

Impact of Covid-19 Pandemic on Services Delivery for Cardiovascular Disease Patients: A Bird's Eye View

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Abstract

Background: Non-communicable disease patients are the most vulnerable to COVID-19 and increase mortality and morbidity especially those with cardiovascular diseases according to previous studies.

Objective: To assess the short and long-term impact of COVID-19 pandemic on services delivery of cardiovascular disease services.

Methods: PubMed, Google scholar and MEDLINE for all peer-reviewed papers adhering to scoping review method.

Results: The summary of studies include 26% (5) reviews, 16% (3) commentaries, 16% (3) expert opinions, 10% (2) letters to editor, 11% (2) editorials, 11% (2) consensus statements, 5% (1) brief communication and 5% (1) prevalence study. The majority of papers were published from Singapore, United States of America and Europe especially in Italy, Canada, New Zealand and Australia. Cardiac surgeries constitute the majority of services disrupted during COVID-19 pandemic caring 41% (9) of all other cardiac services. Cardiac procedures and investigations follow with 27% (6), vascular surgeries 23% (5) and cardiac consultations 9% (2). Cardiac surgeries, procedures and investigations carry the burden with 68% and 90% respectively if vascular surgeries are added up.

Conclusion: Cardiovascular disease services delivery have been affected seriously during COVID-19 restrictions. Cardiac surgeries, cardiac procedures and investigations, vascular surgeries, cardiac consultations and referrals of cardiac emergencies were the most affected. CVD procedures and services including consultations are extremely important to continue under strict measures to prevent mortality and morbidity associated with CVD and COVID-19.

Keywords: Cardiovascular Disease Services; COVID-19; CVD; Cardiovascular Disease Procedures; Cardiovascular Disease Operations; Cardiovascular Disease Consultations

Background

Coronavirus disease (COVID-19) has impacted health systems worldwide especially services delivery [1]. The virus is known to have originated from Wuhan, Hubei province, China in December 2019 [2]. On January 30th, 2020, coronavirus infection 2019, causing CO-

COVID-19 disease was declared by World Health Organization (WHO) the novel coronavirus epidemic, a Public Health Emergency of International Concern [3]. Although infectious diseases have emerged at various times in history, in recent years, globalization has facilitated the spread of pathological agents, resulting in worldwide pandemics. This has added greater complexity to the containment of infections, which has had an important political, economic and psychosocial impact, leading to urgent public health challenges [4]. Following the outbreak, health systems worldwide had to rebrand, reschedule, postpone or cancel normal activities like procedures, surgical operations and routine clinics of NCD including CVDs were cancelled accepting only emergencies [5]. NCD patients are the most vulnerable to COVID-19 mortality and morbidity especially those with cardiovascular diseases according to previous studies. CVDs are conditions that affect the structures or function of the heart such as; arrhythmias, aorta disease, congenital heart disease, coronary artery disease, deep vein thrombosis and pulmonary embolism, heart attack, heart failure, cardiomyopathy, heart valve disease, pericardial disease, peripheral vascular disease, rheumatic heart disease, stroke and vascular disease [6]. Canceling or postponing follow up clinics, procedures or refilling of medications may put CVD patients at high risk of mortality if they are infected with COVID-19 while not stable with the pre-existing condition. The continuation of management of CVD is essential to prevent both early complications and the burden of COVID-19 [7]. Health systems should reorganize in a way such that normal functioning of health care is not disrupted. The population may suffer the burden of other chronic diseases due to lack or delay of healthcare services in favor or excessive fear to COVID-19 pandemic [8]. Early complications such as acute internal organ failure, stroke and even cardiac arrest leading to death may strike due to interrupted medications and missed procedures [9]. The worse may happen if one is infected with COVID-19 while the CVD is not managed properly [10].

Objective of the Study

The objective of this study is to assess the short and long-term impact of COVID-19 pandemic on services delivery of cardiovascular disease services.

Methods

Search strategy

Databases that were searched electronically are PubMed and MEDLINE for all peer-reviewed papers adhering to preferred reporting items for systematic reviews and meta-Analysis (PRISMA). Hand search used for Google scholar. All the papers describing or discussing cardiovascular disease services and COVID-19 worldwide were searched. The following search terms were used; Arrhythmia, heart valve disease, cardiomyopathy, peripheral vascular disease, Aorta disease, rheumatic heart disease, stroke, Congenital heart disease, coronary artery disease, Deep vein thrombosis, pulmonary embolism, Heart attack, pericardial disease, heart failure and Cardiovascular disease consultations suspended OR cancelled OR postponed, Coronary angiograms suspended OR postponed OR cancelled, Open heart surgeries postponed OR suspended OR cancelled, valve replacements suspended OR cancelled, Hypertension clinics suspended OR postponed OR cancelled and COVID-19, Coronavirus, SARS-cov2019 Novel coronavirus, 2019 n-cov2.

This search was performed on the databases and dates below; PubMed on 25th June 2020, Medline on 27th June 2020 and Google scholar on 27th June 2020. The retrieved literatures were peer reviewed papers published in English only. Due to scarcity of original research articles, the authors decided to add letters to the editor, analysis, brief reports, review papers and correspondences. Accepted papers already indexed online were also included. Country policy documents, WHO policies and conference proceedings were excluded but consulted only for background support. This study employed the Boolean operators and thesaurus in which combining two words using "AND" presented articles in which both words appeared. The word "OR" was used to widen the scope of coverage of both words while the word "NOT" was used to extract articles with the first but not the second words. Paper titles were used for hand search to find the full papers where possible. Only papers published open access were downloaded for citation. Mendeley was used for text citations and referencing. We developed a master search string using Boolean operators, thesaurus and truncation.

Inclusion and exclusion criteria

The following table summarizes the inclusion and exclusion criteria of retained papers.

