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The initial experience and response of vascular surgeons in Michigan during the COVID-19 pandemic

Nicolas J Mouawad¹, Judith C Lin², Dawn M Coleman³, Justin Simmons⁴, Loay S Kabbani², Robert F Cuff⁴ and M Ashraf Mansour⁴

Abstract
Background/Objective: The unprecedented pandemic spread of the novel coronavirus has severely impacted the delivery of healthcare services in the United States and around the world, and has exposed a variety of inefficiencies in healthcare infrastructure. Some states have been disproportionately affected such as New York and Michigan. In fact, Detroit and its surrounding areas have been named as the initial Midwest epicenter where over 106,000 cases have been confirmed in April 2020.

Method, Results and Conclusions: Facilities in Southeast Michigan have served as the frontline of the pandemic in the Midwest and in order to cope with the surge, rapid, and in some cases, complete restructuring of care was mandatory to effect change and attempt to deal with the emerging crisis. We describe the initial experience and response of 4 large vascular surgery health systems in Michigan to COVID-19.

Keywords
COVID-19, coronavirus, vascular surgery, pandemic, vascular, Michigan

The unprecedented pandemic spread of the novel coronavirus has severely impacted the delivery of healthcare services in the United States and around the world, and has exposed a variety of inefficiencies in healthcare infrastructure. Thought to have originated in the Wuhan Province of China, in the fall of 2019, reports of severe and highly contagious pneumonia were surfacing. On January 7, 2020, the Centers for Disease Control and Prevention (CDC) isolated the pathogen and called it Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The disease caused by this virus has been identified as Coronavirus Disease 2019, better known as COVID-19.¹⁻³

In just a few weeks, COVID-19 overwhelmed the current healthcare resources, especially in densely populated cities, forcing clinicians to make very difficult triage decisions about what types of care and interventions could be offered to patients during a time of resource scarcity. In fact, as of 15 August 2020, there are more than 23.1 million confirmed cases of COVID-19 worldwide and over 176,000 deaths in the United States alone.⁴ Some states have been disproportionately affected initially, with New York at the top, followed by New Jersey and then Michigan. Detroit and its surrounding areas have been named as the Midwest epicenter with over 106,000 confirmed cases.⁵ Facilities in Southeast Michigan have served as the frontline to the

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pandemic in the Midwest. In order to effectively combat the COVID surge, rapid, and in some cases, complete restructuring of care was required to prepare for the predicted clinical volume and emerging crisis.

The practice of vascular surgery has been severely affected and delays in vascular interventions may have disastrous outcomes such as loss of limb or life. Drastic measures were necessary in order to preserve the scarce resources of personal protective equipment (PPE) as well as ventilators, medications, and importantly, trained personnel (human capital). Prior to formal national recommendations, vascular surgeons in the State of Michigan began restructuring daily practice efforts in order to try to cope with the pandemic, mitigate downstream resource concerns, and help flatten the curve. In this report, we describe the initial efforts of four large Michigan health systems in urgent reduction and postponement of in-person clinics, creation of tiered classification for vascular surgery operations, repurposing of vascular trainees, call coverage, leveraging telehealth and cross covering of other service lines.

Reduction and postponement of in-person clinics and imaging

The prevailing approach in medical care is the in-person visit between patient and physician; this cornerstone has been upended. The very important public health principles of social distancing to flatten the curve have forced a dramatic reduction in such visits if not halting them completely. At McLaren Health during the initial weeks of COVID-19, the clinic staff was reduced to a skeleton crew of one nurse and one medical assistant. A comprehensive patient questionnaire regarding COVID-19 symptoms was developed that was mandatory for each person presenting to the clinic. All staff and patients were required to wear surgical masks (and for the healthcare providers, the mask was maintained for 1 week due to concerns for PPE shortages). All clinic referrals were reviewed by a senior vascular surgeon and stratified according to urgency. Active decisions were taken to “divert” patients from the Emergency Department (ED) and the potential exposure of the highest risk cardiovascular patients to COVID-19. Patients requiring treatment of vascular emergencies were managed with telemedicine visits, diagnostic imaging in “COVID-19 clean” settings and brought directly to the Operating Room bypassing the ED. Operations were relegated to symptomatic carotid disease, large/symptomatic aortic aneurysms, and chronic limb-threatening ischemia with intractable rest pain and/or progressive tissue loss. By the second week of the crisis, these referrals were even selectively micro-stratified where “urgent” referred to large aneurysms (over 7 cm) and Rutherford Class 5/6 peripheral arterial disease; rest pain interventions were discontinued. This was echoed in multiple other systems in Michigan.

