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ECHOCARDIORAPHY IN COVID-19 PATIENTS

ASE STATEMENT

ASE Statement on the Reintroduction of Echocardiographic Services during the COVID-19 Pandemic



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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has changed the manner in which echocardiographic services are provided in all health care settings. As the pandemic unfolded, many nonurgent echocardiographic studies were deferred in an attempt to reduce coronavirus transmission among patients and health care workers, conserve personal protective equipment (PPE), and prepare for a potential surge of patients with COVID-19. Although COVID-19 prevalence and new case trends continue to differ substantially by region, many facilities are now planning resumption of nonurgent and elective medical services.¹ Safe and efficient reintroduction of outpatient echocardiographic services will require consideration of appropriate timing of reopening on the basis of projected COVID-19 case trends, prioritizing procedure scheduling on the basis of current or change in

disease acuity, applying examination protocols to address the clinical question while enhancing laboratory throughput, implementing appropriate PPE and sanitization protocols, and performing preprocedural COVID-19 testing in certain patient cohorts.

WHEN TO REOPEN

The timing of reintroduction of nonurgent and elective echocardiography procedures should be aligned with institutional policies and follow recommendations of regional public health authorities. Important considerations include local COVID-19 prevalence and new case trends, as well as available institutional resources, including facilities, staffing, and equipment (including adequate supply of appropriate PPE). Resumption of echocardiographic services should

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Abbreviations
ASE = American Society of Echocardiography
COVID-19 = Coronavirus disease 2019
PCR = Polymerase chain reaction
PPE = Personal protective equipment
TEE = Transesophageal echocardiography
TTE = Transthoracic echocardiography

be aligned with the gradual introduction of a phased reopening plan, which will vary by institution and region. A summary of operational considerations is provided in [Table 1](#).

SCHEDULING OF DEFERRED CASES

Scheduling prioritization should be developed on the basis of time in queue, patient symptom status, and examination indication urgency. For instance, higher

priority examinations would include patients with acute cardiovascular symptoms or when echocardiography is needed to guide further management (e.g., chemotherapy, preoperative evaluation). Routine indications for echocardiography (e.g., annual echocardiographic evaluation for chronic valve disease) may be deferred until more urgent cases have been scheduled. In cases in which the urgency is unclear, consultation with the referring physician is critical. A suggested prioritization schedule is provided in [Table 2](#).

Laboratory efficiency will be necessarily affected by the institution of social distancing protocols in patient registration areas and waiting rooms.

Potential solutions include staggered scheduling, with additional appointments in the early morning, evening, and potentially during weekends. Patients may be requested to wait in their cars in facility parking areas until contacted by phone or text just before their scheduled appointments. Protocols should be based on institution- and human resource-specific policies while respecting regional guidelines for social distancing. Laboratories may consider, at least during the initial response levels, lengthening the duration between echocardiography appointments (compared with pre-COVID-19) or having open appointment times built into the day. This will allow flexibility for unanticipated delays that invariably occur as we restart in a new environment and with new protocols. For example, new entrance procedures at hospital or clinic facilities, new sanitization protocols, and the use of PPE may result in additional time required for an echocardiography appointment. For reception and waiting areas, floor markings and signs should guide arriving patients so that they may queue at appropriate distances from one another. If possible, Plexiglas or other physical barriers can be placed between front desk staff members and patients. Intake staff members may also need to wear face shields for added protection.

The physical layout of the reception area should also be reevaluated and altered to provide sufficient spacing between seated patients. Patients should also arrive without escorts unless absolutely necessary for their appointments, and should leave the facility immediately following their examinations. Institutional and regional guidelines for universal masking will need to be followed during the initial phase of reintroduction of services.

Table 1 Operational considerations for reintroduction of echocardiographic services