Inclusion	Exclusion
Peer reviewed papers, letter to the editor, briefs, analysis and reviews on COVID-19 and CVDs service delivery	Non-peer reviewed papers, policy documents and conference proceedings on COVID-19 and CVDs service delivery
Papers published in English	Paper published in other languages
Papers focusing both on COVID-19 AND NCD service delivery	Papers not focusing on COVID-19 AND CVD service delivery
From November 2019 to June 2020	Papers published before November 2019 or beyond June 2020

Table1: Inclusion and exclusion criteria.

Data extraction technique and synthesis

The two authors (DAN and DK) extracted results from studies independently and used data extraction form for data collection. Data collected include the following citation, Authors and year of publication, study design, aim/objectives, sample size, cardiovascular services postponed or cancelled, short and long term impact and key findings. Literature search process, data collection and synthesis were checked and validated by both authors. Synthesis of the data was done using a narrative method after data entry on an excel sheet to remove duplicates. Materials were initially downloaded and stored in the watch folder before transfer into Mendeley for referencing and citations. To select the relevant articles, a scoping review method was used. The extracted data was synthesized into findings using descriptive and narrative synthesis. Results were discussed in order to draw conclusions and make recommendations on impact of CVD services delivery during the COVID-19 pandemic.

Results

PRISMA flow diagram

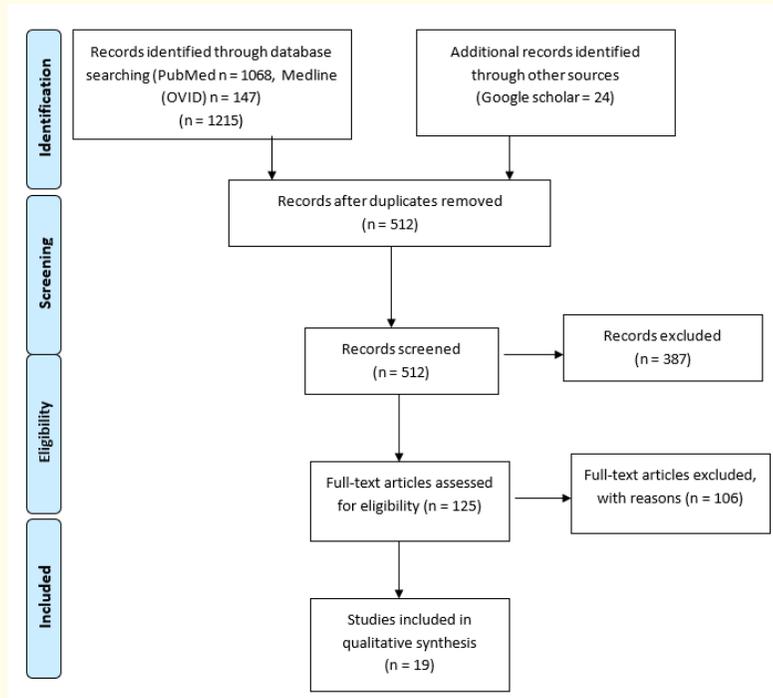


Figure 1: PRISMA flow chart diagram.

The total number of extracted papers is 1239 from all the databases searched. After duplicate removal 512 papers were subject to screening of titles. 125 papers were retained for full text screening which resulted in 67 in which 48 papers were removed with a reason, leaving 19 studies to include.

Types of included papers

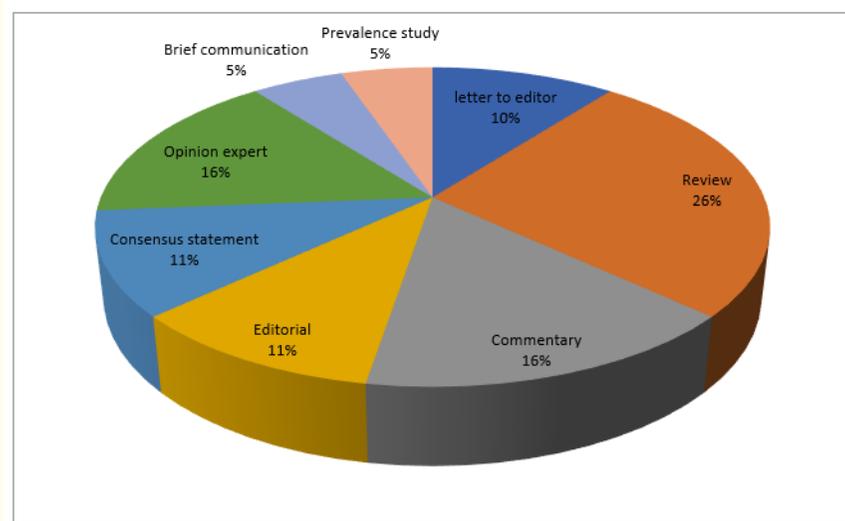


Figure 2: Types of included papers.

The summary of studies include: 26% (5) reviews, 16% (3) commentaries, 16% (3) expert opinions, 10% (2) letters to editor, 11% (2) editorials, 11% (2) consensus statements, 5% (1) brief communication and 5% (1) prevalence study. The majority of papers were published from Singapore, United States of America, and Europe especially in Italy, Canada, New Zealand and Australia. Original research papers were scarce, only one prevalence study was identified. Cardiovascular services affected are mainly cardiac and endovascular as well as structural catheterization, vascular surgeries, cardiac electrophysiology services, aortic valve replacement, cardiothoracic surgeries, cardiovascular disease consultations, carotid stenosis and preclusive repairs, cardiovascular surgeries, valve surgeries, electrophysiology ablations, devices, electrocardiographs, echocardiography, transfers of ST elevation, myocardial infarction, Stroke and Aortic emergencies.

Impacts of COVID-19 on CVD services

The following table summarizes the services, procedures, investigations, operations and consultations most affected by COVID-19 on delivery of CVD services.

