

Living with COVID-19 pandemic – Emerging challenges for ultrasound physicians and their suggested solution

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Abstract

Background: The recent coronavirus disease (COVID-19) pandemic is a serious health concern with far-reaching implications in every facet of human life. New challenges have emerged for ultrasound physicians engaged in diagnostic ultrasound examinations.

Methods: Based on a comprehensive literature review the author has suggested a few precautionary measures that should be incorporated by the ultrasound physicians in their practice against the spread of coronavirus disease.

Suggestions: Multi-level safeguard checks before, during, and after the ultrasound examination are suggested to protect ultrasound physicians, staff, and patients from COVID-19. The importance of triage for patient screening is stressed. Also, limiting patients by deferring non-urgent cases and cancelling aerosol-generating procedures is recommended. The need of counselling of patients and staff is stressed regarding the importance of facemasks, hand hygiene, and safe distancing. Incorporating different types of barriers against the virus such as facemasks, face-shields, personnel protective suits for ultrasound physicians and staff, and shielding the equipment and transducer with disposable or wipeable plastic sheets is suggested. Besides, the significance of cleaning and disinfection of the examination room and equipment by suitable disinfectants after each patient and at the end of the day is highlighted.

Conclusion: Learning to live with the COVID-19 pandemic is the need of the day both for the general public and medical community. Being members of the medical community ultrasound physicians should gear up to the emerging challenges of COVID-19 to protect themselves, their patients, and allied healthcare staff from coronavirus infection.

Keywords: COVID-19, SARS-CoV-2, ultrasound, sonography, disinfection.

Introduction

In December 2019 several cases of atypical pneumonia were reported from the hospitals of Wuhan City in China's Hubei province. The hospital physicians found these cases challenging and difficult to treat and when investigated a new strain of coronavirus was found to be the causative agent for these unusual cases. They named it 2019-novel-coronavirus (2019-nCov). Later many more cases were reported in more than 190 countries across the world. The World Health Organization (WHO) officially recognized this as Public Health Emergency of International Concern (PHEIC)¹ on 30 January 2020 and later announced this a pandemic on 11 March 2020 in Virtual press conference on COVID-19. An official name was given to this disease as coronavirus disease 2019 (COVID-19) and the virus was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by Coronavirus Study Group.²

The coronaviruses (CoVs) belong to a large family of viruses which may cause infections both in humans and animals such as snakes, civet cats, camels, bats, and pangolins. An intermediary animal is thought to be responsible for the spread of these viruses to humans, for example, a bat³, turtle⁴ or a Malayan pangolins⁵ in COVID-19 caused by SARS-Cov-2 in late December 2019, a civet cat⁶ in case of Severe Acute Respiratory Syndrome (SARS) caused by SARS-Cov in 2003 and a dromedary camel⁷ in Middle East Respiratory Syndrome (MERS) caused by MERS-Cov in 2012. The coronaviruses are RNA viruses with a crown-like, spheroid shape under an electron microscope hence the name coronavirus (*coronam* is the Latin word for crown). The crown-like appearance is due to the presence of peplomers or spikes of glycoproteins arising radially out from the outer lipoprotein envelope of the virus. The approximate size of coronavirus is 120-160 nm.⁸ It is sensitive to heat and ultraviolet rays and can be effectively neutralized by lipid solvents⁹ including ether, alcohol (ethanol or isopropanol), chlorine-containing disinfectant (liquid bleach or sodium hypochlorite solutions), etc.

The spread of COVID-19 is through the droplet, contact, or airborne routes. The droplets are produced when a person infected with COVID-19 coughs, sneezes, or speaks. Once droplets containing virus particles have landed on surfaces, their viability depends on the type of surface and temperature. Survival of the coronavirus particles on dry non-living

surfaces such as metal, glass, plastic, ultrasound machine, and probes is between 48 and 96 hours.^{10,11} The most common symptoms are fever, malaise, body aches dry cough. In more severe cases patient develops pneumonia and difficulty in breathing requiring ventilator support. However, in most cases, the disease remains mild and patient recovers without any special treatment. Signs and symptoms usually appear after an incubation period of 2-14 days after the exposure.