Operational area	Work flow considerations
Scheduling	<ul style="list-style-type: none"> • Create priority tiers (see Table 2). • Contact patients using digital communication (e.g., EMR portal, phone, e-mail). • Screen patients for COVID-19 symptoms at multiple time points: initial call/contact, preappointment phone call, and at front desk on arrival. Include temperature screening in initial phase. • Consider COVID-19 testing of symptomatic patients before appointment.* Consider testing before all potentially aerosol-generating procedures regardless of symptoms. • Limit patient escorts/visitors to only essential/required. • Adequate spacing between examinations to allow time for sanitization protocols and minimal in-facility wait time for patients.
Environmental	<ul style="list-style-type: none"> • Disinfection of bathroom facilities after each use. • Disinfection of examination room and equipment between examinations. • Designated special examination rooms with reserved equipment for patients with COVID-19. • Airborne isolation rooms for TEE in COVID-19-positive cases. Ensure adequate air exchange time between cases for complete clearance of airborne particles. • Sanitization of reading rooms and common staff areas.
Waiting area	<ul style="list-style-type: none"> • Communication with patients about readiness for examination before arrival in reception/waiting area (e.g., text messaging, phone call). Minimize use of paper-based communication (e.g., forms, financial transactions) by using digital methods (e.g., online form completion or payment systems). • Ensure appropriate social distancing norms between patients and reception staff members (e.g., Plexiglas barriers) and between patients themselves (e.g., floor markings in front of reception, distance between waiting area chairs). • Disinfection material (e.g., sanitation wipes/hand sanitizers) available for general use. • Facemasks available for patient/escort and all staff members.
Staffing	<ul style="list-style-type: none"> • COVID-19 screening of staff members per institutional policies. • Adequate staffing for covering backlog of cases (extended hours/weekends). • Strategies to cope with stress and enhance resilience during periods of increased workload. • Monitoring of PPE supplies to ensure uninterrupted operations in all work areas (adult, stress, pediatric, intraoperative). • Appropriate social distancing and sanitization in reading rooms, break areas and staff lounges.

EMR, Electronic medical record.

*Screening and COVID-19 testing of patients should follow local institutional policies and recommendations from regional health authorities.

HIGHLIGHTS

- Echocardiography services have been interrupted by the COVID pandemic.
- Services are being gradually reintroduced as healthcare facilities reopen.
- Operational, workflow and prioritization considerations are suggested.

Considerations for Scheduling of Transesophageal Echocardiography

Scheduling prioritization for transesophageal echocardiography (TEE) is similar to that for transthoracic echocardiography (TTE). However, PPE requirements for TEE are more advanced than for TTE, as TEE is considered an aerosol-generating procedure because of the potential to induce coughing in unintubated patients and the need for the operator to be in close proximity to the patient. In addition to appropriate room-cleaning protocols, it is also important to schedule sufficient time between transesophageal studies to allow adequate airflow exchanges within the TEE procedure room. This time is typically institution and examination room specific and guided by infection control policies. This time is generally 1 hour if high-efficiency particulate

air filters or other airflow management systems are not in place. Protocols will vary among institutions depending on the phase of the reintroduction of services. Special rooms may be designated for TEE in patients with positive or suspected COVID-19.

Other Considerations

As echocardiography laboratories manage the backlog of deferred cases, the impact of schedule changes and increase in workload on stress and fatigue among laboratory staff members should also be considered. It is important to recognize that staff members have been under stress since the inception of the pandemic. Because social distancing is impractical for the performance of TTE, this adds additional stress to team members. Effective communication of and strict adherence to safety protocols can help reduce staff members' anxiety about returning to the work environment. Attention should be paid to the daily or weekly staffing schedule to ensure appropriate assignment of workload and rest between cases for all laboratory staff members. Strategies to assist staff members in coping with stress and enhancing resilience should be incorporated. The American Society of Echocardiography (ASE) Wellness Center is an example of a website with helpful resources for echocardiography providers.²

Continued inclusion of learners will be important as echocardiographic services resume. Although education remains a vital consideration in academic institutions, student learners may still need to be

Table 2 Suggested prioritization tiers for rescheduling echocardiography examinations

Priority tier	Basis for priority rating	Examples
Tier 1 (high priority)	Active or recent change in cardiovascular symptoms	Dyspnea, chest pain, syncope, TIA, new arrhythmia, child with new cardiovascular symptoms and/or cyanosis.
	Recent procedure requiring urgent follow-up	Post-device implantation arrhythmias or pericardial effusion. Post-cardiac surgery assessment, including VAD complications.
	Safety monitoring for therapy (even if asymptomatic)	Chemotherapy, clinical trial safety end point
Tier 2 (medium priority)	Echocardiography required before therapy (preoperative, urgent)	Preoperative workup for surgery that is required for significant functional limitation; LVEF assessment before CIED procedure for primary prevention. Baseline assessment before initiation of chemotherapy.
	Asymptomatic but with chronic cardiac disease that requires monitoring for progression	Cardiomyopathy, severe valve disease (AS, MR, AR), pulmonary hypertension, arrhythmias, pericardial effusion. Progression of disease after intervention (recurrent coarctation, conduit stenosis).
	Therapy that requires ongoing monitoring	Pulmonary artery systolic pressure estimation in patients receiving parenteral therapy for pulmonary hypertension. Antirejection therapy after cardiac transplantation. Treatment for Kawasaki disease. Follow-up assessment of VAD function in stable patients.
Tier 3 (low priority)	Echocardiography required before therapy (preoperative but nonurgent)	Preoperative workup for nonurgent surgery
	Routine follow-up for chronic disease	Hypertension, coronary artery disease; annual evaluation for aortic disease or prosthetic valve function (normal function on prior examination and no new symptoms)

AR, Aortic regurgitation; AS, aortic stenosis; CIED, cardiac implantable electrical device; LVEF, left ventricular ejection fraction; MR, mitral regurgitation; TIA, transient ischemic attack; VAD, ventricular assist device.