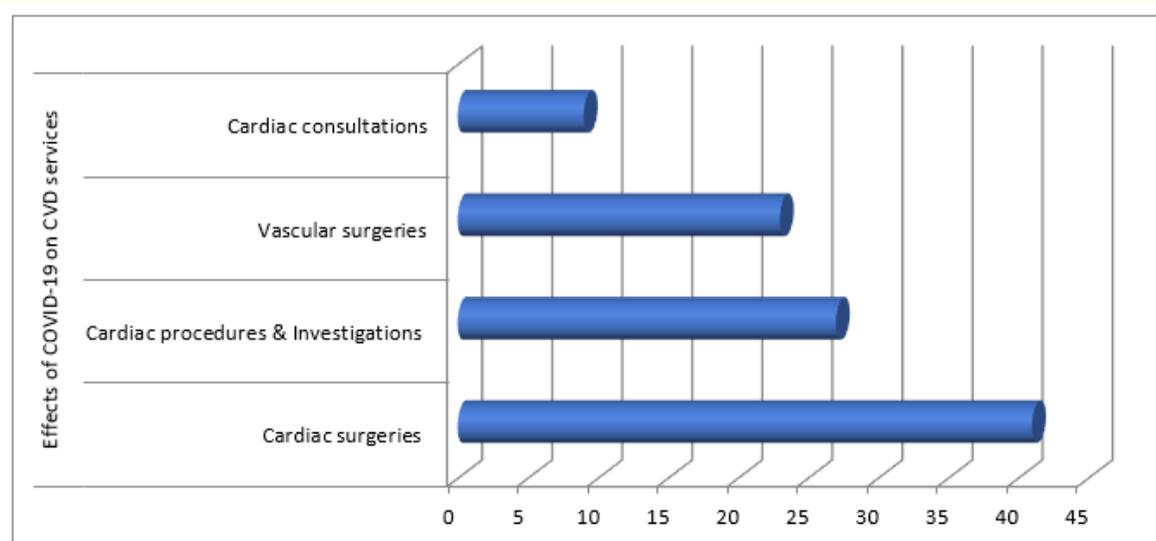


Figure 3: Effects of COVID-19 on CVD services.

Cardiac surgeries	Cardiac procedures and Investigations	Vascular surgeries	Cardiac consultations
9 (41%)	6 (27%)	5 (23%)	2 (9%)

Table 2: Effects of COVID-19 on CVD services.

Cardiac surgeries constitute the majority of services disrupted during COVID-19 pandemic caring 41% (9) of all other cardiac services. Cardiac procedures and investigations follow with 27% (6), vascular surgeries 23% (5) and cardiac consultations 9% (2). Cardiac surgeries, procedures and investigations carry the burden with 68% and 90% respectively if vascular surgeries are added up. The fact that cardiac consultations are carrying the lowest percentage may be because most consultations have been switched to telemedicine, video remote and zoom consultations. In all papers (100%), cardiac surgeries, procedures and investigations and vascular surgeries have been either postponed, rescheduled or cancelled following directives of COVID-19 prevention and control guidelines in the various countries in the world.

Summary of included papers

Authors and title	Study design	Objective of the study	Sample	CVD services affected	Effects of COVID-19 on services delivery	Other findings
1. S. Goel and A. Sharma, COVID-19 pandemic and its impact on cardiology and its subspecialty training, <i>Progress in Cardiovascular Diseases</i> , https://doi.org/10.1016/j.pcad.2020.05.004 [11].	Letter to editor	This article delineates the challenges currently being faced by cardiology and subspecialty fellows in this tough time.	N/A	Cardiac, endovascular and structural catheterization	<p>Deferral of elective cardiac, endovascular, or structural catheterization procedures during the COVID-19 pandemic, 4 elective cases normally done by fellows have been postponed or canceled across the country.</p> <p>Drastic decrease in the procedure and patient volume, decline in the number of patients presenting with acute coronary syndromes in regions severely affected by the pandemic.</p> <p>Cardiology and subspecialty fellows are being actively deployed as attending physicians or fellows/resident physicians in emergency rooms, medical floors or critical care units to care for COVID-19 patients.</p>	With hospitals and private practices reducing elective procedures and outpatient visits, there will be lost of revenues, which is unlikely to be recovered given the current projections of the pandemic
2. Ng JJ, Gan TRX, Niam JY, Menon RK, Ho P, Dharmaraj RB, Wong JCL, Choong AMTL, Experience from a Singapore tertiary hospital with restructuring a vascular surgery practice in response to national and institutional policies during the COVID-19 pandemic, <i>Journal of Vascular Surgery</i> (2020), doi: https://doi.org/10.1016/j.jvs.2020.05.026 [12].	Review (pre-print)	To describe the various governmental and hospital policies that were implemented as a response to COVID-19. We also aim to describe and discuss the after effect these policies had on vascular surgery services in our unit	N/A	Vascular surgeries	<p>Influx of patients.</p> <p>In the extreme situation, challenging decisions like declining surgery for an elderly patient with a ruptured abdominal aortic aneurysm to preserve intensive care unit capacity might have to be made.</p> <p>From late January, the listing of non-urgent elective surgeries was prohibited, except for "time-sensitive cases" such as oncological cases or limb salvage procedure.</p> <p>Vascular surgery outpatient clinics were immediately scaled down.</p> <p>Reduced number of outpatient clinics.</p> <p>Postponement of non-urgent referrals.</p> <p>Adoptions of teleconsultations.</p>	<p>Scaling back of outpatient services, postponement of all elective cases that were already listed prior to COVID-19, suspension of annual leave application for healthcare workers and mandatory temperature screening.</p> <p>Average number of admission reduced from 110/month to 79.</p> <p>Future plans; telemedicine or remote monitoring technology.</p>