In addition, the non-invasive vascular laboratory went through similar phases only offering urgent outpatient and inpatient studies initially; however, also by the second week, imaging was only performed on urgent inpatient cases. By the end of the second week, the laboratory was essentially closed for all studies and requests. At institutions such as the University of Michigan, COVID-19-specific algorithms were devised and the vascular laboratory was left open for specific and urgent outpatient/inpatient studies. At Spectrum Health, a mobile outpatient vascular laboratory was devised where trained technologists traveled to patient homes for urgent studies.

Leveraging telehealth and telemedicine

By Michigan Governor’s Executive Order declared on 23 March 2020, physical distancing became a reality for an extended period in the entire state. Patient care, education, and conferences were transitioned to teleconferencing for the safety of the individual and society during this pandemic. Virtual methods also saved precious resources such as PPE that were needed by the frontline healthcare workers. In fact, leveraging telehealth and telemedicine is no longer “nice to have” but a “must have.”

Prior to the pandemic, Henry Ford Medical Group (HFMG) providers performed about 195 video visits per week (in 2019, there were over 17,006 virtual encounters with 10,124 video visits and 6882 asynchronous visits; these encounters were provided by 603 providers in over 40 specialties). During Michigan’s Shelter-in-Place, over 6000 video visits were performed per week due to high demand. The vascular laboratories provided 15,000 tele-vascular reading of non-invasive studies annually by registered vascular technologists at five remote sites and studies were interpreted by qualified vascular surgeons; this was leveraged during COVID-19.

Regarding regulation and licensure, Michigan is part of the interstate medical licensure compact. However, during the pandemic, physicians were allowed to cross state lines and provide telehealth services without licensure in a particular state to address the shortage of physicians. At the onset of the pandemic, HFMG physicians in all specialties were able to provide virtual care in some capacity due to physician acceptance, patient demand and restrictive access to outpatient clinic.

As the pandemic continued, the Centers for Medicare and Medicaid Services (CMS) has created
extreme flexibility to allow physicians and non-physicians the ability to care for patients outside of the hospital via various platforms with the addition of 80 new telehealth codes. Creation of many telemedicine and other digital technology codes in the COVID-19 environment, loosening scope of practice temporarily to allow for shortage in the public health crisis, and lack of access via traditional clinic visit have fueled the number of these virtual encounters.

For inpatient care, virtual rounding and resident education was performed using several platforms such as Skype for Business and Zoom. One senior resident or vascular fellow, a junior resident, and an advanced practitioner provider conducted morning report with the vascular attending on call from a meeting room equipped with teleconference capability. Photo images stored-and-forward onto Epic media section and computed tomography scans archived in ePACS were reviewed by the rest of the attending vascular surgeons during morning report virtually. Attendance was full every morning due to the convenient method of education and consultation.

Vascular surgery case classification

Vascular surgery operations can require a significant amount of resource and equipment utilization, not only in the operating theater but also post-operatively in the critical care units. Therefore, early on, it was recognized the need to limit operative capacity to only emergent and/or urgent cases. Prior to distribution of the Society of Vascular Surgery (SVS) Tier Classification, Michigan Medicine did develop an early classification system for the management of vascular surgery cases during a time of resource scarcity that considered critical care and blood bank capacity, human capital, and PPE. Surgeons quickly flexed from providing routine vascular surgery care, to a week of providing “Scenario A” cases in early March 2020 (based on urgent/emergent patient needs), to a sustained period of time (through 20 April 2020) providing “Scenario B” emergent cases to preserve only life and limb in response to resource scarcity resulting from significant inpatient/critical care COVID census (Table 1). Following implementation of Scenario A at Michigan Medicine, this prioritization list was shared with the SVS and the Vascular and Endovascular Surgery Society alongside others, to help generate currently accepted guidelines for practicing vascular surgeons.

