34.6% versus 45.6%, $P<0.001$), were less likely to be treated in an intensive care unit setting (8.7% versus 10.8%, $P<0.001$), and had a longer hospital stay (2.91 [1.71–6.05] versus 2.87 [1.82–4.95] days, $P=0.033$). Inpatient cardiovascular mortality during the first epidemic outbreak increased by 111.1% (3.8 versus 1.8, $P<0.001$) and was not related to COVID-19-related admissions, all cause in-hospital mortality, or incidence of out-of-hospital cardiac deaths in New York. Admission during the first COVID-19 surge along with age and positive COVID-19 test independently predicted mortality for cardiovascular admissions (odds ratios, 1.30, 1.05, and 5.09, respectively, $P<0.0001$).

CONCLUSIONS: A lower rate and later presentation of patients with cardiovascular pathology, coupled with deviation from common clinical practice mandated by the first wave of the COVID-19 pandemic, might have accounted for higher in-hospital cardiovascular mortality during that period.

Key Words: acute coronary syndrome ■ COVID-19 pandemic ■ sudden cardiac death

After the announcement of the first confirmed COVID-19 infection in the New York Metropolitan Area on March 1, 2020, New York City almost immediately became the world epicenter of the first COVID-19 pandemic.[1] The upslope of the epidemic curve in New York was very rapid, reaching its peak in only 33 days. The magnitude of the surge was unprecedented, claiming 17 798 confirmed and 4 516 additional probable deaths from COVID-19 by June 1.[2]

Healthcare facilities were forced to rapidly adjust their operations to deal with the pandemic crisis. Hospitals had to repurpose clinical and nonclinical spaces and personnel to provide additional intensive care unit care and accommodate the surge of COVID-19-related hospitalizations.[3] Common clinical practice was altered to reduce patient and healthcare provider exposure. Nonurgent ambulatory visits, testing, and medical procedures were stopped or cancelled. The Centers for Disease Control and Prevention

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CLINICAL PERSPECTIVE

What Is New?

- There was a significant decline in patients admitted with an acute cardiovascular diagnosis across the Northwell Health network during the first wave of the COVID-19 outbreak in New York City with a concomitant increase in hospital mortality.

What Are the Clinical Implications?

- Challenges in access to ambulatory and emergency care and change of common practice in management of patients with cardiovascular disease may in part explain the observed results.

Nonstandard Abbreviations and Acronyms

OHSD	out-of-hospital sudden deaths

recommended that patients with comorbidities stay at home, when possible.[4]

While the number of admissions for COVID-19 surged upward, the number of admissions for critical cardiovascular illnesses such as ST-segment–elevation myocardial infarction (STEMI) and acute strokes plummeted.[5–8] It is unclear whether this was because of changes in access to outpatient care or reluctance by patients to seek medical attention, or both.[9–14] Furthermore, little is known about how deviation from prior clinical practices affected the in-hospital outcomes of patients admitted for acute cardiovascular syndromes.

The purpose of this study is to identify changes in the incidence, management, and outcomes of patients hospitalized with an acute cardiovascular disease as a principal diagnosis in the 13 hospitals of Northwell Health, the largest healthcare system in the Metropolitan New York area, during the first COVID-19 pandemic wave and compare them with a historical control 1 year prior.

METHODS

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

A detailed search of the common electronic medical record in 13 hospitals of Northwell Health, located in New York City and Long Island, was performed for periods January 1, 2020 to May 31, 2020 and January 1, 2019 to May 31, 2019. We identified all hospital admissions and reviewed hospitalizations for an acute cardiovascular syndrome as principal diagnosis. Our search query included the entire 6 months of each year to better identify the onset of the COVID-19 endemic effect on hospital admissions and ensure that both years had a similar number of admissions before the COVID-19 epidemic surge. Principal diagnosis was defined as the condition that caused the admission to the hospital, as identified after discharge. Acute cardiovascular syndromes were defined as patients presenting with 1 of the following as a principal diagnosis:

1. Acute coronary syndromes (STEMI and non-STEMI)
2. Acute congestive heart failure
3. Symptomatic arrhythmias including symptomatic bradycardia, high degree or complete atrioventricular block, supraventricular tachycardia, atrial fibrillation/flutter, and ventricular tachycardia or ventricular fibrillation
4. Acute pulmonary embolism
5. Acute aortic dissection
6. Acute stroke, transient ischemic attack
7. Syncope
8. Other cardiovascular diagnoses

Admissions where the above diagnoses were established during the course of the hospitalization for a different principal admission diagnosis or as a complication were not considered as cardiovascular. Time from onset of symptoms to presentation to the emergency department was identified for patients with acute STEMI and acute stroke after detailed review of medical records for those admissions.

