

# Reconversion of an Echocardiography Department during SARS-CoV-2 pandemic in Mexico

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In this health emergency, guidelines have been adopted for the care of patients and health workers. With the current information available, it is suggested that the route of person-to-person transmission of SARS-CoV-2 can be by drop, contact or air during aerosol-generating procedures. Echocardiographers are in close contact with patients and therefore have a higher risk of becoming infected. To decrease this risk, only those examinations essential to the patient should be performed. The type of protection required is based on risk assessment according to type of patient, type of study, severity of the disease and therapeutic implications. In aerosol-generating procedures, the use of N95 masks as well as eye protection is recommended especially in transesophageal echocardiogram whether is an outpatient, hospitalized or in the perioperative setting, and more recently in exercise stress echocardiogram. Lately, some cardiac imaging associations have changed their recommendations advising the use of the N95 facemasks in all echocardiography studies, in patients with suspicion of infection, regardless of the presence of symptoms. Relevant aspects related to the cleaning of echocardiography equipment, the alertness to avoid cross contamination and the use of ultrasound gel are also included. It must be emphasized that these recommendations could be modified according to the evolution of the pandemic and the evidence generated in the coming months.

**Key words:** Echocardiography, Transesophageal; Perioperative; SARS-CoV-2; Reconversion.

En esta emergencia de salud, se han adoptado pautas para la atención de pacientes y trabajadores de la salud. Con la información actual disponible, se sugiere que la ruta de transmisión de persona a persona del SARS-CoV-2 puede ser por la emisión de gotas, contacto o por el aire durante los procedimientos que generan aerosol. Los ecocardiografistas están en contacto cercano con los pacientes y, por lo tanto, tienen un mayor riesgo de infectarse. Para disminuir este riesgo, solamente se deben realizar los estudios verdaderamente esenciales para el paciente. El tipo de protección requerida se basa en la evaluación del riesgo según el tipo de paciente, el tipo de estudio, la gravedad de la enfermedad y las implicaciones terapéuticas. En los procedimientos de generación de aerosoles, se recomienda el uso de máscaras N95, así como la protección ocular, especialmente en el ecocardiograma transesofágico, ya sea ambulatorio, hospitalizado o en el período perioperatorio, y más recientemente en el ecocardiograma de esfuerzo. Últimamente, algunas asociaciones de imágenes cardíacas han cambiado sus recomendaciones que recomiendan el uso de las máscaras faciales N95 en todos los estudios de ecocardiografía, en pacientes con sospecha de infección, independientemente de la presencia de síntomas. También se incluyen aspectos relevantes relacionados con la limpieza del equipo de ecocardiografía, el estado de alerta para evitar la contaminación cruzada y el uso de gel de ultrasonido. Se debe enfatizar que estas recomendaciones podrían modificarse de acuerdo con la evolución de la pandemia y la evidencia generada en los próximos meses.

**Palabras clave:** Ecocardiografía, transesofágica; Perioperatorio; SARS-CoV-2; Reconversión.

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Due to the large amount of new information during this pandemic, the recommendations described here could be modified according to evidence of a higher degree

in the near future. In this health emergency, guidelines have been adopted for the care of patients and health workers. With the current information available, it is suggested that the route of person-to-person transmission of SARS-CoV-2 can be by drop, contact or air during aerosol-generating procedures.

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These transmission mechanisms are shared with influenza and other respiratory pathogens. Therefore, protective measures should be used during the management of all patients with upper respiratory tract infections, pneumonia or severe acute respiratory infections. Anyone in close contact (within 1 meter) with someone showing respiratory symptoms (e.g. sneezing, coughing, etc.) is at risk of exposure to potentially infectious respiratory drops [1].

Echocardiographers are in close contact with patients and therefore have a higher risk of becoming infected. In order to decrease this risk from patient to patient, patient to echocardiographer, and from there to another patient, the indication of any imaging study should be carefully considered, and only those examinations essential to the patient should be performed.