Ultrasound is an integral part of the healthcare system. It is considered to be a safe and essential diagnostic tool for patient care in a wide variety of medical conditions. However, ultrasound machines and probes can become potential vectors¹² in the transmission of infections including COVID-19 transmission to the ultrasound physician or their patients. A literature survey has shown that a considerable gap exists in knowledge of basic infection prevention and control measures in the field of diagnostic medical ultrasound.¹³ This article has tried to bridge this gap by bringing forward a few suggestions about infection prevention and control. However, this is only a humble effort and ultrasound practice guidelines are required to be developed at the national level in the pretext of COVID-19.

In Pakistan, the effect of COVID-19 on the medical community comprising of doctors, nurses, and paramedical staff is challenging. We are witnessing a steep rise of COVID-19 cases¹⁴ virtually choking our available healthcare resource. The medical community in general and frontline healthcare workers, in particular, have an impending risk of occupational exposure of COVID-19 to themselves with the secondary risk of exposure to their families. In this era of COVID-19 crises, the medical community including ultrasound physicians has to determine how to reinvent their practices and adopt appropriate safeguard measures to provide safe ultrasound care to the community.

Safeguard Checks

Safeguard checks for ultrasound clinics in the pretext of COVID-19

Various preventive measures/safeguard checks are required to be implemented at multiple levels in the ultrasound clinic or hospital setting to prevent the spread of COVID-19.

These can be divided into:

1. Pre-examination safeguard measures

a. Appointments

All appointments for ultrasound examinations must be on the telephone or using IT platforms such as e-mail or WhatsApp; all offline walk-in appointments to be discouraged.

All non-urgent appointments should be postponed¹⁵ including the appointments for aerosol-generating ultrasound procedures such as transesophageal ultrasound.¹⁶ Besides, all high-risk ultrasound procedures such as ultrasound-guided biopsies should be deferred.

While giving an appointment the patient is advised to come wearing a facemask and preferably without the attendant or in extreme cases only one attendant who will stay outside the clinic area.

The patient's hospital record, referral documents, and other relevant tests should be shared digitally with the ultrasound physician via e-mail or WhatsApp on the day of the appointment.

b. Triage

Triage should be set-up straightaway next to the entry door of the clinic just before reception and registration desk.¹⁷ A suggested algorithm to be followed for patient triage is shown in Figure 1.

