



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Cardiovascular Health in the COVID-19 Era: A Call for Action and Education

Saraschandra Vallabhajosyula, MD; Paul A. Friedman, MD; and Malcolm R. Bell, MD

From the Department of Cardiovascular Medicine, Mayo Clinic, Rochester, Minnesota.

The coronavirus disease 2019 (COVID-19), a viral infectious disease caused by the severe acute respiratory syndrome (SARS) coronavirus-2, has reached pandemic status worldwide.¹ COVID-19 primarily burdens the health care system by virtue of its high infectivity, respiratory compromise, and need for critical care supplies such as mechanical ventilators and hemodialysis units. As a consequence of these concerns, the United States Presidential guidelines, on March 16, 2020, recommended stopping all elective procedures and surgeries and nonessential clinic visits, which was endorsed by multiple professional societies and bodies including the Center for Medicare and Medicaid Services.² These recommendations have significant ramifications for elective, urgent, and emergent cardiovascular conditions, which we seek to highlight in this perspective piece.

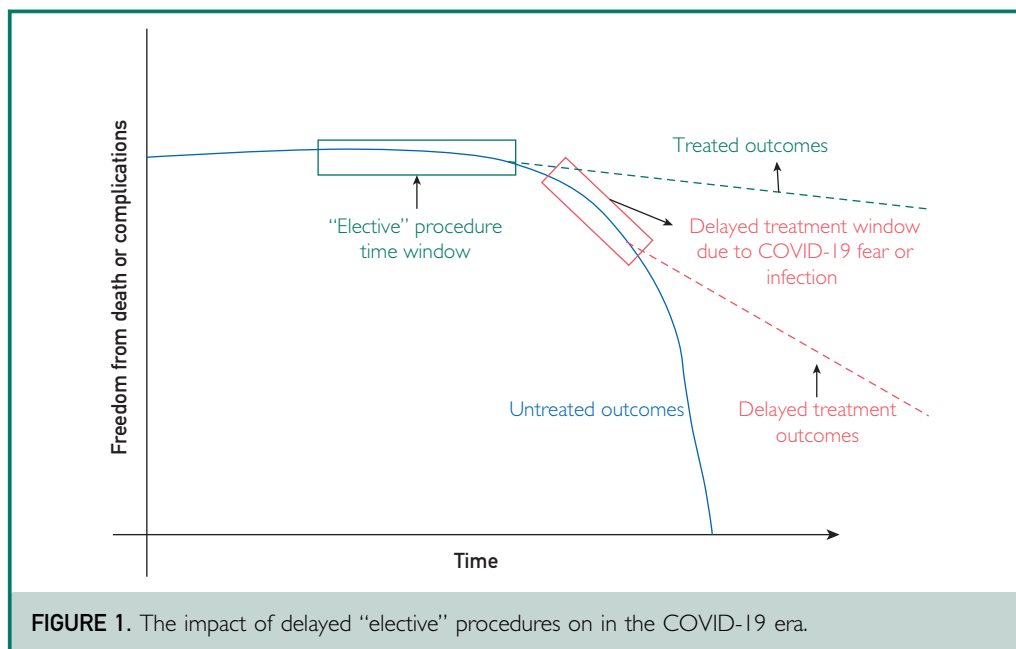
IMPLICATIONS FOR CARDIOVASCULAR CONDITIONS

Cardiovascular disease remains the leading cause of death worldwide in the contemporary era, and patients with cardiovascular disease are at additional risk during the pandemic.³ Cardiovascular risk factors—such as diabetes, hypertension, obesity, and coronary artery disease—have been shown to be associated with worse outcomes in COVID-19.³ Primary, secondary, and tertiary prevention of cardiac disease continue to remain priorities in the COVID-19 era.^{3,4} Therefore, it is important to understand the implications of the current government-mandated restrictions on clinical practice and the care of cardiovascular patients.

First, because of the concerns for the high infectious burden and the lack of established treatment, measures such as social distancing and stay-at-home initiatives have been leading

priorities for society. Because of prolonged periods of staying at home, there is a significant risk of worsening dietary, lifestyle, and exercise habits.³ These may result in worsening of pre-existing cardiovascular disease or the onset of new cardiovascular disease across all age groups.³ Therefore, there is an inherent risk of poorer control of chronic cardiovascular comorbidities, which could lead to development of cardiac emergencies. In addition, those patients with cardiovascular disease who develop COVID-19 infection have been observed to have a 10-fold increase in mortality.³ Pre-existing hypertension has been noted to be associated with higher in-hospital morbidity and mortality in COVID-19–infected patients.⁴ Preclinical studies have noted renin-angiotensin-aldosterone system inhibitors to increase the angiotensin-converting enzyme-2, which is a functional receptor for the severe acute respiratory syndrome coronavirus-2.⁵ However, no clear clinical associations have been noted in clinical studies or human subjects.⁵ It is conceivable that patients with heart failure and hypertension may stop these groups of medications prematurely, placing themselves at a higher risk of worsening of their underlying cardiovascular disease.^{4,5} A recent report from the CVS Health Corporation has shown a sharp decline in health care prescriptions—including for heart disease and diabetes—which might place patients at a higher risk of future events.⁶

