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# Cardiovascular Health Care Implications of the COVID-19 pandemic



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## KEYWORDS

- COVID-19 • Cardiovascular disease • Health care provision • Health inequalities
- Population health

## KEY POINTS

- There are wide reports of excess cardiovascular mortality particularly during the early phases of the pandemic, largely attributed to primary cardiovascular causes, with notable translocation of deaths from hospitals to the community.
- There has been a significant decline in hospitalizations for acute cardiovascular conditions and related procedures such as percutaneous coronary interventions for acute myocardial infarction and mechanical thrombectomy for strokes.
- There are backlogs in elective cardiovascular procedures, such as aortic valve interventions; delays in such time-sensitive treatments are likely to have a significant adverse prognostic impact.
- There is evidence of substantial treatment deficits in primary and secondary cardiovascular prevention, which, if not addressed, may have a longstanding population-level impact on cardiovascular health.
- The pandemic has highlighted the significant adverse public health impact of health care inequalities, the reduction of which requires concerted efforts in multiple areas of health and social care and cohesive action from policy makers and health care professionals.

## INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has placed immense pressure on health care services, necessitating reorganization and reprioritization of resources and changes in models of health care delivery. Large number of COVID-19 inpatient admissions has required restructuring of hospital services and redeployment of staff for the provision of acute clinical care. Furthermore, many governments have postponed nonurgent elective work, due to both staff

and infrastructure limitations, as well as concerns around the exposure of potentially vulnerable patients to infection. These service pressures have been further compounded by staff shortages related to COVID-19 infection or contact exposure requiring isolation.

There have also been changes in the public's pattern of health care utilization, owing, in part, to altered risk perceptions and health-seeking behaviors.<sup>1</sup> Such behavioral changes have perhaps been influenced by national "lockdowns" or "stay at home" public health recommendations. Thus,

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delayed service provision due to resource-constrained health care delivery systems has been augmented by patients' hesitance to access health care.

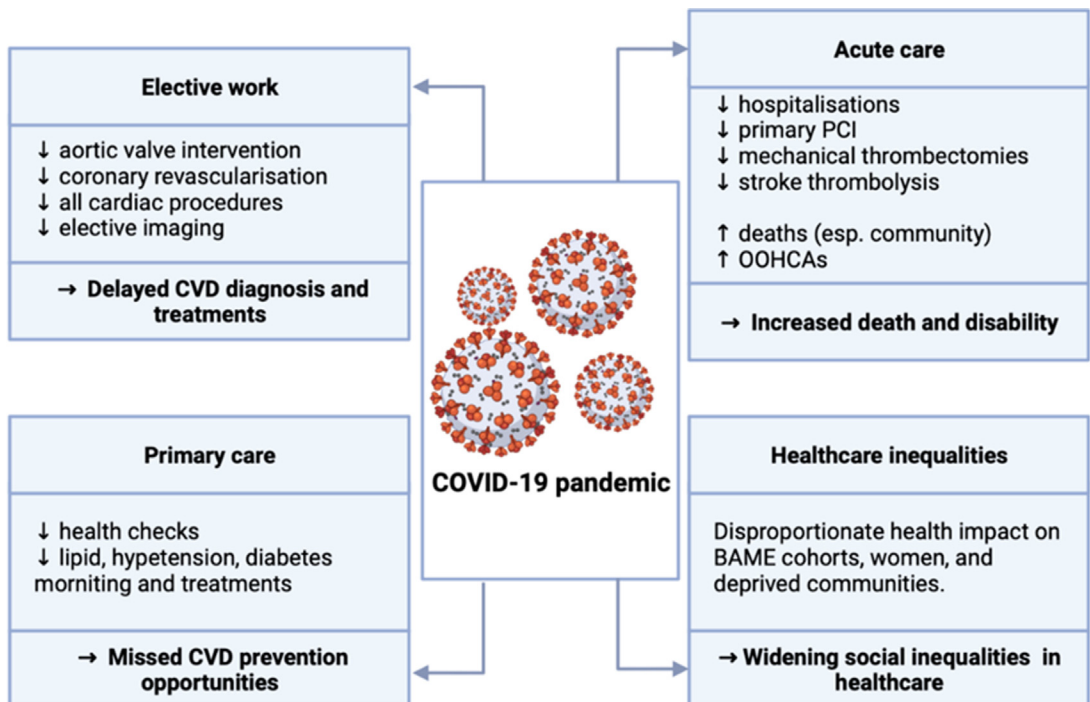
Indeed, growing evidence indicates a significant decline in the use of health care services across multiple key areas. In the UK, emergency department (ED) visits declined by 49% and out-of-hours general practice consultations fell by 11% during the peak pandemic period in 2020 compared with the preceding year.<sup>1</sup> In the US, there was a 42% decline in ED visits.<sup>2</sup> Similar trends were seen across Europe and globally. A study of 27 European nations reported a significant reduction in health care utilization after the first COVID-19 outbreak.<sup>3</sup> While reports from China,<sup>4</sup> Singapore,<sup>5</sup> and Taiwan<sup>6</sup> indicate declines in the utilization of both inpatient and outpatient services.