<p>3. Pow-Li Chia, <i>et al.</i> (2020). Rhythm blues in the time of coronavirus disease 2019 (COVID-19): how the cardiac electrophysiologist adapts to a viral pandemic in Singapore [13].</p>	<p>Commentary</p>	<p>To share experience of significant cardiac rhythm abnormalities seen in COVID-19 patients in Singapore, how the viral pandemic has affected the cardiac electrophysiology and pacing service in a large acute care general hospital and the steps taken to alleviate the negative impact</p>	<p>N/A</p>	<p>Cardiac electrophysiology services</p>	<p>Cardiac electrophysiology studies, catheter ablation, implantation of cardiac implantable electronic devices.</p> <p>Fifteen percent of cardiac technicians are out deployed to support viral outbreak operations within the hospital.</p> <p>Non urgent elective cardiac EP procedures are postponed, based on individualized patient risk assessments.</p> <p>3-dimensional mapping are postponed due to the absence of service representatives.</p>	<p>The use of telemedicine is utilized to reduce unnecessary clinic visits.</p> <p>Referrals from primary care physicians to the cardiology clinics for abnormal electrocardiograms are reduced by remotely reviewing the electrocardiograms and patient's history through secure email or chat groups.</p> <p>Since the start of COVID-19 pandemic and with the introduction of mitigating measures, the total number of CIED and EP procedures has decreased to 1 to 2 cases per week. CIED interrogation volume has also dropped to 30 to 40 patients per week.</p> <p>Tele-consultation during the pandemic.</p>
<p>4. Basman C, Kliger CA, Pirelli L, Scheinerman SJ. Management of elective aortic valve replacement over the long term in the era of COVID-19. <i>Eur J Cardiothorac Surg</i> 2020; doi:10.1093/ejcts/ezaa152 [14].</p>	<p>Editorial</p>	<p>Objective not specified</p>	<p>N/A</p>	<p>Aortic valve replacement</p>	<p>Aortic interventions are done on an elective basis, and therefore have been postponed due to the COVID-19 outbreak.</p> <p>There is a significant relationship between aortic valve replacement (AVR) waiting-time and mortality as well as hospital readmission.</p> <p>Delaying AVR has been associated with poor operative outcomes and risk of mortality during the waiting period.</p> <p>hospitalizations during waiting-time and urgent/emergency AVR have been associated with worse short and long-term outcomes.</p>	
<p>5. George I, Salna M, Kobsa S, Deroo S, Kriegel J, Blitzer D., <i>et al.</i> The rapid transformation of cardiac surgery practice in the coronavirus disease 2019 (COVID-19) pandemic: insights and clinical strategies from a centre at the epicenter. <i>Eur J Cardiothorac Surg</i> 2020; doi:10.1093/ejcts/ezaa228 [15].</p>	<p>Review</p>	<p>To highlight the effects of COVID-19 from the perspective of a busy cardiac surgery programme at the epicentre of the COVID-19 pandemic, including implications for those with cardiovascular disease, disease pathophysiology in the context of common cardiac surgical procedures and the impact on adult cardiac surgical practice during and after the pandemic</p>	<p>N/A</p>	<p>Cardiac surgeries (coronary bypass grafting and valve operations, aortic surgeries, heart transplantations and mechanical circulatory support)</p>	<p>Multiple studies have identified cardiovascular disease, hypertension and diabetes mellitus as among the most common comorbidities reported among patients with COVID-19, and the reported case fatality rate among patients with cardiovascular disease has been reported at 10.5%, compared with only 0.9% in patients with no comorbidities.</p> <p>Therefore delaying, postponing or cancelling consultations and procedures for these diseases result to the high fatality rate.</p>	<p>Most institutions transitioned to a distance model of health care, using existing telemedicine as well as Zoom platforms.</p> <p>Alternative solutions; smartphone video chat applications, voice calls.</p>

<p>6. Geoffrey A Rubin., <i>et al.</i> (2020) Restructuring Electrophysiology During the COVID-19 Pandemic: A Practical Guide From a New York City Hospital Network [16].</p>	<p>Review</p>	<p>Aims: (1) essential practical steps to approaching procedures, as well as outpatient and inpatient care of EP patients, with relevant examples, (2) successful strategies to minimize exposure risk to patients and clinical staff while also balancing resource utilization, (3) challenges related to redeployment and restructuring of clinical and support staff, and (4) considerations regarding continued collaboration with clinical and administrative colleagues to implement these changes</p>	<p>N/A</p>	<p>Electrophysiology</p>	<p>Telemedicine across the country advanced dramatically within 1 week. A phone based evaluation services. Rescheduling normal annual visits.</p>	<p>3 broad categories of reorganization; (1) procedure-related and inpatient care, (2) outpatient care, and (3) administrative restructuring. Technicians and nurses, have been “redeployed” to other units, we function by the mantra, “If it can be done by one person, then it should be done by one person”.</p>
<p>7. Arnold RH., <i>et al.</i> Rural and Remote Cardiology During the COVID-19 Pandemic: Cardiac Society of Australia and New Zealand (CSANZ) Consensus Statement. Heart, Lung and Circulation (2020). https://doi.org/10.1016/j.hlc.2020.05.001 [17].</p>	<p>Consensus statement</p>	<p>N/A</p>	<p>N/A</p>	<p>Cardiovascular diseases consultations and cardiothoracic surgeries</p>	<p>People with known CVD have increased morbidity and mortality from coronavirus disease 2019 (COVID-19). COVID-19 is associated with serious cardiac manifestations, potentially placing additional demand on limited regional services at a time of diminished visiting metropolitan support with restricted travel</p>	<p>Telehealth ECG reading and cardiology consultation 24/7 should be uniformly available. Regional centers should have equitable access to thrombolytic. Patient transfer should be limited but, when required, should be actioned in a timely manner within available resources. Outpatient cardiac care and rheumatic heart disease management should be maintained for rural cardiac patients. Staff safety, provision of appropriate personal protective equipment (PPE), and onsite COVID-19 polymerase chain reaction testing are a priority for regional cardiac services. Patients requiring urgent cardiothoracic surgery should continue to be referred during the COVID-19 pandemic.</p>