Second, because of the concerns for infectious risk, multiple studies have shown a decrease in the uptake of cardiovascular services, especially for medical emergencies.⁷⁻⁹ Garcia et al reported a 38% decrease in ST-segment elevation myocardial infarction (STEMI) activations during March 2020 at 9 high-volume catheterization laboratories in the United States.⁷ Data from Lombardy,

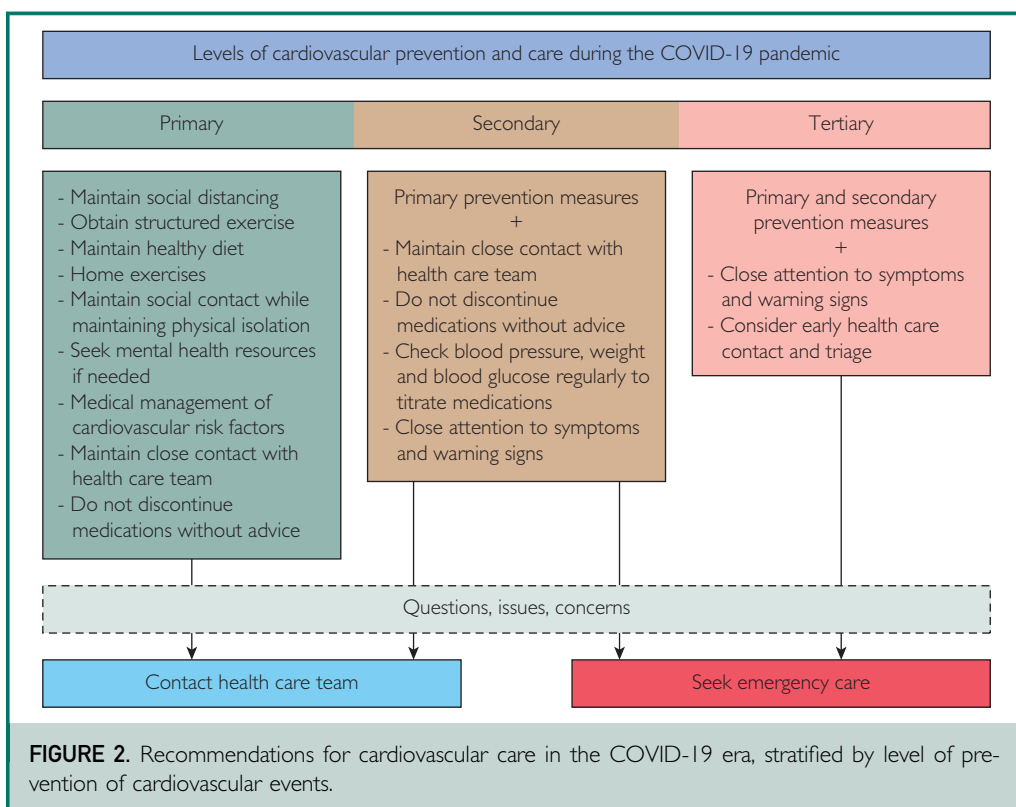


Italy, showed late presentations of STEMI with advanced heart failure, cardiogenic shock, left-ventricular aneurysms, mechanical complications, and thromboembolic phenomena from dislodged left-ventricular thrombi.⁹⁻¹¹ Anecdotal data from cardiac catheterization laboratories from the United States and abroad have shown a sharp uptick in delayed complications, mechanical sequelae of untreated STEMI, and concerns for higher-risk presentations.⁹⁻¹¹ COVID-19 infection has been associated with significantly higher rates of out-of-hospital cardiac arrest.¹² Data from 15 Italian hospitals during the COVID-19 outbreak have shown a sharp decrease in admissions for acute coronary syndromes, which was consistent across the STEMI, non-STEMI and unstable angina subgroups.¹³ Although the mechanisms are unclear, it is conceivable that, in addition to the known respiratory complications, undetected acute coronary syndromes, cardiac arrhythmias, and higher rates of arterial/venous thrombus formation may contribute to this inexplicable rise in rates of cardiac arrest. This was associated with a concomitant increase in out-of-hospital mortality that could not be fully attributable to COVID-19.¹³