Available evidence suggests major disruptions to the delivery and utilization of cardiovascular services during the pandemic, with important clinical consequences. Cardiovascular diseases are the most common cause of morbidity and mortality worldwide.<sup>7</sup> Their management requires a combination of preventive medicine, acute care, and chronic disease management. The longer-term impact of service disruptions during the pandemic on population cardiovascular health is likely significant and not yet fully appreciated.

In this narrative review, we examine the implications of the COVID-19 pandemic for cardiovascular health care, including excess cardiovascular mortality, acute and elective cardiovascular care, and disease prevention. Additionally, we consider the long-term public health consequences of disruptions to cardiovascular care across both primary and secondary care settings. Finally, we review health care inequalities and their driving factors, as highlighted by the pandemic, and consider their importance in the context of cardiovascular health care.

## ACUTE CARDIOVASCULAR CARE

The COVID-19 pandemic has resulted in excess premature mortality across many countries worldwide.<sup>8,9</sup> Cardiovascular disease and its risk factors have been linked to higher risk of adverse COVID-19 outcomes, including more severe disease manifestations and higher risk of death<sup>10–12</sup> (Fig. 1). In a meta-analysis of 51 studies including a total of 48,317 patients, Bae and colleagues<sup>10</sup> identified pre-existing cardiovascular risk factors (hypertension, diabetes) and CVD itself as independent predictors of mortality among patients with COVID-19 across all age groups. A large nationwide study from Korea similarly reports significant associations of diabetes, hypertension, and heart failure



**Fig. 1.** Central illustration. Impact of COVID-19 on cardiovascular care. BAME, Black Asian and Minority Ethnic; CVD, cardiovascular disease; OOHCA, out-of-hospital cardiac arrest; PCI, percutaneous coronary intervention.

with critical illness among patients hospitalized with COVID-19.<sup>11</sup> Accordingly, Wu and colleagues<sup>13</sup> report an 8% increase in acute cardiovascular deaths in England during the pandemic period. However, the excess cardiovascular deaths are not fully attributed to direct COVID-19 effects. While a proportion of these deaths were related to COVID-19 (5.1%), the most frequent primary causes of death were stroke (35.6%), acute coronary syndrome (ACS, 24.5%), and heart failure (23.4%).<sup>13</sup>

These observations may reflect reduced access to emergency services for these conditions, compounded by the hesitance of patients to seek medical care during the pandemic. In the UK, public health messaging during the early stages of the COVID-19 pandemic centered around the slogan of “stay home, protect the NHS, save lives,” with similar variations in other nations, which may have increased the reticence of patients to seek medical attention for acute cardiovascular events. Others have pointed out confusion around hospital protocols as a key reason for delays in seeking treatment for non-COVID-19 illnesses during the pandemic.<sup>14</sup> Wu and colleagues<sup>13</sup> demonstrate a translocation in the place of death, with substantial increases in cardiovascular deaths at home (+35%) and in care homes or hospices (+32%), with more modest increase in hospital deaths. Mafham and colleagues,<sup>15</sup> also report a significant decline in the number of patients hospitalized with ACS per week in England at the end of March 2020 compared with weekly prepandemic averages. Braiteh and colleagues<sup>16</sup> report similar trends from the US with 40.7% reduction in total hospital admission for ACS. There is also evidence that patients who did seek medical help waited significantly longer to do so compared with the prepandemic period. In a study from Switzerland, Nils and colleagues<sup>17</sup> report both a significant decline in the incidence of ACS and prolonged delays from symptom onset to time of first medical contact. Studies from the US and Germany report similar experiences of increased delays in time to presentation for ACS.<sup>18,19</sup> Such treatment delays have important adverse implications for infarct size and future heart failure risk. The consequently reduced access to acute revascularization and secondary prevention medications are expected to contribute importantly to excess acute cardiovascular deaths in the community, as reported by Wu and colleagues.<sup>13</sup>