Additional issues that are not explicitly listed may also affect prioritization, including duration of test deferral and whether echocardiography is needed before further nonurgent therapy. Integration of these factors should also be considered when rescheduling patients. Consultation with referring provider is encouraged if priority of echo study is unclear.

excluded from high-risk examinations (e.g., TEE in patients with COVID-19), while trainees in advanced educational programs should be incorporated in the daily schedule while minimizing exposure risk. Opportunities for remote education using video conferencing should continue to be used during the initial phases of reintroduction of services to minimize exposure. Institutions will also need to plan for ensuring adequate PPE and continued training in PPE use.

PROTOCOL CHANGES

In general, the ASE recommends comprehensive two-dimensional echocardiography for the evaluation of patient conditions, particularly if there has been no prior echocardiographic evaluation, if there has been a long interval since the previous study, or if there are new symptoms or signs. However, focused protocols for select indications and limited examinations for follow-up studies may still be considered, particularly in patients with higher risk for COVID-19 illness. Focused or limited protocols allow necessary imaging acquisition while limiting contact between sonographer and patient and promoting general safety. This balance between the completeness of data and provider safety should be considered for every protocol. A comprehensive discussion of the limited echocardiographic examination has been published in a previous ASE guideline.³ Point-of-care protocols in the COVID-19 setting have also been discussed in a recent guideline.⁴

Sanitization Protocols

Common areas such as waiting rooms and door handles should be regularly sanitized by cleaning staff members. If possible, non-cloth-based seating material is preferred to facilitate sanitization.

PPE

As health care providers, we have a duty to care for patients, but we must also continuously consider the risk for occupational coronavirus transmission. Strategies to minimize risk to sonographers, advanced practice providers, and physicians should balance this risk with the judicious stewardship of PPE. Close cooperation and communication among echocardiography laboratory leaders, cardiovascular service line leaders, institutional supply-chain directors, and regional health authorities is essential to ensure appropriate protection of patients, sonographers, and echocardiographers. There should be a plan in place to intensify or relax PPE protocols depending on a variety of factors, including local COVID-19 prevalence and new case trends.

The levels of PPE used for echocardiographic examinations should broadly follow the recommendations of the initial ASE COVID-19 statement.⁵ Briefly, the levels or categories of PPE can be grouped as follows:

- Standard precautions: handwashing or hand sanitization, gloves, and surgical face mask
- Droplet precautions: surgical/isolation gown, double gloves, headcover (depending on location), surgical facemask or N-95-level respirator, and eye/face shield
- Airborne precautions: add special masks (e.g., N-95 or N-99 respirator masks, powered air purifying respirator systems), and shoe covers

The level of PPE used will depend on the phase of the response, local institutional policies, and COVID-19 testing status. The pro-

posed levels of response for reintroduction of services were recently published by North American cardiovascular societies.⁶ Briefly, level 2 is the initial phase of response, with the reintroduction of select services. Level 1 reintroduces most services with appropriate precautions and safeguards in place. Level 0 includes provision of all routine services with ongoing COVID-19 testing and surveillance with monitoring of PPE.⁶

Appropriate hand hygiene and equipment cleansing remain critical at all times. During the initial phase of declining COVID-19 case admissions and partial reopening of services (response level 2), standard precautions should be followed for outpatient TTE and require a surgical mask for both the patient and provider(s).⁷ This requirement for wearing surgical facemasks may be adjusted in subsequent response levels as the pandemic abates from “mandatory” to “recommended” or “optional.” Meticulous disinfection of equipment and examination areas, including laboratory office spaces with viricidal agents, should remain unchanged through different response levels and is likely to become a permanent change induced by the pandemic. Inpatient TTE should follow standard precautions for known COVID-19-negative cases and be escalated to droplet precautions for intensive care unit cases. During response levels 1 and 0, given lower COVID-19 prevalence in the community, standard precautions may be considered appropriate in intensive care unit and other inpatient cases for TTE.