Third, cardiac procedures are traditionally classified as elective, urgent, and emergent. In

reality, however, cardiac procedures are an intervention along the spectrum of the disease process that possesses the ability to significantly affect disease trajectories. For example, percutaneous coronary interventions in patients with medically refractory angina, aortic valve replacement in severe aortic stenosis, or the use of cardiac resynchronization therapy in advanced heart failure are landmark events along the disease spectrum. However, in light of the recent call to cease all elective operations, there is a danger of oversimplification of procedural urgency. As a consequence, it is conceivable that many patients and health care teams might consider postponing these important procedures, thus leading to adverse patient outcomes (Figure 1).¹⁴

Finally, the cardiovascular ramifications of noncardiac diseases remain an underexplored avenue. For example, social distancing and loss of pre-existing social constructs adversely affects mental health and emotional well-being. Patients with pulmonary, endocrine, neurologic, rheumatologic, and oncologic diseases also experience cardiovascular dysfunction, either by virtue of their disease or therapy. The impact of these conditions on cardiovascular health—especially in the setting of a pandemic—needs further careful study.



In light of these data, it is understandable that the COVID-19 pandemic has caused significant and overwhelming fear in patients and their families. Because of concerns for contracting the infection, cardiovascular patients are avoiding medical contact at all costs, sometimes to their detriment.¹¹ In a recent analysis using the National Center for Health Statistics, deaths in the United States far exceeded that attributable to the pandemic.¹⁵ Similar trends in excess mortality were noted in Italy.¹³ Although the pandemic has resulted in high mortality thus far in the United States and worldwide, there has been a sharp rise in unrelated deaths. Importantly, it is highly probable that more people will die of cardiovascular disease than of COVID-19 in the United States in 2020.

RECOMMENDATIONS FOR CARDIOVASCULAR CARE

Three key components are essential to care in the time of COVID-19: modifications on health care campuses to permit safe

in-person care, adoption of remote-care options, and patient education on strategies to maintain health and fitness and to seek care immediately for urgent cardiovascular symptoms. Despite the increase in health care concerns surrounding the COVID-19 pandemic, our institution and others are striving to achieve a safe, effective, and timely delivery of cardiovascular care.¹ Pre-visit phone calls and screening, point-of-care screening tools upon arrival, a universal masking policy, rapid rule-out testing, correct use of personal protective equipment, and enhanced cleaning practices have mitigated infection risk to permit safe care on campus.

In-person care is supplemented by a number of established and novel remote-care options, including video consultations and remote smartphone-enabled technologies, using traditional and novel artificial intelligence-supported tools.³ The enhanced expanded coverage of telemedicine has provided access to these new tools in the health care armamentarium.³ Particular established patient encounters, preventive cardiology

consultations, and triage encounters can be rapidly and effectively performed in this manner. Remote evaluations may serve to identify the need for—and timing of—in-person care, identify required testing in advance, and plan for expedited itineraries on campus. In addition, social distancing may provide patients and physicians the unique opportunity to use health care technology to monitor, communicate, and follow up with the health care team.³ For medical emergencies, current protocols at our institution continue to emphasize primary percutaneous coronary intervention as it remains feasible—because of a strong institutional triage system—and is still the preferred mode of acute reperfusion therapy in the United States.¹

Education is the third component of pandemic cardiovascular care. From a cardiovascular standpoint, it is imperative for patients, communities, and health care providers to understand and emphasize that cardiac emergencies demand immediate care. In a recent statement, the European Society of Cardiology stressed to the community that the appeals to stay at home do not apply to cardiac emergencies and requested that patients seek care as they have been previously.¹¹ In addition to cardiac emergencies, chronic cardiovascular conditions may worsen, either related or unrelated to the pandemic. Therefore, patients and physicians need to be cautious, vigilant, and prepared. We recommend that physicians and patients act upon these important considerations (Figure 2). Universal deferment of perceived elective procedures may place patients at an undue risk of future complications, which may overwhelm the health care system once the social distancing restrictions are lifted. Guidance documents from professional cardiovascular interventional and surgical societies have proposed a tiered system toward patients requiring procedures to prevent unwarranted complications from deferment secondary to the pandemic.¹⁴

CONCLUSION

COVID-19 is a global tragedy that remains an ongoing stressor on the health care system that will likely result in significant

restructuring of health care practices both now and in the future. As it may persist into the foreseeable future, we must adapt health care delivery to continue to combat the number-1 killer of Americans: cardiovascular disease. Strategies to mitigate risk for in-person care, adoption of novel strategies to enable remote care, and robust education regarding prevention and immediate care for cardiovascular emergencies are the foundations of cardiovascular care during the pandemic and beyond.