Further reports indicate that there was, indeed, a significant drop in percutaneous coronary intervention (PCI) activity in the early stages of the pandemic, with Kwok and colleagues<sup>20</sup> demonstrating a 49% reduction in PCI procedures

performed in England during the first wave of COVID-19 (March 2020), compared with prepandemic levels. Although (as expected) the greatest decline was in elective PCIs for stable coronary artery disease (–66%), PCIs for non-ST elevation myocardial infarctions (NSTEMI) or unstable angina (–45%) and ST-elevation MI (STEMI) also declined (–33%) substantially. In a national survey of interventional cardiology activity in Spain, Rodríguez-Leor et al.<sup>21</sup> also report significant reductions across all procedural activities, with 56% reduction in diagnostic coronary procedures, 48% reduction in PCIs for stable disease, and 40% reduction in PCI in STEMI. Consistently, Garcia and colleagues<sup>22</sup> reported a 38% reduction in PCI for STEMI across 9 hospitals in the US.

As may be expected from these observations, Rashid and colleagues<sup>23</sup> report a significant increase in the incidence of out-of-hospital cardiac arrests after the first wave of the pandemic in England (May 2020 vs February 2020). Ischemic disease is the most common precipitant of cardiac arrests. Disruptions in appropriate treatment of ACS as outlined previously predispose to greater and more prolonged ischemia, which may act as substrates for life-threatening ventricular tachyarrhythmias. Thus, the observed increase in out-of-hospital cardiac arrests by Rashid and colleagues<sup>23</sup> may reflect delays or failure to seek medical attention for ACSs.

A similar picture is seen in the context of acute stroke care. In a global registry of 187 stroke centers across 40 countries, Nogueira and colleagues<sup>24</sup> report a reduction in the number of stroke admissions, mechanical thrombectomy procedures, and intracranial hemorrhage admissions in association with the COVID-19 pandemic, independent of prepandemic admission/procedure volumes. Similarly, in a study of 19 EDs in the US, Uchino and colleagues<sup>25</sup> reported approximately 30% reduction in acute stroke presentations to the ED as well as a significant reduction in acute thrombolysis procedures suggesting delays in presentation. Indeed, in a study from China, Gu and colleagues<sup>26</sup> indicate significant prolongation of both pre and posthospital delays and significant reduction in the number of patients arriving within the time window for intravenous thrombolysis. These trends were consistent with those observed in the US by Schirmer and colleagues,<sup>27</sup> who also report significant prolongation of time to the presentation of acute ischemic strokes in the COVID-19 period compared with baseline prepandemic times. Poorer stroke outcomes in terms of death, disability, and recurrent stroke have been widely linked to increasing time from symptom onset to the initiation of stroke therapies such as

thrombolysis and thrombectomy.<sup>28</sup> As such, the adverse public health impact of the described disruptions to stroke therapy is anticipated to be substantial.

Omissions and delays in care were also reported for other cardiovascular conditions with similar adverse prognostic consequences. Heart failure hospitalizations were notably reduced parallel to the first and second national lockdowns in the UK.<sup>29</sup> In a nationwide study, Shoaib and colleagues<sup>30</sup> demonstrate a decline in heart failure hospitalizations in England and Wales in March 2020 compared with preceding years. They further demonstrate a concordant increase in community heart failure deaths during this period.<sup>30</sup>

Overall existing evidence indicates reduced utilization of acute cardiovascular services with the resultant omission of key guideline-directed therapies and procedures, which likely explain excess cardiovascular mortality observed during the earlier phases of the pandemic. Individuals who survived acute untreated events are more likely to present in later postacute stages with complications or clinical decompensation and to have poorer outcomes than if they were treated appropriately at the outset. The longer-term impact of these missed care opportunities is yet to be fully appreciated, but likely will comprise an increase in both premature deaths and disability. In the clinical setting, it is important to remain vigilant to such potential late presentations of previously undetected acute events and to initiate appropriate therapies to minimize subsequent risks.