In addition, we identified all nonelective cardiac procedures performed in those patients during their hospitalization. These procedures included cardiac catheterizations (with and without percutaneous coronary interventions), cardiovascular implantable electronic devices procedures, catheter ablation, external cardioversions, open heart surgeries, percutaneous structural heart procedures, and transesophageal echocardiograms. Cardiac procedures performed on patients with principal diagnosis other than the aforementioned cardiovascular diseases were also excluded. In addition, per New York State guidelines, no elective procedures were performed after March 16, 2020.

We also gathered data on patients admitted with a diagnosis of COVID-19 utilizing an “isolation banner” within the electronical medical record. This banner reflected all patients who either had a positive polymerase

chain reaction test result for SARS-CoV-2 or patients who were placed on COVID-19 isolation precautions because of clinical diagnosis of COVID-19. We identified the peak of the first COVID-19 epidemic wave as weeks 11 to 21 (March 11–May 26, 2020), after presenting COVID-related admissions on a weekly basis (Figure 1).

We identified the following outcomes for cardiovascular admissions: length of hospital stay, discharge to a facility other than home, treatment in an intensive care unit setting, and in-hospital mortality. The above cardiovascular outcomes during the COVID-19 surge were compared with a historical control a year earlier.

Finally, we used the number of daily out-of-hospital sudden deaths (OHSD), as reported by the Fire Department of New York, as a surrogate to outpatient sudden cardiovascular-related mortality in an effort to examine correlations between in-hospital and out-of-hospital cardiovascular mortality. This study was approved by our Institutional Review Board, which granted a waiver of consent and Health Insurance Portability and Accountability Act authorization for this retrospective chart review.

Statistical Analysis

Categorical values were compared using the χ^2 test and are summarized by count and percentage. Continuous variables were compared using the independent samples *t* test. Continuous variables are shown as means with SDs. Nonparametric variables are shown as median with interquartile range and were compared using the Whitney *U* test. Odds ratios (ORs) for in-hospital cardiovascular mortality during the COVID-19 outbreak in New York were calculated using logistic regression analysis. Correlation analysis was performed using the Spearman rank correlation coefficient. Statistical significance was set at $P<0.05$. Statistical analyses were performed with SPSS 25.0 (IBM Corp., Armonk, NY). Patients were not involved in the research process because this was a retrospective chart review.

RESULTS

During the peak COVID-19 pandemic surge, between weeks 11 and 21 (March 11–May 26, 2020), there was a total of 35 852 hospital admissions compared with 55 418 in 2019, representing a relative reduction of 35.3% ($P<0.001$) (Table 1, Figure 1). Before the onset of the first COVID-19 epidemic outbreak (weeks 1–10), the 2 years had a similar number of admissions (51 338 versus 51 258, P 0.901). Of admissions during the COVID-19 era, 3016 patients (8.4% of all admissions) were hospitalized for an acute cardiovascular syndrome as the primary reason compared with 9422 patients (17.0% of all admissions) 1 year prior (relative reduction 68.0%, $P<0.001$). Of the cardiovascular admissions during the COVID-19 epidemic surge, 242 patients (8.0%) tested positive for COVID-19 (Table 1, Figure 1). This decline in cardiovascular admissions was seen across all diagnoses. Specifically, admissions for acute coronary syndromes decreased by 71.6% ($P<0.001$), acute decompensated heart failure by 68.2% ($P<0.001$), acute arrhythmias by 72.8%, ($P<0.001$), acute aortic dissections by 74.5% ($P<0.001$), acute pulmonary embolisms by 20.6% ($P=0.025$), acute strokes or transient ischemic attacks by 44.9% ($P<0.001$), and syncope by 64.5% ($P<0.001$) (Table 1).