In conjunction with colleagues in cardiovascular anesthesia, urgent protocols for management of the airway with patients suspected or confirmed for COVID-19 requiring emergent surgery were drafted and implemented at McLaren Bay Region and shared around the country. Furthermore, due to the volume, Michigan manufacturers have begun producing and donating aerosol shields for local hospitals to help cover patients during intubation, preventing fluids from reaching healthcare workers (Figure 1). Since its use in Michigan, they have now been requested nationally and are donated free of charge to assist in this pandemic.

Repurposing of trainees

The repurposing of trainees was different among various health systems in Michigan. At the University of Michigan, the March patient census increased dramatically in line with projections, and modeling suggested that inpatient care needs would exceed bed capacity in early April. Additionally, several units underwent rapid transition into critical care units, more than doubling intensive care unit (ICU) capacity. Hospital leadership executed plans to expand capacity, including strategizing a “field hospital” to off-load non-critical COVID inpatients from the general care wards. The additional staffing needs required to cover incremental ICU and general care beds required an “all hands on deck” mandatory deployment approach hospital wide. The University of Michigan House Officers continued to play a critical role, alongside the rest of the collective Michigan Medicine workforce, in responding to this human crisis. As such, GME declared COVID ACGME stage 3 (Pandemic Emergency Status) alongside plans for wide redeployment that ensured house officers would redeploy in physician roles, with appropriate supervision and continued compliance with an 80-h work week.

Clinical service lines within the Department of Surgery were compacted, and house officers deemed not high-risk for COVID were identified from the General Surgery, Cardiothoracic, Vascular Surgery, Plastic Surgery, and Oral Maxillo-Facial Surgery (OMFS) training programs for critical care redeployment alongside other surgical faculty and house officers as well as dedicated “line” teams for invasive vascular access. Alongside the national shortage of PPE, this was a concern for the house staff and each were given an appropriate N95 mask and asked to cover it with a regular mask. Guidance for extended use and limited reuse was based on the contemporary CDC guidelines. Fortunately, University of Michigan researchers assisted in the national effort offering guidance on mask decontamination with three methods involving heat and humidity; ultraviolet C light; and hydrogen peroxide vapors. After exposure, the masks were to be in a paper bag away from light and rotated every three to four days. Steaming was used for 5 min and then air-dried for up to three uses. Regular testing of asymptomatic personal was not employed during this time and no repurposed trainee contracted COVID-19, although
symptoms of headache were noted (those that were symptomatic were tested and were negative).

Proactively, a Resident Wellness and Advocacy Group was appointed, supported by a faculty Ombudsman and a Resident Safety Advocate whose efforts supported the following aims: (1) administration of an ongoing (weekly) survey to assure the resident voice is heard to catalog concerns and escalate to leadership; (2) weekly DIRECT outreach to every resident for peer support and accountability; (3) identification and communication of work and best practices; (4) amplification of excellence; and (5) wellness promotion. Social hours were conducted over Zoom technology once weekly and were very well received, allowing an opportunity for residents and staff to remain in touch despite being socially distant. An assessment of vascular surgery trainees nationwide conducted by some of the authors reported significant changes to clinical responsibilities, exposure to COVID-19 and pandemic-related stressors but demonstrated healthy coping mechanisms with low self-reported anxiety levels.8

The Grand Rapids Spectrum Health – Michigan State University affiliated vascular fellowship and integrated residency programs, staffed by one fellow and five residents needed to adjust to the emerging situation as well. The trainees were divided in two teams of three individuals each, with a one week on and one week off rotation. In person morning sign outs were converted to virtual sign-outs using Microsoft Teams programs, and the relevant imaging and clinical data could easily be shared. Weekly case conferences, morbidity and mortality, and journal clubs were also changed to virtual meetings. The group also had a virtual happy hour to encourage socialization, albeit from afar. These changes allowed the service to run smoothly while minimizing person to person contact for concerns that the individuals of the vascular team would need to be quarantined. In the event of surge in the community, the plan was to bring all six of the trainees under direct supervision continuously. The clinical nurses were working every third week. In the current configuration there was one point of overlap between the two teams which occurred as the day call surgeon hands off to the night call surgeon. Importantly, medical students were relieved of all clinical activities although much could be learned from triaging in the emergency room or critical care units.