## ELECTIVE ACTIVITY

As with acute care, there have been declines in elective procedures. While these procedures do not carry the same immediate urgency as the previously discussed acute conditions, substantial delays in their delivery lead to significantly poorer health outcomes. In this context, patients with severe aortic stenosis (AS) are a particularly at-risk group; these patients have an extremely poor prognosis in the absence of valvular intervention with a mortality rate of more than 50% at 2 years.<sup>31</sup> In a study of UK procedural registry data, Martin and colleagues<sup>32</sup> report a rapid and significant reduction in surgical aortic valve replacement (SAVR) and transcatheter aortic valve replacement (TAVR) procedures following the COVID-19 pandemic. The authors estimate that almost 5000 patients with severe aortic stenosis had not received appropriate procedural intervention in the months following the start of the pandemic (November to March 2020). These notable treatment delays are expected to translate to poorer

outcomes in this patient population, including higher risk of death and presentations with acute cardiovascular decompensation. Indeed, in a study of 22,876 patients with severe AS, Albassam and colleagues<sup>33</sup> report an association of greater wait time for valve intervention with higher risk of death and hospitalization for heart failure while on the waiting list. Thus, there is an urgent need to address strategies for service provision which may ameliorate these procedural backlog and treatment deficits.

The decline in elective work was observed across all cardiac interventions. In a study considering a wide range of cardiac procedures from the UK, Mohamed and colleagues<sup>34</sup> report a total deficit of more than 45,000 procedures over the COVID-19 period (March to May 2020) compared with previous years. In a study of over half a million patients referred for elective cardiovascular procedures from Canada, Tam and colleagues<sup>35</sup> report a significant decline in the number of coronary revascularization procedures performed during the pandemic compared with the prepandemic period. Importantly, the authors also observed an increased risk of all-cause death while waiting for coronary revascularization for referrals made during the pandemic. There was also evidence of change in the choice of procedural strategy. Among patients with left main coronary artery stenosis in the UK, there was an observation of both a reduction in revascularization procedures and greater use of PCI over coronary artery bypass grafting.<sup>36</sup>

The pandemic has also had a dramatic impact on cardiovascular imaging services with reduced activity due to the redeployment of staff and fewer referrals from both primary and secondary care. Cardiovascular imaging is central to the accurate diagnosis of many CVDs. In a survey of 909 centers covering 108 European centers, Williams and colleagues<sup>37</sup> report that total cardiac imaging reduced by 45% in March 2020 and by 69% in April 2020, compared with prepandemic levels. The authors demonstrate geographic variation in these trends with greater reductions observed in Southern European nations compared with elsewhere.<sup>37</sup> Consistent with these observations, in a study of 52 Italian centers, Dondi and colleagues<sup>38</sup> report a reduction in imaging volumes of 67% in March 2020 and 77% in April 2020, compared with the preceding year. These disruptions to clinical care raise concerns about large number of patients with delayed or missed diagnoses and the potential adverse impact of this on long-term risk of cardiovascular morbidity and mortality.

## IMPACT ON PRIMARY CARE

The adverse impact of COVID-19 has extended to primary care, the key setting for primary prevention strategies and management of patients with stable chronic cardiovascular diseases. A UK report from NHS Digital,<sup>39</sup> indicated a near 30% reduction in appointments recorded in general practice systems in mid-March 2020, compared with prepandemic averages. In an analysis of nationwide general practice prescribing trends, Dale and Takhar and colleagues<sup>40</sup> demonstrate a reduction of incident use of antihypertensive and lipid-lowering medications in early 2021 compared with prepandemic levels in 2019. The authors estimate that the undertreatment of hypertension alone, is likely to result in 13,659 preventable cardiovascular events including 2281 additional myocardial infarctions and 3474 additional strokes.<sup>40</sup> In a study of more than 600,000 UK patients, Carr and colleagues<sup>41</sup> report a near 50% reduction in the measurement of blood pressure in general practice and 22% reduction in the prescription of new antihypertensive medications during the first year of the COVID-19 pandemic. An earlier nationwide study of patients with type 2 diabetes in the UK demonstrated a 31% reduction in glycated hemoglobin A1c (HbA1c) testing, 20% reduction in starting new metformin prescriptions, and 5% reduction in the initiation of insulin therapy.<sup>42</sup> These missed diagnosis and treatment optimization opportunities are concerning and have significant and sustained implications for population cardiovascular health. There is a need for dedicated efforts to address missed opportunities for primary and secondary prevention to alleviate the future population burden of cardiovascular disease.