The 103 patients who were admitted with STEMI during the first COVID-19 pandemic surge had a significantly later presentation than the 167 STEMI admissions in 2019, with a time from onset of chest pain to presentation of 360 (85.5–1440.0) and 120 (55.6–420.0) (median and interquartile range) minutes, respectively ($P=0.004$). Similarly delayed was the presentation of the 477 patients admitted with acute stroke during the

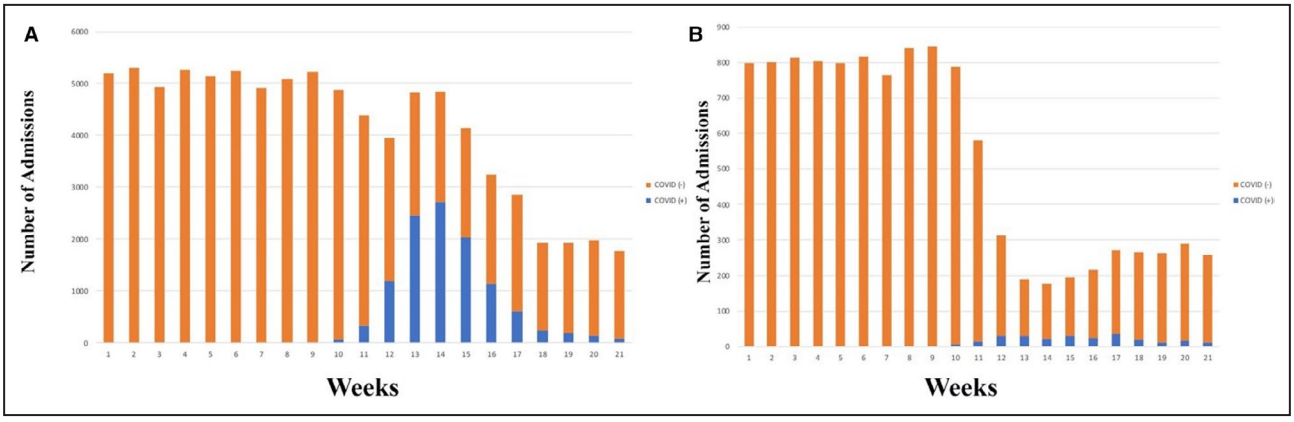

Figure 1. Northwell admissions (A) and cardiovascular admissions (B) stratified by COVID-19 status.

Table 1. Admissions and Interventions for Patients with Acute Cardiovascular Syndromes During the First Wave of the COVID-19 Epidemic in 2020 Versus Historical Control in 2019