### Table 1. University of Michigan vascular surgery case prioritization classification in response to the covid-19 pandemic and resource scarcity.

<table>
<thead>
<tr>
<th>Pathology/surgical case</th>
<th>Scenario A: emergent / urgent</th>
<th>Scenario B: emergent only</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA: Symptomatic, Ruptured, Asymptomatic &gt;8 cm</td>
<td>Ruptured AAA</td>
<td></td>
</tr>
<tr>
<td>Symptomatic non-aortic intra-abdominal aneurysm</td>
<td>Acute aortic dissection with malperfusion</td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular: Symptomatic (lateralizing)</td>
<td>Vascular injury with hemorrhage</td>
<td></td>
</tr>
<tr>
<td>Limb Ischemia: Progressive tissue loss, acute limb ischemia, wet gangrene, ascending cellulitis</td>
<td>&gt;2b Severe, acute limb ischemia</td>
<td></td>
</tr>
<tr>
<td>Prosthetic graft infection with sepsis</td>
<td>Stroke in evolution, crescendo TIA</td>
<td></td>
</tr>
<tr>
<td>Mesenteric Ischemia: Acute or acute-on-chronic</td>
<td>Acute mesenteric ischemia</td>
<td></td>
</tr>
<tr>
<td>Compartment Syndrome/Fasciotomy</td>
<td>Compartment syndrome/fasciotomy</td>
<td></td>
</tr>
<tr>
<td>Vascular Trauma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudoaneurysm – non-candidate for thrombin-injection/compression, rapidly expanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative Consults</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.** Local Michigan community repurposing their efforts to create and donate aerosol shields (courtesy Corey Smith CP).
Revision of call schedules

Modifications in the call schedule were mandatory for the health and welfare of the service line and the vascular surgeons. Prior to the adjustments necessary for the novel coronavirus, at Spectrum Health, a dual surgeon call system centered around a night float call schedule existed which has been previously described.9 While facing potential redeployment to ICUs, it was felt necessary to modify the call structure. The rationale behind this was to separate the partners to minimize exposure risk while remaining prepared for the impending surge and clinical responsibilities. The division was separated into two teams of four surgeons with one group active and the other resting per week. Personnel were only tested if symptomatic (none were symptomatic).

With the restrictions on elective cases and the concern over supplies, strategy went from running two to three operating rooms to one operating room daily which was staffed by the individual day call surgeon who would also continue to provide secondary call coverage during the night. The regional clinics were shut down and the main office was staffed by allied health professionals and a ninth surgeon who normally manages the vein practice. A surgeon was placed within the ambulatory space to help triage patients for the nursing staff, reschedule patients, or perform telehealth visits. Each team had one surgeon who floated and could be flexed into any position where additional help was necessary. The night float system was maintained but the weekend component was modified to prevent people from becoming sleep deprived (Table 2). During the early part of the surge, the division decided to designate one surgeon for the ICU and remove the float designation. Once the surge was anticipated to near its peak, two surgeons were designated to the ICUs. In this situation, the ambulatory center would have been managed by the allied health provider allowing the surgeon to be available.

Integral role of the vascular surgeon

Estimates suggested at peak capacity, there will be a need for more than 260,000 hospital beds and more than 87,000 ICU beds across the United States. This expansion demanded an increase in manpower to take care of the unanticipated patient load and vascular surgeons were redeployed. Vascular surgery was deemed an appropriate and essential service to cover ICUs. Those who could be “repurposed” (i.e., <60 years old; no significant health conditions) were deployed in the ICUs to help off-load the intensivists. Vascular surgery attendings rounded in ICUs with a mix of COVID-positive and negative patients in 12 h shifts. Staff from other surgical services were deployed on COVID floors, the emergency room, and patient screening. The transition to becoming an ICU attending was made feasible by using protocols based on best practices. Incoming surgeons were paired with established ICU staff in a shift schedule. A large cohort of support staff provided for assistance including ICU nurses, allied health providers, and trainees. At one point in time Henry Ford Health System had over 2000 confirmed positive with over 150 ICU beds dedicated only for COVID-19 and over 100 patients on a ventilator.