## INEQUITIES OF CARDIOVASCULAR CARE

The COVID-19 pandemic has highlighted the impact of social inequalities on health. Black Asian and Minority Ethnic (BAME) communities experienced higher infection and mortality related to COVID-19 compared with the White population.<sup>43–48</sup> Geography, deprivation, occupation, living arrangements, and health conditions such as cardiovascular disease and vascular risk factors account for some, but not all, of the excess mortality risk of COVID-19 in BAME populations.<sup>46,49</sup> As well as experiencing more severe outcomes from COVID-19, BAME cohorts also had disproportionately poorer cardiovascular outcomes during the pandemic. For instance, Kwok and colleagues<sup>20</sup> report the decline in PCI procedures to be more marked among patients with

BAME, while Rashid and colleagues<sup>23</sup> found that BAME individuals were more likely to suffer out of hospital cardiac arrest during the pandemic. In a multisource linked cohort study, Rashid and colleagues<sup>50</sup> demonstrate that BAME individuals with acute myocardial infarction were less likely to receive guideline-directed therapies and had higher early mortality than White ethnicities, and, importantly, that these disparities seemed wider during the COVID-19 period compared with the prepandemic period. These poorer health experiences also extended to women and those from a more deprived background. For instance, Carr and colleagues<sup>41</sup> found that individuals with the highest levels of socio-economic deprivation experienced the greatest decline in general practice health checks for key cardiovascular risk factors. Similarly, Hartnett and colleagues<sup>2</sup> report a significant decline in ED visits of 42% during the early pandemic period and found that the steepest decreases were among women. These social inequalities were further exacerbated by the economic impact of the pandemic, which also disproportionately affected the most vulnerable in society. In a study including 27 European countries, Jiskrova and colleagues<sup>3</sup> report that job losses during the pandemic were significantly more likely among women, those with lower educational level, and lower household income.

Social and economic disadvantage are key determinants of health outcomes. The disproportionate impact of the pandemic on the most vulnerable in society mirrors the effect of other catastrophic natural disasters, where, consistently, the most devastating impacts are experienced by communities who are already disadvantaged and underserved.<sup>51</sup> COVID-19 has highlighted social inequalities and emphasized the urgent need for dedicated interventions to prevent and manage ill health in the most vulnerable populations. There is a need for high-quality data to understand the social and health care needs of deprived groups and to permit the development and tracking of appropriately targeted strategies by policy makers and health care professionals.

## SUMMARY

The COVID-19 pandemic has adversely disrupted cardiovascular care across key areas of health care delivery including acute and chronic disease management and preventive interventions. The reduction in access to guideline-directed therapies and procedures in the acute setting has likely driven early observations of excess cardiovascular disease mortality. The substantial decline in elective cardiovascular procedures and significantly

related backlog, if not promptly addressed, is expected to translate into excess death and disability in the medium term. Meanwhile, treatment deficits in primary and secondary disease prevention are expected to have a wider longer term impact in adversely impacting population cardiovascular health. The pandemic has shone a light on health care inequalities, which have been observed both in direct relation to COVID-19 and in the context of cardiovascular care during the pandemic. There is a need for concerted efforts from policy makers and clinicians to identify and actively address the deficits in cardiovascular health care resulting from the pandemic.

### CLINICS CARE POINTS

- Health care professionals should remain vigilant to late presentations of acute cardiovascular conditions such as acute myocardial infarction and stroke, with a view to prompt the initiation of guideline-direct therapies to minimize subsequent cardiovascular risk.
- There is an urgent need for service planning to ensure the backlog of elective procedures, such as coronary revascularization, TAVR and SAVR, are addressed to prevent avoidable death and disability.
- Directed strategies in primary care to identify treatment deficits in primary and secondary cardiovascular prevention are strongly recommended to ensure the optimization of population cardiovascular health in the longer term.
- The pandemic has highlighted disproportionate adverse health outcomes experienced by BAME and deprived populations. There is a need for comprehensive high-quality data to better understand the specific health care needs of these communities. The reduction of health care inequalities requires directed efforts in multiple areas of health and social care and cohesive action from policy makers and health care professionals.

### DISCLOSURE

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