Demographics	2020		2019	Relative Change (%)	*P*
	Weeks 11 to 21				
	All	COVID+	Weeks 11 to 21		
Age, y, mean±SD	50.1±28.1	63.5±17.1	51.7±28.1	N/A	<0.001
Males, %	46.90%	57.00%	43.80%	7.08	<0.001
Race n(%)					
Asian	3101 (8.7)	910 (8.2)	4262 (7.7)	13.0	<0.001
Black	6002 (16.7)	2322 (16.5)	9177 (16.5)	1.21	0.472
White	17 036 (47.5)	4203 (37.8)	29 916 (54.0)	−12.0	<0.001
Other/multiracial	9713 (27.1)	3683 (33.1)	12 063 (21.8)	24.3	<0.001
Ethnicity n(%)					
Hispanic	6618 (20.4)	2671 (26.9)	8133 (16.4)	24.4	<0.001
Non-Hispanic	25 751 (79.6)	7250 (73.1)	41 514 (83.6)	−4.78	<0.001
Insurance n(%)					
Commercial	14 018 (39.1)	3350 (30.1)	21 086 (38.0)	2.89	0.001
Medicare	12 572 (35.1)	5094 (45.8)	21 249 (38.3)	−8.35	<0.001
Medicaid	8410 (23.5)	2339 (21.0)	11 987 (21.6)	8.80	<0.001
Other*	852 (2.4)	335 (3.0)	1096 (2.0)	−22.3	<0.001
Acute cardiovascular admissions by principal diagnosis (COVID19+ patients)					
ACS	790	34	2784	−71.6	<0.001
Acute heart failure	594	36	1868	−68.2	<0.001
Acute arrhythmias	406	38	1494	−72.8	<0.001
Acute stroke (CVA and TIA)	477	51	866	−44.9	<0.001
Acute aortic dissection	25	1	98	−74.5	<0.001
Acute pulmonary embolism	170	28	214	−20.6	0.025
Syncope	179	17	504	−64.5	<0.001
Other cardiovascular diagnosis	366	36	1577	−76.8	<0.001
Total admissions for acute CVS	3016	242	9422	−68.0	<0.001
Total all-cause admissions	35 852	11 118	55 418	−35.3	<0.001
% of CVS admissions compared with total	8.4	2.2	17.0	−50.6	<0.001
Interventions in patients with acute cardiovascular syndromes (%)†					
Acute arrhythmia+cardiovascular/ablation/CIED	134 (33.0)	6 (15.8)	686 (45.9)	−80.4	<0.001
ACS+LHC	479 (60.6)	15 (44.1)	1749 (62.8)	−72.6	0.262
ACS+PCI	218 (27.6)	8 (23.5)	1026 (36.9)	−78.8	<0.001
ACS+open heart	57 (7.2)	1 (2.9)	232 (8.3)	−75.4	0.309
Aortic dissection+repair	6 (24.0)	1 (100.0)	24 (24.5)	−75.0	0.960
Noncardiovascular admission+cardiovascular procedure	622 (1.89)	227 (2.09)	1073 (2.33)	−42.0	<0.001
All cardiovascular admission+cardiovascular procedure‡	1044 (34.6)	48 (19.8)	4294 (45.6)	−75.7	<0.001

ACS indicates acute coronary syndrome; CIED, cardiac implantable electronic device; CVA, cerebrovascular accident; CVS, cardiovascular syndromes; LHC, left heart catheterization; N/A, not applicable; PCI, percutaneous coronary intervention; and TIA, transient ischemic attack.

*Other includes union, military, and worker's compensation.

†Numbers in parentheses represent percentage of patients receiving procedure related to the principal diagnoses.

‡Cardiovascular procedures: Cardiac catheterizations (with and without percutaneous coronary interventions), cardiovascular implantable electronic devices (CIED) procedures, catheter ablation, external cardioversions, open heart surgeries, percutaneous structural heart procedures, and transesophageal echocardiograms.

first wave of the pandemic compared with the 866 patients during the controlled period in 2019 with median times from onset of symptoms to presentation of 329 (91.5–968.3) and 187 (81.0–427.0) minutes, respectively (*P*<0.001).

Except for patients presenting with acute dissection, patients with all other cardiovascular diagnoses received proportionally less invasive procedures during their hospitalization, with an overall reduction of cardiovascular procedures relative to cardiovascular admissions of 31.8% (34.6% versus 45.6% for 2019 and 2020, respectively, *P*<0.001), as compared with the prior year (Table 1, Figure 2). The number of nonelective cardiac procedures were similar for the first 10 weeks of 2020 (before the onset of the COVID-19 epidemic) compared with the same time period in 2019 (1351 versus 1313, *P*=0.724).

In addition, patients with an acute cardiovascular syndrome admitted during the first pandemic wave were less likely to be admitted to an intensive care unit setting (8.7% versus 10.8%, relative reduction 19.4%, *P*<0.001) and had a longer hospital stay (2.91 [1.71–6.05] versus 2.87 [1.82–4.95] days, *P*=0.033). The risk of in-hospital death in patients admitted with an acute cardiovascular diagnosis during the first COVID-19 epidemic wave was 3.8% compared with 1.8% for the same period in 2019, representing a relative increase of 111.1% (*P*<0.001). After excluding patients with cardiovascular disease who tested positive for COVID-19 during the same period, inpatient mortality remained higher during the epidemic surge compared with historic control (3.4% versus 1.8%, relative increase of 88.9%, *P*<0.001) (Table 2, Figure 3). This increase in mortality of patients with cardiovascular disease was in the setting of an overall 400% increase of mortality (9.0% versus 1.8%, *P*<0.001) among all admissions during the first COVID-19 epidemic wave.