<p>8. Leong Tan., <i>et al.</i> (2020). Early experience in the COVID-19 pandemic from a vascular surgery unit in a Singapore tertiary hospital. <i>Journal of Vascular Surgery</i>. Volume 72, Number 1 [18].</p>	<p>Commentary</p>	<p>N/A</p>	<p>N/A</p>	<p>Vascular surgery</p>	<p>Suspension of annual leave.</p> <p>Vascular surgery consultants deployed to COVID-19 treatment center leaving only one vascular consultant standby.</p> <p>Non-essential departmental and unit meetings were suspended in favor of zoom meetings.</p> <p>Daily major ward rounds were replaced by consultant rounds accompanied by 2 junior staffs and emergencies were seen by one consultant.</p> <p>Clinical resources have been reduced by 50%.</p> <p>Option for home delivery drug was availed.</p>	<p>Elective surgeries still going on: Limb salvage surgery (bypass and lower limb angioplasty) for critical limb ischemia.</p> <p>Aortic aneurysm surgery.</p> <p>Vascular oncology surgery.</p> <p>Major and minor amputations.</p> <p>Endovascular salvage of arteriovenous fistula and grafts.</p> <p>Creation of arteriovenous fistula.</p> <p>Special consideration:</p> <p>Availability of PPE.</p> <p>Availability of operating rooms.</p> <p>Availability of essential drugs.</p> <p>Increase in need for ICU beds for COVID-19 pandemic patients.</p> <p>Availability of surgical manpower.</p>
<p>9. Maria Lucia Mangialardi., <i>et al.</i> Routine in an Italian High-Volume Vascular Surgery Unit during the COVID-19 Era: How the Pandemic Changed the Vascular Daily Practice. <i>Ann Vasc Surg</i> 2020; 66: 6–7 https://doi.org/10.1016/j.avsg.2020.05.002 [19].</p>	<p>Commentary</p>	<p>N/A</p>	<p>N/A</p>	<p>Carotid stenosis and preocclusive (repairs)</p> <p>Abdominal aortic aneurysm</p> <p>Complex aortic procedures</p> <p>Arch repair</p> <p>Thoraco-abdominal Endovascular Repair</p>	<p>Implementation of the number of carotid stenting (CAS) when possible using combined proximal and distal protection devices as it allows a faster in-hospital course than carotid endarterectomy.</p> <p>Open aortic repair, a postoperative fast track protocol has been applied allowing no ICU postoperative stay and a shorter (4 days on average) postoperative hospitalization.</p> <p>Local anesthesia is a preferred approach whenever possible also in complex aortic procedures.</p>	<p>In Italy, vascular surgeons were required to modify their daily practice and to respond to the emergency redistributing resources: we strongly believe that sharing experiences will be fundamental to better manage our patients in these trivial weeks.</p>

<p>10. Ryan Gouveia e Melo and Luís Mendes Pedro. Vascular surgery department adjustments in the era of the COVID-19 pandemic. <i>Journal of Vascular Surgery</i>. https://doi.org/10.1016/j.jvs.2020.04.017 [20].</p>	<p>Letter to the Editor</p>	<p>N/A</p>	<p>N/A</p>	<p>Vascular surgery</p>	<p>First, we postponed and discharged every non urgent patient (asymptomatic carotid stenosis, non-limb-threatening ischemia, aortic aneurysm). Second, we divided our entire staff into two teams alternating on a week-to-week basis. Some staffs got specific ICU training to be called on to support COVID-19 ICUs if the hospital needed it.</p>	<p>Third, all other activities were turned toward urgent (chronic limb-threatening ischemia, symptomatic carotid stenosis, and aortic aneurysm >5.5 cm) and emergent patients. Shortened the length of stay (endovascular aneurysm repair, percutaneous approach, and use of local or regional anesthesia). In the hospital, wards were divided into three types: triage (waiting for a SARS-CoV-2 result) and COVID-19 or non-COVID-19 wards. As a measure to increase the ICU capacity, the vascular surgery ward was turned into an ICU for COVID-19 patients.</p>
<p>11. Griffin., <i>et al.</i> Aortic disease in the time of COVID-19: Repercussions on patient care at an academic aortic center. <i>J Vasc Surg</i> 2020;:-1-6 0741-5214 https://doi.org/10.1016/j.jvs.2020.04.487 [21].</p>	<p>Review</p>	<p>N/A</p>	<p>N/A</p>	<p>Aortic diseases</p>	<p>Surgery for most patients with isolated descending thoracic or abdominal aortic aneurysms. Patients with both proximal aortic aneurysms and Coronary artery disease or valve disease are considered on a case-by-case basis. Symptomatic aortic stenosis with concomitant aortic aneurysm has been classified as time-sensitive, and we have proceeded with these procedures.</p>	<p>Hospitals with a greater number of patients with COVID-19 will likely be forced to impose strict restrictions on elective surgical scheduling</p>
<p>12. Hemingway., <i>et al.</i> Emerging practice patterns in vascular surgery during the COVID-19 pandemic. <i>Journal of Vascular Surgery</i>.2020 (article in progress) [22].</p>	<p>Review</p>	<p>To elevate the peer-to-peer communication for other vascular surgery groups who will face similar challenges in the coming days to weeks. To present the lessons learned and provide guidelines for daily workflow and continued medical education during these unprecedented times.</p>	<p>N/A</p>	<p>Vascular surgery</p>	<p>Average weekly clinical volume decreased by 96.5% (from 43.1 patients to 1.5 per week), with the average weekly surgical volume decreasing by 71.7% (from 15 cases to 4.25 cases per week). The inpatient volume also decreased to 1.81 consultations daily (47 consultations within 26 days), with 60% consisting of telemedicine "e-consults"</p>	<p>The trainee weekly surgical volume also decreased by 86.4% (from 12.9 cases weekly to 1.75) for the vascular surgery fellow and 84.8% (from 8.2 cases weekly to 1.25) for the postgraduate year 3 integrated resident. 60% of consultations were performed as e-consults.</p>