Grant Support: S.V. is supported by the Clinical and Translational Science Award (CTSA) Grant Number ULI TR000135 from the National Center for Advancing Translational Sciences (NCATS), a component of the National Institutes of Health (NIH). Its contents are solely the responsibility of the authors and do not necessarily represent the official view of NIH.

Potential Competing Interests: The authors report no competing interests.

Correspondence: Address to Malcolm R. Bell, MD, Department of Cardiovascular Medicine, Mayo Clinic, 200 First Street SW, Rochester, MN 55905 (Bell.Malcolm@mayo.edu).

ORCID

Saraschandra Vallabhajosyula:  <https://orcid.org/0000-0002-1631-8238>; Paul A. Friedman:  <https://orcid.org/0000-0001-5052-2948>

REFERENCES

1. Bennett CE, Anavekar NS, Gulati R, et al. ST-segment elevation, myocardial injury, and suspected or confirmed COVID-19 patients: diagnostic and treatment uncertainties. *Mayo Clin Proc.* 2020;95(6):1107-1111.
2. The President's coronavirus guidelines for America: 30 days to slow the spread. 2020: https://www.whitehouse.gov/wp-content/uploads/2020/03/03.16.20_coronavirus-guidance_8.5x11_315PM.pdf. Accessed April 29, 2020.
3. Duffy EY, Cainzos-Achirica M, Michos ED. Primary and secondary prevention of cardiovascular disease in the era of the coronavirus pandemic. *Circulation.* 2020. <https://doi.org/10.1161/CIRCULATIONAHA.120.047194>.
4. Gupta AK, Jneid H, Addison D, et al. Current perspectives on coronavirus 2019 (COVID-19) and cardiovascular disease: a white paper by the JAHA editors. *J Am Heart Assoc.* 2020:e017013.
5. Vaduganathan M, Vardeny O, Michel T, McMurray JJV, Pfeffer MA, Solomon SD. Renin-angiotensin-aldosterone system inhibitors in patients with Covid-19. *N Engl J Med.* 2020; 382:1653-1659.
6. Terlep S. CVS warns of surge in non-coronavirus health problems. *The Wall Street Journal.* <https://www.wsj.com/articles/cvs-sales-jump-as-shoppers-stock-up-on-medication-11588765912?mod=searchresults&page=1&pos=1>. Accessed May 8, 2020.
7. Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in ST-segment elevation cardiac catheterization laboratory activations

- in the United States during COVID-19 pandemic. *J Am Coll Cardiol*. 2020;75(22):2871-2872.
8. Mahmud E, Dauerman HL, Welt FG, et al. Management of acute myocardial infarction during the COVID-19 pandemic. *Catheter Cardiovasc Interv*. 2020. <https://doi.org/10.1002/ccd.28946>.
 9. Moroni F, Gramegna M, Ajello S, et al. Collateral damage: medical care avoidance behavior among patients with acute coronary syndrome during the COVID-19 pandemic. *JACC: Case Reports*. 2020;459. <https://doi.org/10.1016/j.jaccas.2020.04.010>.
 10. Wood S. Dire, unusual STEMI complications blamed on COVID-19 hospital avoidance. *tctMD. The Heartbeat*; 2020. https://www.tctmd.com/news/dire-unusual-stemi-complications-blamed-covid-19-hospital-avoidance?utm_source=TCTMD&utm_medium=email&utm_campaign=Newsletter043020. Accessed April 30, 2020.
 11. European Society of Cardiology. Appeals to "stay at home" during COVID-19 do not apply to heart attacks. <https://www.escardio.org/The-ESC/Press-Office/Press-releases/Appeals-to-stay-at-home-during-COVID-19-do-not-apply-to-heart-attacks-bis>. Accessed April 30, 2020.
 12. Baldi E, Sechi GM, Mare C, et al. Out-of-hospital cardiac arrest during the Covid-19 outbreak in Italy. *N Engl J Med*. 2020. <https://doi.org/10.1056/NEJMc2010418>.
 13. De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced rate of hospital admissions for ACS during Covid-19 outbreak in Northern Italy. *N Engl J Med*. 2020. <https://doi.org/10.1056/NEJMc2009166>.
 14. Haft JW, Atluri P, Alawadi G, et al. Adult cardiac surgery during the COVID-19 pandemic: a tiered patient triage guidance statement. *Ann Thorac Surg*. 2020. <https://doi.org/10.1016/j.athoracsur.2020.04.003>.
 15. Brown E, Tran AB, Reinhard B, Ulmanu M. U.S. Deaths soared in early weeks of pandemic, far exceeding number attributed to Covid-19. <https://www.washingtonpost.com/investigations/2020/04/27/covid-19-death-toll-undercounted/?arc404=true>. Accessed April 30, 2020.