Recently, limited evidence has showed generation of bio-aerosols with drops of less than 5 microns, during speaking or breathing, that remain in a closed space for up to 3 hours, and can be resuspended in the place they were released later. This theory can explain the high contagion rate and has an implication regarding the protective measures of healthcare workers as well as for the general population, specifically related to the use of facemask, that helps to limit the exposure of aerosols generated by patient [2].

The cardiology and cardiac surgery departments are being significantly affected by this rapidly changing situation. The COVID-19 pandemic also increases the burden of cardiac imaging services in general. Given the wide availability and the advantage of being a bedside study, echocardiography is the most affected imaging modality. Common challenges imaging modalities face during the pandemic include limited availability of experts, due to disease or reassignment in priority areas, such as intensive care units, and the risk of periprocedural transmission of SARS-CoV-2 among patients and medical staff [3].

The different recommendations of International Societies included in this document are mainly expert consensus due to the lack of evidence-based data and the rapidly changing global situation [3-6].

#### **Risk classification based on the patient and type of study**

Patients considered with low risk are those without symptoms, no risk behavior, negative test, or low risk areas for COVID-19. Intermediate risk applies for asymptomatic patients or with atypical symptoms, in an area with moderate or high risk of COVID-19. And finally, high risk patients are defined by typical symptoms and confirmed cases.

Echocardiographic studies considered as moderate risk are transthoracic echocardiogram (TTE) and pharmacological stress echocardiogram (PSE), because of the exposure with droplets. TTE and exercise stress echocardiogram (ESE) are considered by now as high risk, because of the potential exposure with aerosols [5,6].

**Table 1. Facemask use in patients**

RISK OF INFECTION	SURGICAL MASK
<i>Low risk</i>	<b>Preferred</b>
<i>Moderate risk</i>	<b>Required</b>
<i>High risk</i>	<b>Required</b>

*Adapted from [3].*

#### **General Aspects of Personal Protection**

##### *Hand Hygiene*

###### *Health workers*

The use of hand hygiene technique described by World Health Organization (WHO), with soap and water or 70% alcohol solution is recommended during intervals of 20 to 30 minutes; also, before and after touching the facemask, before touching the patient, before performing a study on a patient, after exposure to body fluids, after touching a patient and after contact with the patient's environment.

###### *Patient*

It is recommended to use the same WHO technique by the patient upon arrival at the department, before performing the echocardiogram and before leaving the department after the study is completed.

##### *Use of facemasks*

###### *Health workers*

The use of surgical facemask is recommended to all healthcare workers in contact with patients with no suspicion of COVID-19, for the protection of exposure with drops. The use of facemasks with filter of class n95 or equivalent (kn95, FFP2) is recommended to all healthcare workers when performing aerosol-generating procedures, in this case TEE and ESE.

###### *Patient*

It is recommended to use 2 or 3-layer cloth covers, preferably cotton or surgical covers, avoiding the use of class N95 or higher filter masks to prevent the supply shortage for health care workers (Table 1).

##### *Social distancing*

A 1.5 meters separation between each person is recommended, this applies to any situation within the hospital, and for both patients and healthcare workers.

##### *Symptoms and temperature control*

###### *Patients*

It is recommended to use a symptom questionnaire and temperature registration of all patients prior to any echocardiographic examination [6].

###### *Echocardiography staff*

It is recommended to use a binnacle for each person who works in the echocardiography department in order to have a daily registry of symptoms and temperature as part of the monitoring for health care personnel [7].



Figure 1. Use of plastic film between patient and operator.



Figure 2. Protection equipment for patients with negative symptoms questionnaire.

## PERFORMANCE OF STUDIES.

### *Transthoracic echocardiogram*

*Studies for outpatient with negative symptom questionnaire and normal temperature*

Only studies considered priority, urgent or emergent must be performed [4]. Routine follow-up studies should be rescheduled, this includes patients with stable congenital heart defects [3]. Echocardiography studies should be reserved for patients with cardiovascular symptoms in functional class NYHA III-IVV [3]. Patients with acute heart failure, valvular heart disease presenting with syncope, chest pain or dyspnea should be prioritized, since their prognosis without treatment is probably worse than patients with COVID-19 [3,8]. Also consider carrying out studies on patients in whom this will change the therapeutic approach (endocarditis, myocardial revascularization) [4,8].