<p>13. Hassan., <i>et al.</i> Ramping Up the Delivery of Cardiac Surgery During the COVID-19 Pandemic: A Guidance Statement From the Canadian Society of Cardiac Surgeons. <i>Canadian Journal of Cardiology</i>. 2020 (1-5) https://doi.org/10.1016/j.cjca.2020.04.030 [23].</p>	<p>Expert opinion</p>	<p>N/A</p>	<p>N/A</p>	<p>Cardiac surgery</p>	<p>Prioritize and delay elective cardiac surgeries. Prioritize emergencies. Collaboratively manage and prioritize patients awaiting cardiac surgeries.</p>	<p>Hand hygiene, the use of personal protective equipment, the creation of COVID-19-free units, social distancing, self-isolation, and travel restrictions. Wait lists have grown, and those being asked to wait for surgery might be forced to experience excessively prolonged wait times. There remains a significant number of patients in whom timely surgical intervention, even if during a global pandemic, outweighs the risk of further delay.</p>
<p>14. David A Wood., <i>et al.</i> Safe Reintroduction of Cardiovascular Services During the COVID-19 Pandemic: From the North American Society Q1 Leadership. <i>Canadian Journal of Cardiology</i> Volume - 2020 [24].</p>	<p>Consensus report</p>	<p>N/A</p>	<p>N/A</p>	<p>Cardiovascular services; cardiovascular surgeries, valve surgeries, electrophysiology ablations, devices, electrocardiographies</p>	<p>Restrictions on medical care Cardiovascular procedures and diagnostic tests have been deferred Delay in cardiovascular treatment</p>	<p>Ethical framework with appropriate safeguards for the gradual reintroduction of invasive CV procedures and diagnostic tests after the initial peak of the COVID-19 pandemic</p>
<p>15. Kirkpatrick., <i>et al.</i> ASE Statement on Protection of Patients and Echocardiography Service Providers During the 2019 Novel Coronavirus Outbreak. <i>JACC VOL. 75, NO. 24, 2020</i> [25].</p>	<p>Expert opinion</p>	<p>N/A</p>	<p>N/A</p>	<p>Echocardiography</p>	<p>COVID-19 led to the following conditions: Defer/rescheduling procedures. Assessment first for COVID-19 status. Consider appropriate level of self-protection. Limiting exposure during exams. Identify and appropriately re-assign special at risk personnel</p>	<p>Determine all elective and reschedule them and perform all others. Identify non-elective indications and to defer all others</p>
<p>16. Reza., <i>et al.</i> Secondary Impact of the COVID-19 Pandemic on Patients With Heart Failure. <i>Circ Heart Fail.</i> 2020; 13:e007219. DOI: 10.1161/CIRCHEARTFAILURE.120.007219 [26].</p>	<p>Expert opinion</p>	<p>N/A</p>	<p>N/A</p>	<p>Consultations on Heart failure patients</p>	<p>Reduction in US cardiac catheterization laboratory activations for ST-elevation myocardial infarction Undiagnosed ST-elevation myocardial infarction complications. Changes in organ availability and center-level practice variation may negatively impact waitlist mortality.</p>	<p>Prioritization schemes for evaluation and treatment were implemented. Our patients may suffer from suspension of or lack of access to interventions that may improve their quality of life, morbidity and mortality.</p>

<p>17. Bonalumi G, di Mauro M, Garatti A, Barili F, Gerosa G, Parolari A., <i>et al.</i> The COVID-19 outbreak and its impact on hospitals in Italy: the model of cardiac surgery. <i>Eur J Cardiothorac Surg</i> 2020;57:1025–8 [27].</p>	<p>Editorial</p>	<p>N/A</p>	<p>N/A</p>	<p>Cardiac surgery</p>	<p>Elective surgery has been cancelled and beds dedicated to cardiac, neurosurgery and partially coronary care units reassigned to COVID-19-patients.</p> <p>16 of the 20 cardiac surgical units in the Lombardy region have discontinued their activities, with the remaining 4 units forming 'the hub' for the 16 other closed units</p> <p>Beds for critically ill patients are also obtained from the reconversion of operation and recovery rooms.</p>	<p>All patients coming to the emergency room (ER) should be treated as COVID-19-positive, and contact with other patients should be avoided.</p> <p>Shifts are organized in such a way that surgeons and perfusionists from different centers take turns being on call, in order to enhance cooperation, and also the inclusion of nurses and perfusionists.</p> <p>Patients with a regular postoperative course should be discharged as quickly as possible and managed with outpatient care as soon as their physical condition allows.</p> <p>Reservation of 3 - 4 ICU beds, in a separate area of the hospital without any contact with the COVID-19 zone, which is dedicated to the management of chronically ill patients, already in hospital before the quarantine.</p> <p>Majority of anesthesiologists are involved in COVID-19 patients, cardiac surgeons should be involved in ward and chronic ICU management during the transitional phase</p>
<p>18. Wang NC, Jain SK, Estes NAM 3rd., <i>et al.</i> Priority plan for invasive cardiac electrophysiology procedures during the coronavirus disease 2019 (COVID-19) pandemic. <i>J Cardiovasc Electro-physiol.</i> 2020; 31:1255–1258. https://doi.org/10.1111/jce.14478 [28].</p>	<p>Brief communication</p>	<p>N/A</p>	<p>N/A</p>	<p>Invasive cardiac electrophysiology</p>	<p>On 13 March, the American College of Surgeons recommended that every "hospital, health system, and surgeon review all scheduled elective procedures with a plan to minimize, postpone, or cancel electively scheduled operations, endoscopies, or other invasive procedures.</p> <p>18 March, the Centers for Medicare and Medicaid Services (CMS) issued "Guidance to limit non-essential adult elective surgery and medical and surgical procedures" and referenced the Elective Surgery Acuity Scale.</p> <p>On 20 March, a Heart Rhythm Society (HRS) COVID-19 Task Force message agreed with "CDC recommendations to postpone elective EP procedures:</p> <p>"Ablation in clinically stable patients, device upgrades, most primary prevention implantable cardioverter-defibrillator (ICD) implants, left atrial appendage closure device implants, and implantable loop recorders".</p>	<p>Priorities;</p> <p>Older age and co-existing medical conditions are associated with increased mortality risk and should be taken into consideration.</p> <p>The minimum number of personnel should be involved with patients with known or suspected COVID-19, and trainee participation is discouraged.</p> <p>All workers should be trained and fitted for personal protective equipment (PPE). N95 masks or powered air-purifying respirators are recommended for COVID-19 cases.</p> <p>Increasing availability of SARS-CoV-2 testing should allow more accurate stratification of PPE needs in the procedure planning phase.</p> <p>Devices within the elective replacement interval should be considered urgent or equivocal, depending on the indication and the estimated remaining battery life.</p> <p>Same-day discharges for new implants may be encouraged to lower inpatient time and resource utilization.</p>