At Henry Ford Hospital Main all dialysis catheters in COVID patients were placed by a dedicated line team from vascular surgery (previously performed by the nephrology service). This was a reflection that vascular surgeons could do it more proficiently and efficiently than the other teams in the hospital. Teams were deployed in twos with either a general surgery or vascular surgery trainee along with a vascular surgery attending. In other hospital facilities, like McLaren Health, vascular surgery was already the

### Table 2. Modified call schedules during COVID-19 pandemic.

<table>
<thead>
<tr>
<th>Duty</th>
<th>Saturday</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night call</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Day call and inpatient rounder</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Backup call</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Ambulatory support</td>
<td>N/A</td>
<td>N/A</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Float</td>
<td>N/A</td>
<td>N/A</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Night call</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Day call and inpatient rounder</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Backup call</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Ambulatory support</td>
<td>N/A</td>
<td>N/A</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Float</td>
<td>N/A</td>
<td>N/A</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Team A surgeons: 1, 2, 3, and 4. Team B surgeons: 5, 6, 7, and 8.
dedicated line service team were there were days where over 20 invasive catheters ranging from arterial lines, dialysis catheters or central lines were placed. The overwhelming hypercoagulable state of these COVID-19 patients has proven to be frustrating as multiple lines were needed to be placed in some patients due to their thrombosis which has raised ethical questions of when is it enough as to not exhaust our already limited supply. Patients with confirmed COVID-19 were placed on low-dose heparin (500 u/h) or enoxaparin injections on a prophylactic basis; anecdotal reports noted a significant decrease in recurrent thrombosis. Ethical discussions about resource utilization were based on a case-by-case basis and dependent on current supplies at the time and anticipated patient prognosis. Of note, such central venous access teams were implemented at many hospitals during this healthcare crisis, not just in Michigan, and the structure, practice patterns, and outcomes were evaluated during the course of the initial surge and described.\textsuperscript{10}

Impact of Michigan and Michigan specific changes

The staggering numbers have continued to increase for the State of Michigan with an expected preponderance in the Southeast where the population is densest (Figures 2 and 3). Following the first diagnosed cases, and reviewing the general trends across the country, the gradual but exponential increase became very concerning. Specifically, at Henry Ford Health System, in early May, two of the five hospitals were over capacity with 80% COVID-19 positive patients and over 800 Henry Ford employees and over 2500 healthcare workers in Southeast Michigan. At Michigan Medicine, from the time the Shelter-at-Home order was placed until the peak, the COVID-19 cases increased 1272% up to 229 cases and ICU utilization to 130 beds (Figure 4). Critical care capacity rapidly nearly tripled from a baseline of 107 adult ICU beds to 243 adult COVID ICU beds and 24 non-COVID ICU care beds with the intentional transition of moderate care, post-anesthesia care unit (PACU) and children’s hospital beds into “flex” critical care space. As another epicenter in the country, emergency planning was paramount.

Quite quickly, Michigan strategized four alternate care sites (i.e., field hospitals) to care for the surge of patients anticipated from COVID-19 as the number of cases has continued to increase very dramatically. The emergency preparedness was unparalleled by any other state due to the proactive planning for the surge (and anticipated second surge). A 1000-bed field hospital was operationalized at the Detroit TFC Convention Center alongside another 250-bed hospital at the Suburban Showplace in Novi. A 500-bed Michigan Medicine Field Hospital 1 was strategized in Ann Arbor alongside yet another hospital-affiliated alternate care side on the west side of the state. In addition, specialized COVID-19 dashboards and software were created to maintain updates for testing, recoveries, and visits, including surge planning and resource allocation (Figure 5).
Furthermore, early during the pandemic, Michigan vascular surgeons across various health systems reached out and communicated with one another, and urgently set up a Michigan Vascular Surgery WhatsApp™ Network that was sent out by the Michigan Vascular Society (MVS) under the order of the MVS President to all its members. Communications, memos, and clinical updates, including the latest pre-proof COVID-19 Communications from the Journal of Vascular Surgery were forwarded for best evidence management at the front lines. This served as a vital engagement tool to learn specific management activities along various health systems in Michigan and allowed for direct interaction among vascular surgeons. This proved helpful as we were able to monitor each system’s surge and review capacity issues particularly with regard to the ICU and ventilators.