Increase in mortality for patients with cardiovascular disease during the first COVID-19 surge was not

Figure 2. Nonelective cardiac procedures for patients with cardiovascular admissions between January 1 and May 26, 2019 vs 2020.

Table 2. Outcomes of Patients Admitted With Acute Cardiovascular Syndromes During First COVID-19 wave in 2020 Versus 2019.

Hospital Outcomes for Patients With Admitted for Acute Cardiovascular Syndromes	2020		2019	Relative Change (%)	*P*
	Weeks 11 to 21		Weeks 11 to 21		
	All	COVID+			
ICU setting n(%)	261 (8.7)	24 (9.9)	1020 (10.8)	–19.44	0.001
Length of stay, median (IQR)	2.91 (1.71–6.05)	5.66 (2.83–9.96)	2.87 (1.82–4.95)	N/A	0.033
Discharge other than home n(%)	557 (18.5)	85 (35.1)	1488 (15.8)	17.1	0.000
Mortality n(%)	116 (3.8)	23 (9.5)	166 (1.8)	111.1	<0.001

ICU indicates intensive care unit; IQR, interquartile range; N/A, not applicable.

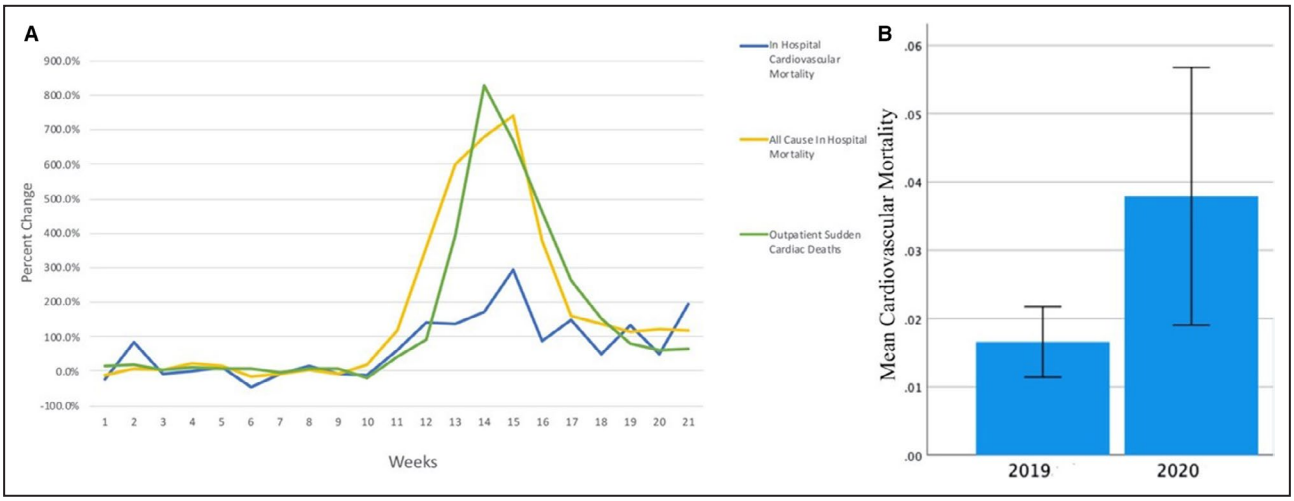

Figure 3. Changes in mortality during the first wave of COVID-19 epidemic.
A, Changes in in-hospital cardiovascular mortality, all-cause hospital mortality, and out-of-hospital sudden cardiac deaths during the first wave of the COVID-19 epidemic. **B,** Northwell in-hospital cardiovascular mortality during the first wave of the COVID-19 epidemic compared with historical control.

uniformly distributed across all 10 weeks. It peaked the same week with in-hospital mortality; however, despite a downward trend after its peak, cardiovascular mortality did not follow the same rate of decline as the all-cause in-hospital mortality (Figure 3). Correlation analysis showed that there was no association between in-hospital mortality for patients with cardiovascular disease and either number of hospitalized patients with COVID-19-positive status (Spearman rho 0.062) or all-cause in-hospital mortality (Spearman rho 0.221, P=0.491). On the contrary, all-cause in-hospital mortality correlated strongly with number of COVID-19-positive hospitalized patients (Spearman rho 0.996, P<0.001).