#### *Echocardiographer protection equipment*

Start with hand wash before the study. It is recommended to use a plastic film or transparent rigid plastic between the patient's bed and the physician/technician, which helps to avoid drop transmission (Fig. 1). Use surgical facemask, gloves, disposable gown or cloth gown and glasses or face shield (Fig. 2). Hand washing after finishing the study.

#### *Transthoracic echocardiogram*

Carry out a quickly complete study focused on the cardiovascular pathology of the patient. Ventilation of the echocardiography room after the patient leaves must be performed.

#### *Studies for outpatient with respiratory symptoms*

If patient answers positively to two or more respiratory symptoms and/or presented with temperature  $>37.5^{\circ}$ , then the urgency/emergency of conducting the study should be evaluated, considering also if cardiovascular symptoms (NYHA

III-IV) are present. Patient should be evaluated in emergency room with proper PPE to avoid transmission of aerosols and decide hospital admission and therefore the need of the echocardiogram. If the patient does not present cardiovascular symptoms, with a stable condition, he/she must be sent to the corresponding evaluation for detection of COVID-19 and call to reschedule the study [3,4,6].

#### *Studies in hospitalized patients with negative symptoms questionnaire*

First specify the indication for TTE, verify by phone call the symptom questionnaire as well as temperature and once the patient arrives, verify that he/she wears facemask and does hand wash when entering the echocardiography room [3,4,6].

#### *Studies in hospitalized patients with respiratory symptoms or confirmed cases*

When requesting the study, it should be informed that the patient is a suspected or confirmed case as well as the reason for the echocardiogram. It is important not to duplicate studies that show similar information [4]. An echocardiogram is justified in patients with cardiogenic shock, clinical data of heart failure, suspected endocarditis, pericardial effusion. In patients with dyspnea, before performing an echocardiogram, it is important to discard changes in the chest x-ray and in recent thorax CT [3]. All echocardiographic studies should be carried out in the emergency departments, isolated hospital rooms, intensive care units, operating room recovery rooms and hemodynamic or electrophysiology laboratories, always carrying the echocardiography equipment to these rooms. Considerations must be done to minimize the number of personnel in contact with infected or highly suspicious patients. Use the echocardiographic modality with the best ability to solve questions, carrying out a focused study limited to what is required and always considering the safety of the medical staff, ensuring the shortest duration of exposure [3,4,6,9].



**Figure 3. Personal Protection Equipment for prevention due to aerosol generating procedures.**

#### *Ecocardiographer protection equipment.*

Always perform hand wash before the study. Use N95 filter mask equivalent or higher grade, double gloves, disposable gown, boots, hat or complete waterproof suit, goggles and helmet. At the end of study wash hands (Fig. 3).

#### **Placement of PPE**

- ☑ Put on the first pair of gloves
- ☑ Put on the disposable coverall or gown
- ☑ Check mask with filter n95 or higher, put it on, adjust and seal the nasal bridge
- ☑ Put on safety glasses or goggles.
- ☑ Put on the disposable cap.
- ☑ Put on the helmet.
- ☑ Raise the overall hat (in case of gown does not apply)
- ☑ Put on disposable boots.
- ☑ Put on a second pair of gloves, make sure it covers the cuff of the gown or overall.
- ☑ Place tape over the glove cuff to join the gown [10].

#### **Removal of PPE (step by step)**

- ☑ Take off the gown with the second pair of gloves, place it in a container dedicated to its use.
- ☑ Remove the boots, deposit them in a container.
- ☑ Alcohol gel hand wash.

- ☑ Mask removal and place in a container with 70% alcohol solution.
- ☑ Alcohol gel hand wash.
- ☑ Remove the disposable cap, deposit in container.
- ☑ Alcohol gel hand wash.
- ☑ Remove the lenses or goggles and deposit them in a container with 70% alcohol solution.
- ☑ Alcohol gel hand wash.
- ☑ Remove the n95 mask, store it in a new paper bag labeled with the user's name, for subsequent disinfection.
- ☑ Alcohol gel hand wash.
- ☑ Remove excess alcohol from face shield and glasses, then wash them with soap and water.
- ☑ Removal of last pair of gloves.
- ☑ Washing hands with soap and water for 40-60 seconds [10].