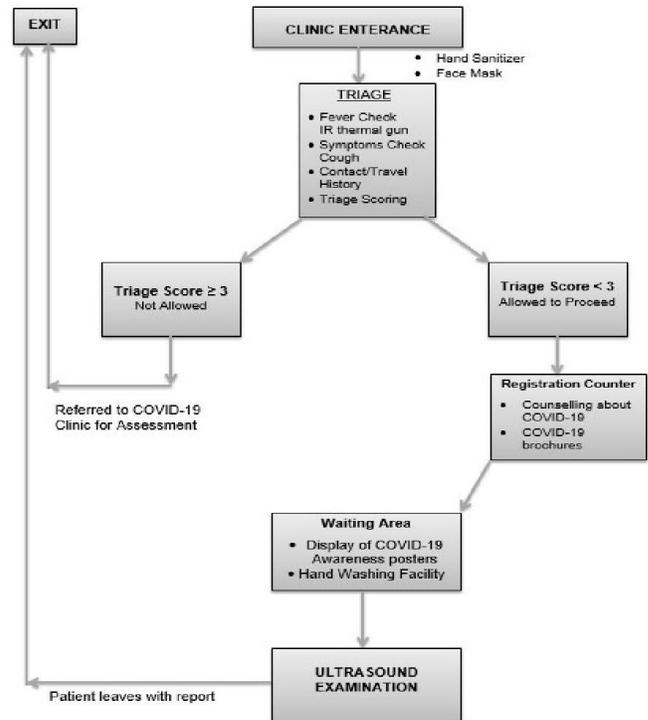


Figure 1: Triage scoring algorithm for patient screening

At triage, it is ensured that the patient is wearing a facemask. Every patient will undergo hand sanitization, forehead temperature check by non-contact IR thermal gun followed by a triage scoring on triage scorecard based on travel or contact history or symptoms (Table 1). The patients with triage score ≥ 3 will not be allowed to move forward into the clinic for ultrasound examination and will be asked to contact general hospital OPD for further evaluation and assessment regarding possible COVID-19 infection. All patients with triage score < 3 will move forward for registration and ultrasound examination (Figure 1.) The staff doing triage should know the importance of good contact history as there could be asymptomatic carriers of the virus.

Only patients will be allowed to pass through the triage while the entry of accompanying relatives or attendants will be restricted. For weak, debilitated, and old-age patients one attendant may be allowed but he or she will also undergo triage scoring and clearance.

Table 1: Triage Score Card

COVID-19 Risk	Score	
A. Exposure Risk (14 days before or after the onset of symptoms)	Person undergoing triage (Adult / Child)	
<ul style="list-style-type: none"> ▪ History of travel to an area of local transmission ▪ History of contact with confirmed COVID-19 case ▪ Working or attended healthcare facility where confirmed COVID-19 patients were admitted 	3	
B. Clinical Signs and Symptoms	Adult	Child
<ul style="list-style-type: none"> ▪ Fever ▪ Dry cough ▪ Myalgia/fatigue ▪ Any of the following symptoms <ul style="list-style-type: none"> ○ Sore throat ○ Shortness of breath ○ Runny Nose 	2 2 2 1	2 2 2 1
Total Score		

c. Registration

The registration counter must have a vertical glass shield interposed between the registration staff and the patient and applying the “principle of safe distance” (minimum of 1 m). Based on available literature physical distance of 1m or more is associated with a much lower risk of infection¹⁸; and added benefits are more with even larger physical distances such as 2 m or more.

After registration, the patient’s hospital record will be digitally shared with the registration staff, sharing of hospital record in the form of paper documents will be discouraged, however, in extreme cases the registration clerk will note down the salient features of the hospital record for later sharing with the ultrasound physician.

d. Waiting area

The seating arrangement should be spaced keeping in mind the “principle of safe distancing”. The seats should be of a material that can be easily wiped and all floor carpets should be removed.

The SARS-Cov2 is sensitive to many chemicals including sodium hypochlorite – an active ingredient of household bleach.¹⁹ The floor and seats in the waiting should be disinfected at the start of the day before the arrival of the patients by bleach solution, chlorine solution, or commercial surface cleaners containing 0.1% sodium hypochlorite solution.

2. Safeguard Measures during the ultrasound examination

a. Modifications in the examination room

A flexible transparent plastic sheet should be interposed hanging vertically down between the patient couch on one side and ultrasound physician and ultrasound machine on the other side. A carpenter will be required to carry out this task (Figure 2). A rounded hole will be made in the plastic sheet for the ultrasound probe and arm of the ultrasound physician for conducting an ultrasound examination through the sheet.

The examination room floor and patient's couch should be disinfected by disinfectant solutions (0.1% sodium hypochlorite solution) at the start of the day and patient examination couch disinfected after each patient.



Figure 2: Transparent sheet hanging vertically down between patient’s couch and ultrasound physician

b. Barrier Shielding of Ultrasound Machine keyboard and console

The ultrasound machine key-board and console should be covered by a thin transparent sheet at the start of the day which is later on removed and replaced with a new sheet on the next working day.

c. Barrier Shielding of Ultrasound Probes

The ultrasound transducer or probe should be covered with latex sheath (condom) or cling wrap which is changed after each ultrasound examination. Alternately it should be disinfected with a soft wipe of low to intermediate level disinfectant such as 0.1% sodium hypochlorite solution after each patient.

d. Use of Personal Protective Equipment (PPE)