TEE

The level of PPE for TEE deserves special mention. TEE is considered an aerosol-generating procedure, and airborne precautions are recommended for symptomatic patients with positive or suspected COVID-19 when TEE cannot wait until test results are known. Droplet precautions should be followed for all other transesophageal studies performed during response level 2, including TEE performed in the surgical operating room and hybrid operating rooms for structural heart interventions. The requirement for a face shield is optional in known negative cases and should be judiciously considered in the context of local institutional resources and policies. Standard precautions may be considered appropriate for TEE performed during lower response levels when routine services have resumed across the institution. Conservation of PPE is an important consideration in all approaches to maintain preparedness for a surge in cases, while minimizing risk to providers with reasonable certainty.

Exercise Echocardiography

Exercise stress echocardiography can be considered a potentially aerosol-generating procedure, because of the frequent and heavy respiration generated during exercise; this is in contrast to dobutamine stress echocardiography, which is not considered aerosol generating. Because of this potential for enhanced aerosol generation, all patients and providers should consider wearing surgical facemasks at a minimum. In certain instances, N-95 masks may be warranted (coughing patient) at the discretion of exercise echocardiography operators. Pharmacologic testing is preferred, and alternative imaging modalities may be advisable for symptomatic patients.

COVID-19 SCREENING AND TESTING

Facilities should establish COVID-19 symptom screening for all patients. This should be done at multiple time points, including when

the appointment is scheduled, during registration, and upon arrival. Ongoing COVID-19 screening (e.g., symptom questionnaire, temperature testing) of all patients is recommended before any echocardiographic examination, regardless of level of response. Appropriate triage should be established for patients with symptoms consistent with COVID-19. Subsequent COVID-19 testing may be reserved for symptomatic patients or those who have failed the initial screening. Testing affords the opportunity to defer examinations in patients who are COVID-19 positive, particularly when echocardiographic results are unlikely to alter immediate management.

The sensitivity of different types of tests remains variable. At the time of writing, more than 65 different kinds of COVID-19 molecular or serologic tests were available in the United States that received emergency use authorizations from the US Food and Drug Administration.⁸ Because this is a new virus, past experience and recommendations for standardized testing do not exist, leading to variability in the sensitivity and specificity of each test type.⁹ The principal concern is false-negative test results in asymptomatic individuals presenting for echocardiography who could pose a transmission risk that could be amplified in a health care setting. It is likely that as the pandemic abates, testing protocols will vary among institutions to minimize the risk to both patients and providers. Rapid point-of-care tests that are based on lateral flow technique to detect specific antibodies may be used for emergent inpatient echocardiography, while antigen-based tests with longer turnaround times are recommended for surveillance testing for electively scheduled cases. Testing and retesting for severe acute respiratory syndrome coronavirus-2, and procedures for patients to self-quarantine, if required, should follow institutional protocols guided by local and regional health authorities.

Echocardiography in COVID-19-Positive Patients

Echocardiography should be deferred in COVID-19-positive patients, or those under investigation for COVID-19, when possible. Recommendations on echocardiography timing in the COVID-19 recuperative phase should be guided by infection control experts at the local institution and focused on minimizing staff exposure and ensuring the appropriate use of PPE. However, after COVID-19 recovery, patients will require serial temporally negative COVID-19 test results and resolution of respiratory symptoms (cough and shortness of breath) for a prespecified time interval. There may be instances in which echocardiograms are required in acutely ill patients with COVID-19. The indications will be similar to the prioritization schedule noted above. Development of special pathways for echocardiography in patients with COVID-19 should be considered for infection control. Examples include dedicated clinic and testing areas for these patients, with portable examinations preferred, including the use of focused protocols.¹⁰ If dedicated areas are not feasible, patients with COVID-19 expected to arrive to the testing facility should be identified and escorted directly into the echocardiographic examination room, bypassing the waiting area. A facemask should be mandatory throughout the stay in the facility. Dedicated examination rooms and machines, including portable systems for point-of-care exams for COVID-19-positive patients, are recommended. Additionally, procedure rooms and bathroom facilities require sanitization immediately after each use, which will require coordination with institutional hygiene and environmental services. Consultation with local infection control experts will be helpful to confirm the adequacy of proposed work flows for patients with COVID-19.

SPECIAL CONSIDERATIONS FOR PEDIATRIC ECHOCARDIOGRAPHY LABORATORIES

Guidelines for pediatric echocardiography, including fetal and transthoracic imaging during the COVID-19 pandemic, have recently been published.¹¹ As the medical community considers reintroduction of services, there are several unique considerations for pediatric echocardiography laboratories.