#### **N95 mask cover sealing test**

##### *Positive sealing control*

Exhale hard. Positive pressure inside the respirator must be with no leak. If there is a leak, adjust the position and tension of the tapes. Recheck the seal and repeat the steps until the respirator seal is adequate [11].

##### *Negative sealing control*

Inhale deeply. If there is no leak, negative pressure will make the respirator stick to your face. A leak will cause loss of negative pressure in the respirator due to air entering through unsealed points [11].

#### **Recommendations for the echocardiographic equipment**

Only portable equipment should be used for patients with or suspicion of COVID-19. Use of individual 10-20ml gel doses in syringes is recommended. Electrocardiographic monitoring and measurements can be omitted and mentioned in the report. It is recommended to use plastic to cover the equipment before the study, and sanitize it with chlorinated solution at the end of the study [4].

#### **Protocol of image acquisition and interpretation**

This is a modified Point-of-Care Ultrasound (POCUS) protocol for COVID-19 of the American Society of Echocardiography (ASE) [8]. The indications for performing an echocardiogram in patients with COVID-19 are: detection or characterization of pre-existing cardiovascular disease, early identification of impaired cardiac function, monitoring and examination. It is recommended to assess changes in cardiac function through routine rapid examinations, rather than cardiac or pulmonary auscultation. Elucidate cardiovascular abnormalities potentially associated with COVID-19, evaluate pericardial effusion or myocarditis that progress to shock, hypercoagulable state related to deep vein thrombosis and pulmonary thromboembolism with data of pulmonary hypertension and impairment of right ventricular function. Evaluate left ventricular function: establish Ejection Fraction (EF), segmental mobility and diastolic diameter of the cavity while also determine a pattern of affection (regional, global, Takotsubo, myocarditis, epicardial coronary thrombosis or microvascular thrombosis. The evaluation of right ventricle must include regional and global function, fractional area change, tricuspid annular plane systolic excursion, diastolic diameter of the cavity and presence of tricuspid regurgitation to determine the transvalvular reverse gradient. In heart valve

evaluation, look for signs of valve disease only in cases of critical importance for management. At pericardium, evaluate thickening or effusion [3,8].

#### **Focused lung ultrasound**

In mild cases, search for irregular and thickened pleural line and presence of B lines. In severe cases, look for lung consolidation and confluence of B-lines. It may help to exclude pneumothorax and large pleural effusion [8].

#### **Focused vascular ultrasound**

Evaluate hydration state with inferior vena cava and jugular venous pulse. Search, in a focus and fast manner, for deep vein thrombosis with unilateral study of the pelvic limb with suspicion [8].

#### **Transesophageal Echocardiogram (TEE)**

Studies for outpatients with negative symptom questionnaire Consider other diagnostic modalities such as TTE, cardiac computer tomography or angiography that can answer the question that led to the indication of the TEE. If the study cannot be replaced and will modify the course of treatment, it must be carried out with the specific protection measures listed below [3]. A focused study on the cardiovascular pathology must be carried out and the time of exposure of the echocardiographer involved must be limited.

#### **Studies for confirmed outpatients or with respiratory symptoms**

The risk of contamination for the equipment and healthcare personnel is very high during this procedure due to drops and aerosols. It must be reserved for patients where expected findings are of crucial importance to confirm or exclude a diagnosis or to guide treatment [3].

#### **Perioperative TEE in confirmed or suspected patients**

The perioperative transesophageal study in patients with mechanical ventilation, should be performed evaluating the benefit and the risk of Covid-19 transmission. Although conducting a TEE in an already intubated patient may reduce the risk of viral aerosolization, viral transmission may still occur through direct contact with the patient's secretions, resulting in contaminated hands and surfaces. It is crucial to maintain airway protection with a closed ventilation circuit to reduce the risk of aerosols in these patients. It is imperative to avoid accidental extubation or disconnection of the circuit. Surgical procedures in which the benefit of performing a TEE exam may outweigh the risk of contamination or cross-contamination include but are not limited to the following: Infective endocarditis with valvular and perivalvular involvement, Stanford type A aortic dissection in the presence of associated complications, initiation of temporary or durable mechanical circulatory support, myocardial infarction with mechanical complications (e.g., ventricular septal defect, left ventricular wall rupture, papillary muscle rupture) and prosthetic valve assessment [12].