Regression analysis was performed for all cardiovascular admissions during weeks 1 to 21 for 2019 and 2020. Admission during the weeks of the first COVID-19 wave was a univariate predictor of mortality for patients with cardiovascular disease (OR, 1.499; 95% CI, 1.231–1.826, P<0.001). Multivariate models were also created using age, race, insurance, sex, admission during the first COVID-19 wave, and COVID-19 test as covariates. Admission during the first COVID-19 epidemic outbreak independently predicted in-patient mortality for patients with cardiovascular disease (OR, 1.301; 95% CI, 1.050–1.611, P<0.001), along with age (OR, 1.047; 95% CI, 1.040–1.054, P<0.001) and a positive COVID-19 test (OR, 5.091; 95% CI, 3.225–8.038, P<0.001).

The Fire Department of New York reported that 7191 people were pronounced dead on the scene out of a total of 10 975 emergency calls for presumed cardiac arrest between March 11 and May 26 in 2020. This represents a 2.86-fold increase in the number of OHSD compared with the reference period the year prior (1859 OHSD of 4929 cardiac arrests calls). The daily distribution of OHSD during the COVID-19 pandemic surge also follows a bell-shaped curve following a similar distribution of all-cause in-hospital mortality at Northwell (Figure 3). OHSD during the first COVID-19 surge correlated positively with the in-hospital all-cause mortality at Northwell (Spearman rho 0.899, P<0.001) but not with in-hospital mortality in patients with cardiovascular disease (Spearman rho 0.117, P=0.718).

DISCUSSION

The main findings of this study were that during the first wave of the New York COVID-19 epidemic surge compared with the prior year: (1) total hospital admissions decreased; the decrease was most significant in cardiovascular admissions; (2) patients with acute STEMIs and strokes presented to the health system later; (3) patients with cardiovascular disease were less likely to receive invasive interventions or get admitted to the intensive care unit; (4) in-hospital mortality was higher among patients with cardiovascular disease irrespective of COVID-19 status; and (5) contrary to the all-cause in-hospital mortality, cardiovascular mortality was not associated with the number of hospitalized COVID-19-positive patients or number of OHSD.

The exact factors that resulted in these findings are difficult to prove. The Centers for Disease Control and Prevention advised patients to stay home in an effort to avoid exposure to the virus. Similarly, on March 22, 2020, the State of New York issued a health guidance recommending that the public avoid healthcare facilities, and only seek medical attention for severe

symptoms.[4] This likely resulted in increased anxiety and fear about seeking medical attention, especially in those at highest risk of contracting the virus, including patients with cardiovascular disease. Fear of contracting the virus was found to be a factor in not seeking healthcare services during the peak of the surge in Italy.[15] This behavior could explain the drastic decline in healthcare encounters and delayed presentation, both of which have a negative impact on patients' care.

Fear of seeking care was not the only factor that impacted patient–healthcare interactions. As the number of COVID-19 patients began to rise in New York, hospital systems and public policy officials were concerned about the healthcare system becoming overwhelmed, running out of beds, and running out of resources. A strong "flatten the curve" campaign was mounted. Hospitals and ambulatory offices were quickly reorganized in an attempt to absorb the surge in patients with COVID-19. Ambulatory primary and specialty care services were curtailed. Many were closed to allow for redistribution of nursing and physician staff into in-hospital settings.[16] Offices that remained open struggled initially with the transition to telemedicine-only appointments, especially as the at-risk older population was challenged with this mode of clinical encounter. Suddenly, access to health care for many patients became difficult. This was further complicated by the State's guidance that care should only be sought for severe symptoms. Because patients could not reach their doctors, the decision on what constituted a severe symptom was left to the patient, leaving many not to seek care in a timely and appropriate fashion.