Work Flow Considerations

Children undergoing echocardiography are often uncooperative, particularly when younger than 3 years or when developmentally delayed. In addition, children typically have caretakers in the room when the examination is being completed. Furthermore, a complete pediatric echocardiographic examination requires approximately 45 to 60 min because of additional pediatric views, complexity of disease, and long sweeps.¹² These aspects of pediatric echocardiography pose a higher risk for exposure to sonographers and physicians in the typical inpatient and outpatient setting. Potential strategies to address these issues include the following:

- Communication among the sonographer, echocardiography attending physician, and referring physician is vital, particularly if the echocardiography request or question to be answered is unclear or to agree upon when to discontinue the study if the patient is persistently uncooperative.
- Focused echocardiography protocols should be used when possible (i.e., follow-up studies, answer of a focused question) to limit exposure time.
- Higher level PPE should be in routine use for all pediatric echocardiographic studies, including gloves, surgical facemask, and eye protection with a shield or goggles. The use of specific PPE would need to be aligned with institutional policies. N-95 respirators may be considered in high-risk cases.
- Only one caretaker, wearing a facemask at all times, should be permitted to accompany the patient in the echocardiographic examination room. Attempts should also be made to have the patient wear a facemask when possible.
- Patients and families should spend as little time in a waiting area as possible, so consideration should be made to stagger appointment times and to room patients immediately in the echocardiographic examination room to limit exposure for the family and health care providers.

Sedation

Many laboratories have sedation protocols that are used typically for children aged 3 weeks to 3 years. These may include oral or intranasal medications or even inhaled anesthetics.¹³ Sedated echocardiographic examinations are typically performed before a surgical or catheter-directed intervention to ensure that all pertinent information regarding structural abnormalities and ventricular performance is obtained. Conscious sedation may be considered an aerosol-generating procedure at many institutions. Therefore, for the reintroduction of sedated echocardiographic services, polymerase chain reaction (PCR) testing for severe acute respiratory syndrome coronavirus-2 within 24 hours of the procedure should be strongly considered. Many institutions now have turnaround time for PCR testing of 1 to 3 hours. Thus, testing could be performed on the day of the sedated echocardiographic study. If PCR results are positive, consideration should be made to defer the sedated echocardiographic examination. For conscious sedation in PCR-negative patients, standard or droplet precautions may be used as appropriate for the sonographer, sedation provider, and other health care providers in the room. A mask could

be placed on the patient as long as he or she is monitored by a frontline provider with expertise in monitoring patients undergoing conscious sedation. Centers using inhaled anesthetics and intubation for sedated echocardiography should consider conscious sedation protocols to avoid more significant aerosolized procedures.

Finally, it has been noted that the majority of children who acquire COVID-19 are asymptomatic or experience only mild symptoms. However, a new and troubling pediatric presentation of COVID-19 has appeared, particularly in Europe and the United States. This “pediatric multisystem inflammatory syndrome” includes fever, elevated inflammatory markers, abdominal pain (sometimes mimicking appendicitis), vomiting, diarrhea, and, in extreme cases, multiple-organ failure. PCR results for severe acute respiratory syndrome coronavirus-2 can be positive or negative, but immunoglobulin G antibodies are often positive. The presentation can look similar to Kawasaki disease or toxic shock syndrome, with some reports of myocarditis, ventricular dysfunction, arrhythmias, and coronary artery aneurysms.^{14,15} Elevated B-type natriuretic peptide, troponin, white blood cell count, C-reactive protein, and ferritins have been reported. Pediatric echocardiographers need to be aware of this illness and its echocardiographic findings. Serial echocardiographic examinations, even daily for those in the critical care setting, may be required given the rapid evolution and changes in function. Importantly, children who present with these symptoms should be treated as if they are COVID-19 positive, even if test results are negative. Thus, higher level PPE with N-95 masks or airborne precautions should be used to image these patients when echocardiography is needed. Moreover, focused echocardiography should be performed when possible to limit exposure time, and the echocardiographic machine should be decontaminated after the study is completed.

CONCLUSION

As the COVID-19 pandemic recedes from its initial surge, cardiovascular diagnostic services must be safely reintroduced. There will be a continued need to ensure that coronavirus transmission risk is minimized. PPE considerations include the balance between current local coronavirus transmission risk and the adequacy of current PPE stores, as well as supply chain capabilities. Monitoring of patients and providers for COVID-19 resurgence will be key in determining the response level of the institution and protocols for diagnostic echocardiography.

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