<p>19. Umesh N. Khot, Andrew P. Reimer, Abigail Brown, Fredric M. Hustey, M. Shazam Hus-sain, Samir R. Kapadia and Lars G. Svensson. Impact of COVID-19 Pandemic on Critical Care Transfers for ST-Elevation Myocardial Infarction, Stroke, and Aortic Emergencies. Circulation, cardiovascular quality and outcomes. 10.1161/CIRCOUT-COMES.120.006938 [29]</p>	<p>Prevalence study</p>	<p>To measure the impact of the COVID-19 pandemic on emergency transfers for STEMI, stroke, and acute aortic emergencies within our regional health system</p>	<p>N/A</p>	<p>Transfers of ST elevation, myocardial infarction, Stroke, and Aortic emergencies</p>	<p>Decrease in patients presenting to hospitals with serious cardiovascular diseases such as ST-elevation myocardial infarction (STEMI) and stroke</p>	<p>Overall daily transfers fell from 4.2 ± 2.2 to 2.5 ± 1.5 (Relative Reduction: -39%, $P < 0.001$).</p> <p>Reductions in transfer volume for STEMI (1.1 ± 1.1 vs. 0.6 ± 0.7, Relative Reduction: -48%, $P < 0.001$).</p> <p>stroke (2.5 ± 1.6 vs. 1.5 ± 1.2, Relative Reduction: -39%,</p> <p>Aortic emergencies (0.6 ± 0.7 vs. 0.4 ± 0.7, Relative Reduction: -21%, $P = 0.258$), compared to the second baseline, daily transfers fell from 4.1 ± 2.2 to 2.5 ± 1.5 (Relative Reduction: -38%).</p>
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Table 3: Summary of included papers.

The cardiac surgeries which are most affected among CVD services are valve replacements (aortic, mitral, tricuspid), heart transplant, coronary bypass grafting and arch repair. The second group of CVD services affected is cardiac procedures and investigations viz. cardiac, endovascular and structural catheterization, cardiac electrophysiology, cardiac ablation therapy, devices and mechanical circulatory support, carotid stenosis and pre-occlusive repairs, invasive electrophysiology and coronary angiograms. The third group of CVD services affected being vascular surgeries mostly comprised by endovascular repairs. The last group of CVD services affected is the cardiac, hypertension, heart failure and other cardiovascular disease consultations. Hospitals in different countries have urgently reviewed their health policies, protocols, rules and regulations to suit the need for prevention and management of COVID-19 patients. These changes in policies include cancelling non-urgent procedures, postponing non-emergency cardiac operations and deferring most routine consultations.

Solutions and mitigation measures for CVD services

The interruption of these CVD services in hospitals and private practices reduced considerably the number of elective procedures and outpatient visits which according to hospital predictions led to a loss of revenues which may not be recovered due to the lifetime of the pandemic [11]. In Singapore tertiary hospital, most outpatient services were discouraged and all elective cases scheduled prior COVID-19 were postponed and healthcare workers annual leaves were suspended. The average number of admissions reduced from 110 patients to 79 patients per month. Telemedicine and technology were the future plans [12]. Again in the same country, referrals from primary care to cardiology clinics for abnormal electrocardiograms have drastically reduced and patients were reviewed remotely through secure emails and chat groups [13], others on top of telemedicine started zoom platforms as well as smart phone video chat and voice calls to support continuous patient management [15]. For Singapore tertiary hospital again, the following elective surgeries have been advised to continue; limb salvage surgery (bypass and lower limb angioplasty) for critical limb ischemia, aortic aneurysm surgery, vascular oncology surgery, major and minor amputations, endovascular salvage of arteriovenous fistula and grafts, creation of arteriovenous fistula, and some special considerations were put in place: availability of PPE, availability of operating rooms, availability of essential drugs, increase in need for ICU beds for COVID-19 pandemic patients, availability of surgical manpower [18].

In Portugal (university hospital, Lisbon), all non-urgent patients were postponed and others discharged (asymptomatic carotid stenosis, non-limb-threatening ischemia, aortic aneurysm) as the first measure. Then staffs were divided in two shifts alternating on a week basis. Some staffs got ICU training to support COVID-19 ICU if need be. Some other procedures were turned to be urgent viz. chronic limb-threatening ischemia, symptomatic carotid stenosis and aortic aneurysm > 5.5 cm. Other measures like shortening the length of stay for endovascular aneurysm repair, as well as to use local or regional anesthesia where ever applicable. Hospital wards were also divided in three types namely triage room (while waiting for results COVID-19), COVID-19 confirmed and non-COVID-19 ward. The vascular surgery ward was turned into ICU for COVID-19 patients [20]. For some hospitals, the weekly clinical volume dropped by 96.5% (from 43 patients to 2 /week) and weekly surgical volume decreased by 71.7% (from 15 to 4 cases/week). 60% of outpatients were converted to "e-consults". Hospitals with high number of COVID-19 patients imposed strict restrictions on elective surgeries [22].

In Italian high volume vascular unit, the vascular surgeons have been required to modify their daily duties to respond to the emergency redistribution of human resources [19]. In Italian hospitals, the consensus was that all patients entering emergency room was treated as COVID-19 and contact with other patients were to be avoided. Post-operative patients were to be discharged as quickly as possible and managed as outpatients as soon as their condition allowed. 3 - 4 ICU beds were to be reserved in a separate area without any contact with COVID-19 zone

for management of chronically ill patients already in the hospital before lockdown. Anesthesiologists were involved in COVID-19 patients whereas cardiac surgeons involved in ward and chronic ICU management [27]. Hospitals have set some priorities-older age patients and those with co-existing medical conditions were seen to be associated with increased mortality risk. COVID-19 patients were to be managed by a minimum number of personnel and trainee participation was discouraged. Patients with devices within elective replacement interval were considered urgent depending on indication and the remaining battery life. Hospital workers have been trained and fitted for personal protective equipment (PPE), and N95 masks, powered air-purifying respirators were recommended for COVID-19 patients [28].