The "flatten the curve" campaign also resulted in home confinement of many patients. Consequently, a significant reduction in physical activity among patients was seen.[17,18] Early symptoms of decompensated cardiovascular disease such as exertional angina, decreased functional capacity, and worsening dyspnea on exertion likely went undetected. This, along with the guidance to only seek care for severe symptoms, explains in part why patients either sought care late or not at all. These factors most likely resulted in the observed reduction in hospitalization volume for serious cardiovascular conditions. In a similar fashion, those who made it to the hospital were more likely to die during their index admission.

In addition to lower presentation volume, there were significant changes in the management of patients with cardiovascular disease; namely, fewer patients received a cardiovascular procedure, were admitted to the intensive care, or received mechanical ventilation. One possible explanation for this finding is that concerns and confusion about the availability of personal protective equipment and its ability to protect healthcare workers forced hospitals to re-examine diagnostic testing and all procedures. Many scientific societies published consensus statements advocating the preference of medical therapy over early-invasive strategy for multiple acute cardiovascular diseases including acute myocardial infarctions and arrhythmias.[19,20] These mandated changes were all in the direction of minimizing exposure risk to healthcare personnel; however, they may have led to deviation from established evidence-based medical care. Another possible explanation is that the admitted patient population was an overall sicker cohort of patients compared with the historical control and was less likely to have benefited from invasive procedures.

In this study, in-hospital cardiovascular mortality increased during the first COVID-19 wave regardless of the COVID-19 epidemiologic burden. In contrast to all-cause in-hospital mortality, cardiovascular mortality was not associated with number of COVID-19 hospitalized patients or cases in the community. The onset of the cardiovascular mortality rise and its peak timed with the onset and peak of COVID-19-related hospitalization and all-cause in-hospital mortality. However, after its peak the rate of decline in cardiovascular mortality was not as abrupt as that of all-cause in-hospital mortality and has appeared to have plateaued at the level of 50% increase (Figure 3). This observation further supports that in-hospital cardiovascular mortality was driven by behavioral and operational changes that were mandated in response to a healthcare crisis and might be still be in place at the time of the completion of this review.

The findings of this study highlight the need to adhere to guideline-driven therapy when possible, maintain access of care to the best of our ability, and educate patients to seek appropriate care even in the midst of a healthcare crisis. This is particularly important for the areas currently experiencing surges, but also to areas where decisions need to be made about the timing of returning back to established clinical practice.

Limitations

Limitations of this study include its retrospective nature. Given that our search of the electronic medical record was performed to identify acute cardiovascular syndromes, and potential omissions in documentation during the pandemic because of the surge in volume across the health system, the potential for a reporting bias exists. In addition, our cohort was selected based on identifying a single principal diagnosis, and this method can be challenging for patients with multiple comorbidities. SARS-COV-2 infection often leads to exacerbation of an underlying cardiovascular pathology or has direct cardiac manifestations. The majority of these patients were excluded from our population because SARS-COV-2 was listed as a principal diagnosis for those patients. Other factors might have

accounted for the changes in cardiovascular mortality between the 2 years; however, using a control year, as well as observation before COVID-19 outbreak, allows us to infer that our outcomes are directly or indirectly related to the epidemic surge. The severity of illness presentation may have differed between the patient cohorts in 2019 and 2020. Therefore some may have been less likely to benefit from invasive procedures. Finally, there are inherent limitations to the reporting of OHSD; further information is not available to ascertain the exact cause of death, and limited autopsies were performed during the COVID-19 pandemic.

CONCLUSIONS

There was a significant decline in patients admitted with an acute cardiovascular diagnosis across the Northwell Health network during the first wave of the COVID-19 outbreak in New York City with a concomitant increase of in-hospital mortality. Challenges in access to ambulatory and emergency care and change of common practice in management of patients with cardiovascular disease may in part explain the observed results. Further studies are needed to better identify the factors that impact both patients and the healthcare system during a large-scale state of emergency, such as the COVID-19 pandemic, in order to improve outcomes in the future.

ARTICLE INFORMATION

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Disclosures

None.

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