The ultrasound physician will observe complete droplet, contact, and airborne precautions such as the use of disposable surgical gloves and gown, surgical cap, and a facemask (Figure 3). Ordinary disposable surgical gown and surgical facemask are sufficient in routine cases but for suspected or known COVID-19 patients N-95, FFP2, FFP3 type of respirator (Table 2) and Personnel Protective Suits such as reusable commercially available Tyvek suits or Hazmat suits made of vinyl or non-porous material or single-use personnel protective suits is recommended. Also, the use of eye protection (goggles and face-shield) is recommended for ultrasound physicians. The assisting staff or nurse in the examination room should also wear the same personnel protective equipment. The surgical gloves should be discarded after each patient and replaced with a new pair for the next patient.



Figure 3: Ultrasound Physician wearing personnel protective suit, head and eye shield while performing an ultrasound examination

Table 2: Classes of disposable particulate respirators

Class of respirator	Characteristics
FFP1	80% filtration percentage Used as a dust mask in home renovation
FFP2	94% filtration percentage Used against influenza virus and coronavirus
FFP3	99% filtration percentage Used against coronavirus and fine asbestos particles

e. Use single-use gel packets

For external abdominal ultrasound examination of confirmed or suspected COVID-19 patients, use single-use non-sterile gel packets or use gel bottles which should be disinfected with low-level disinfectant after each patient. However, these bottles should not be refilled or heated and the lid of the gel bottle must remain closed.

f. Avoid high-risk ultrasound procedures

All aerosol-generating ultrasound procedures such as trans-esophageal ultrasound should be cancelled. Also, ultrasound-guided biopsies should be deferred.

3. Post-examination safeguard measures

a. Cleaning and disinfection:

After the last ultrasound examination of the day is complete; disinfection and decontamination procedures are immediately instituted. It should be kept in mind that disinfectants are meant for disinfection only and are not meant for cleaning. Therefore before applying disinfectant on any surface it is advisable to clean the surface first with some detergent solution to remove any organic material, dirt or soil, etc.

Cleaning and disinfection of equipment

The ultrasound machine console, computer keyboard, and ultrasound probes, gel bottle should also be disinfected by wiping with gauze soaked in disinfectant. All external transabdominal probes or transducers must undergo cleaning followed by low-level disinfection to denature any presence of SARS-CoV-2.

Cleaning:

For cleaning use purified (deionized) water or detergent solution and cleaning should be done with clean soft cloth or gauze or non-abrasive single-use sponge.²⁰ Do not use a brush as it will damage the transducer. For thick organic matter immerse the transducer in cleaning solution (purified water or detergent solution) for 30 minutes following by drying with a soft cloth; the heat should not be used for drying.

Disinfection:

For disinfection, the chemicals recommended by the United States Environmental Protection Agency (EPA) effective against SARS-Cov2 can be used. For surface disinfection in an ultrasound setting, these are Sodium hypochlorite (0.1 - 0.5%), Ethyl alcohol (76.9 to 81.4%), or Isopropyl alcohol (70%).²¹ Disinfection of the transducers should be done by wiping and not by immersion in the chemical solution. After cleaning and disinfection is complete confirm that transducer shows no sign of peeling, damage, or deformation. The thin plastic sheet covering the ultrasound machine console may also be disinfected; however, it should be removed and replaced the next working day before the start of the ultrasound examination. The staff should wear gloves and perform hand hygiene before and after cleaning and disinfecting equipment.

Cleaning and disinfection of room surfaces

The examination couch, room floors (examination room, waiting area room, and registration area room) and washrooms should be cleaned and disinfected by spraying bleach or sodium hypochlorite solution. A checklist for daily cleaning and disinfection should be made and displayed in the rooms mentioning areas to be cleaned such as tabletops, switches, door handles, mobile phones, intercoms, keyboards, and computer accessories, etc. The procedure should be done in the morning before the start of the work and after the last patient of the day. For disinfecting, surfaces use a 0.1% sodium hypochlorite solution.