The Cardiac Society of Australia and New Zealand have made the following recommended that telehealth ECG and cardiac consultations be available 24/7. Remote areas and regional centers should have accessible thrombolytic and patient transfers to be limited. Cardiac outpatient and rheumatic heart disease should be maintained for rural cardiac patients. For regional cardiac services, staff safety, provision of personal protective equipment (PPE), and COVID-19 testing should be made a priority and patients requiring urgent cardiothoracic surgery should continue to be referred during COVID-19 pandemic [17].

In US, according to Reza, *et al.* [26] prioritization and evaluation were implemented but there is an argument that patients may suffer from suspension of CVD services especially interventions that may improve their quality of life, morbidity and prevent mortality. In New York City hospital, procedures, inpatient, outpatient care and administration have been restructured. Technicians and nurses have been redeployed to other units, as they say "if it can be done by one person, then it should be done by one person" [16]. In OHIO, US (Cleveland Clinic) COVID-19 have affected not only interventions but also referrals of patients who need more specialized care. The overall transfers fell from 4.2 ± 2.2 to 2.5 ± 1.5 (Relative Reduction: -39%, $p < 0.001$). STEMI transfer reductions (1.1 ± 1.1 vs. 0.6 ± 0.7 , Relative Reduction: -48%, $P < 0.001$), stroke transfer was affected by (2.5 ± 1.6 vs. 1.5 ± 1.2 , Relative Reduction: -39%), aortic emergencies (0.6 ± 0.7 vs. 0.4 ± 0.7 , Relative Reduction: -21%, $P = 0.258$), compared to the second baseline, daily transfers fell from 4.1 ± 2.2 to 2.5 ± 1.5 (Relative Reduction: -38%) [29].

Discussion

Cardiovascular disease patients are more vulnerable when they contract COVID-19. Almost 10% of these patients die compared to 1% of patients without this pre-existing condition [30]. The same risk has been observed among hypertensive and coronary artery disease but this has not been justified so far. Postponing or cancelling CVD procedures or management, put these patients at high risk of mortality. This review highlights the essence of continuity of CVD disease services to prevent the mortality linked to the association between CVD and COVID-19 [31]. Cardiac surgeries constitute the majority of affected services with 41%. The reason of this high rate of disruption might have been due to the fact that cardiac surgeries require sterile space (theatres), cardio-thoracic surgeons, anesthesiologists, nurses, theatre technicians, etc. During COVID-19 pandemic, all the resources (human and infrastructure) mentioned are scarce due to re-allocation of duties, rearrangement of the services such as rescheduling non-urgent operations. Vascular surgeries are also affected secondarily in the same way [32]. Cardiac consultations were the last being affected by the shutting down of some CVD services and this is because in some countries, consultations were still going on under strict measures of COVID-19 prevention and rules of social distancing. A good number of hospitals shifted to telemedicine, e-health, zoom consultations, etc [33]. In Singapore for example, telemedicine was used to reduce the unnecessary clinic visits during COVID-19, referrals from primary care physicians to cardiologists for abnormal electrocardiograms (ECG) were reduced by remotely reviewing ECG through emails, chat groups and tele-consultations [34]. What will be the clinical impact of the remote consultations during COVID-19? In medical training, it is clear that an examination of a patient is composed by complaints, history taking, physical examination (inspection, touching, auscultation and percussion) and investigations [35]. The big question is, do remote consultations will fully respect the patient examination rules? Will the diagnosis be accurate? What if the diagnosis is wrong due to examining the patient on the screen? This lead to wrong treatment which has two main implications in patient's health; one, the patient may develop side effects for no reason. Second, the patient will continue to deteriorate instead [36]. The Cardiac Society of Australia and New Zealand recommended that telehealth ECG and cardiac consultations be available 24/7. During such a pandemic, it is

very important to maintain the cardiac consultations to stabilize cardiac patients who are vulnerable to the virus [17]. Another important issue to consider during pandemic is sustainability of private hospitals. It was acknowledged that some hospitals dropped their weekly clinical volume by 96.5% (37) (43 patients to 2/week) and weekly surgical volume decreased by 71.7 % (from 15 to 4 cases/week) [22]. With this significant reduction of the number of patients, private hospitals with no subsidies may not sustain. This may leave a serious economic impact to these hospitals and the closure of these hospitals may have a significant impact on patients as well. Reza., *et al.* [26] in US argued that patients may suffer from suspension of CVD services especially interventions that may improve their quality of life, morbidity and prevent mortality. COVID-19 affected transfers of patients who need specialized care among them STEMI, stroke and aortic emergencies [21]. This suspension of transfers may lead to immediate mortality or morbidity due to lack of urgent cardiac interventions.

Limitations of the Study

This review has a number of limitations, due to scarcity of research papers in this field, among papers included only one paper is a peer review. This may affect internal and external validity of the results presented therefore generalizability may be compromised.

Conclusion

Cardiovascular disease services delivery have been affected seriously during COVID-19 restrictions. Cardiac surgeries, cardiac procedures and investigations, vascular surgeries, cardiac consultations and referrals of cardiac emergencies were the most affected. Many mitigating factors and measures have suggested by experts and ministers of health to prevent COVID-19 transmission during procedures or consultations. Some experts suggest postponing or canceling some non-urgent CVD services. Others suggest a continuation of services whether urgent or not but under strict prevention measures. CVD procedures and services including consultations are extremely important to continue under strict measures to prevent mortality and morbidity associated with CVD and COVID-19.

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Declaration of Interest

Authors declares no conflict of interest.

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