Impact on service line

The unprecedented international pandemic has rapidly, completely, and probably irreversibly changed the healthcare landscape, particularly for vascular surgery. There are now tiers of what is considered urgent and emergent, and we are now able to have a longitudinal description of the natural history of some pathologies that we have been previously never waited on repair. It is clearly understood the public health necessity to restrict the use of valuable equipment and resources; however, this did place undue stress on the vascular surgeon as all were very uncomfortable postponing care due to the uncertainty of short- and long-term patient outcomes due to these unanticipated delays. Along with other vascular surgeons around the world, this led to the inception of the Vascular Surgery COVID-19 Collaborative (VASCC), a combined international effort to help obtain prospective data on the impact of widespread vascular surgical care delays due to the COVID-19 pandemic.11

The early experience in Michigan has been exhausting, both mentally and physically. As the epicenter in the Midwest, our facilities have been hit very hard. Researchers and cardiovascular providers still cannot fully define the long-term implications of COVID-19 on patients without preexisting cardiovascular conditions. Health system finances are already feeling the effects of the costs of COVID-19 care combined with significant and unanticipated reductions in revenue across multiple service lines. The already long wait times to see a vascular specialist may get longer when hopefully the crisis starts to settle and the curve flattens. One of the unexpected results of this pandemic is how unevenly it affects geographic regions. In Michigan, the Southeast part of the state was heavily affected while some of the other remote and rural parts saw only a handful of cases. The Michigan hospitals have been consulting models in an attempt to predict when a surge will occur. What has emerged is that, geographically, some areas have peaked while others, such as Western Michigan, would experience the surge sometime later. Furthermore, the predicted curves suggest that pandemic will continue its course through the summer and not abate until the Fall or even into the new year. There is a concern for a second surge in the Fall. The effect of COVID-19 on the practice of vascular surgery in the United States was studied as well as vascular surgeons’ experience, stressors,
and coping mechanisms during the pandemic, and described elsewhere.\textsuperscript{12,13} For the foreseeable future, operational efficiency will be paramount to navigate the backlog of non-COVID-19 vascular surgery cases affected by the pandemic. Prioritization of vascular operations will be a very important part of the ramping up and it is expected that hospitals and health systems will look to the cardiovascular service line to help improve the much needed future margins.

**Suggested recommendations**

With the serious concern for a second surge, these initial efforts by multiple health systems in Michigan may offer opportunities to satisfactorily manage incoming concerns. Minimal staff should be instituted in an effort to limit exposure and the use of PPE. Guidelines for PPE use and reuse as well as disinfection and cleaning protocols should be clearly expressed. If a repeat surge occurs, hopefully enough PPE will have been produced and distributed, but if not, rotating masks using decontamination strategies per CDC protocols should be performed.

Reappropriation of staff due to limited personnel appears likely. We suggest creation of at least two separate teams functioning independently to limit exposure, with one week off and one week on, including call responsibilities, serving as each other’s back up. Education for trainees should focus on didactics and simulation until resumption of adequate case volume can be established safely and PPE restored. Requests for vascular laboratory studies should be reviewed by division personnel to ensure urgency of the evaluation. A shift towards more technology use is helpful including virtual visits with education for providers on appropriate billing. In addition, personnel wellness is critically important and regular check-ups of staff by a set up Wellness Department and virtual social hours has allowed for satisfactory coping strategies for trainees.

Currently we do not have specific recommendations regarding the delay of vascular surgical care and its impact on patients. We are actively involved in the VASCC to help determine the future impact. However, the focus has been overwhelmingly transitioned from elective, urgent, and emergent cases to vascular operations that are limb-saving or lifesaving.

**Final conclusions**

The COVID-19 pandemic has affected all parts of life, personal, professional, emotional, social, and psychological. Early communication among healthcare professionals within a state, and then within a nation, is imperative and mandatory to assist and mobilize against a common enemy. Facility competition and bottom line revenues should not upstage the need to share best practices and newly devised algorithms for clinical care. Duplication of services must be vehemently avoided and consolidation of resources and personnel with re-appropriation is paramount in such times. Only with such open, transparent, and expedient collaboration, with sufficient resources and personnel, can a solution anticipating success be presented.

**Author roles**

NJM conceived the manuscript. NJM, JL, DMC, JS, LSK, RFC, and MAM wrote, contributed and critically reviewed the manuscript.

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