#### **Echocardiographer protection equipment**

Perform hand wash before the study. Use n95 filter mask,



**Figure 4. Figure 4. Aerosol box for TEE in intensive care areas, with non-intubated patients.**

equivalent filter or higher. Double pair of gloves, disposable gown, boots, hat or complete waterproof suit, goggles and face shield. Hand washing after conducting the study.

It is recommended to choose only one echocardiography equipment for use exclusively with suspected patients. Use the plastic curtain separation between the patient and the echocardiography equipment, if possible. In intensive care areas with non-intubated patients, it is recommended to use an acrylic box designed to place the probe and hands inside it, allowing limited exposure to aerosols at the time of the study (Fig. 4).

It is advisable to individualize gel packs of 10-20 ml in a pre-filled syringe to avoid contamination of the entire vial. Electrocardiographic monitoring can be omitted, measurements can be taken offline and mentioned in the report. Proper handling and cleaning of the equipment with chlorine dilution at the end of the study, is crucial in prevention of virus transmission to other health care providers and other patients [4,12].

#### **Pharmacological and exercise stress echocardiography**

ESE poses an increased risk of infection. The indications are very limited in patients with COVID-19 infection. In patients with acute infection it should be avoided, in asymptomatic or non-suspicious patients, the stress echocardiogram should be postponed or may be replaced by a PSE. Pharmacological studies will be preferred instead of ESE, because it represents a higher risk of droplet exposure with hyperventilation or cough during the study. In Valvular heart disease that require

ESE to decide treatment, it is recommended to use protective measures with complete PPE similar to TEE protection [5,7]. Recent recommendations of SISAC advice the use of n95 facemask in asymptomatic patients without a PCR test for SARS-CoV-2, and avoid the use of ESE. In case of a negative PCR test performed in the last 48 hours, the operator can use a surgical facemask and perform and exercise study [13]. Also, the Spanish Society of Cardiac Imaging (SEIC) recently change their recommendation for the use of n95 facemask in all echocardiography studies when there is suspicion of COVID-19 infection, regardless of the patient respiratory symptoms [5]. This is probably due to the possible airborne nature of the infection and the unknown positive cases of asymptomatic patients, but the routine use of n95 facemask for all health care workers could not be feasible in all centers, so it is recommended to evaluate its application according to their possibilities as well as patient risk, study risk and epidemiologic time of the pandemic.

### Equipment cleaning

The available evidence has shown that viruses are effectively inactivated with appropriate disinfection procedures including the use of common disinfectant solutions for hospital use. The use of the latter must have an adequate contact time. It is advice that ordinary cleaning of the echocardiograph must be performed with 70% alcohol solutions, commonly used

in a hospital setting. It is recommended to sanitize the transducer after carrying out a transthoracic study, and the entire equipment at the beginning and at the end of the working day. In the case of transthoracic probes, it is recommended to use solutions based on sodium hypochlorite (10% chlorinated solution for domestic use with 0.4-0.6% active sodium hypochlorite); this solution lasts for 30 days, subsequently the chlorine concentration decreases by 50%, and it must also be kept in dark containers to avoid degradation by sunlight [14]. Other disinfectant solutions like Quaternary Ammonia Based (total concentration should be less 0.8%) can be also used [14]. Surface of the equipment can also be cleaned with 0.5% hydrogen peroxide. However, since not all cleaning solutions are compatible with the available transducers, it is recommended to consult the maintenance and cleaning manuals for each equipment. Cleaning of the transesophageal probe should be done in a common manner using protective equipment. Finally, we consider that equipment and probes should be protected by disposable material; for example, sheaths for transthoracic or transesophageal probes.

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