Cleaning and disinfection of Personal Protective Equipment

The personal protective equipment which is reusable such as goggles and face-shields should also be cleaned and disinfected.

According to World Health Organization recommendations, the utility gloves or heavy-duty, reusable plastic aprons or PPEs should be first cleaned with soap or detergent and water followed by disinfection after 30 min submersion in 0.5% sodium hypochlorite solution.

b. Waste disposal

All the contaminated waste material utilized during ultrasound examination such as single-use surgical gowns, facemasks, surgical gloves made of latex or nitrile, disposable personal protective suits are worn by ultrasound physician and staff, tissue papers, latex sheaths and cling wraps used to cover ultrasound probes and plastic sheets used to cover ultrasound machine console or computer keyboard should be disposed in off in a waste bin with a lid or cover and sent for incineration immediately.

c. Dealing with body fluids

Accidental spillage of body fluids of the patient such as blood, vomitus, urine, and other excreta may occur in the waiting area, ultrasound examination room, or else in the clinic. As per WHO recommendations use 0.5% sodium hypochlorite solution for disinfection of blood or bodily fluids spills in ultrasound clinics.

d. Self-disinfection

At the end of the day when ultrasound examinations are over the ultrasound physician and nursing or paramedical assistant should perform hand hygiene and if possible take shower before leaving for home.

e. Digital means to deliver ultrasound examination report

After the ultrasound examination is over, the report should be quickly typed on a computer and handed over to the patient in printed format; however to shorten the residence time of the patient in the waiting area the patient may be instructed to go home immediately after the examination and report digitally delivered by using electronic media such as e-mail.

Any prolonged face-to-face discussion between the patient and the ultrasound physician or staff should be discouraged and phone or electronic media should preferably be used.

A summary of safeguard checks is given in Table 3.

Table 3: Summary of safeguard checks in ultrasound clinics

Safeguard checks before ultrasound examination	Limit appointments Do triage, facemask and hand sanitization Glass barrier at the registration desk Patient counselling at the registration desk Safe distancing in the waiting area A hand-washing facility in the waiting area Awareness posters in the waiting area
Safeguard checks during an ultrasound examination	Avoid high-risk ultrasound procedures Barrier sheet between doctor and patient Barrier shielding of an ultrasound machine Barrier shielding of an ultrasound transducer Use of Personal Protective Equipment (PPE) Use of single-use ultrasound gel packet
Safeguard checks after an ultrasound examination	Cleaning and disinfection Waste disposal Dealing with body fluids Self-disinfection Digital ultrasound report

Types of Disinfectants

In healthcare settings such as ultrasound clinics low and intermediate level disinfectants can be used. It should be kept in mind that disinfectants are meant for disinfection only and are not meant for cleaning. Therefore before applying disinfectant on inanimate surfaces or objects it is advisable to clean the surface first with some detergent solution to remove any organic material, dirt or soil, etc. As per recommendations of the USA Environmental Protection Agency (EPA) following types of disinfectants can be safely used in ultrasound clinics:

1. Low-level disinfectants (LLD)

- Quaternary ammonium compounds e.g., alkyl dimethyl benzyl ammonium chloride, alkyl dimethyl ethyl benzyl ammonium chloride.
2. Intermediate level disinfectants (ILD)
- Alcohols e.g., isopropyl alcohol, ethyl alcohol, and methylated spirits.
 - Chlorine releasing agents e.g., bleach/sodium or calcium hypochlorite, sodium dichloroisocyanurate (NaDCC).
 - Improved hydrogen peroxide e.g., 0.5% enhanced action formulation hydrogen peroxide, 3% hydrogen peroxide.

The advantages and disadvantages of different types of disinfectants are shown in Table 4, below. For all practical purposes bleach (sodium hypochlorite solution) ethanol or isopropyl alcohol are sufficient in an ultrasound clinic setting; quaternary ammonium compounds are respiratory irritants and have limited virulence against viruses. Alcohols are highly flammable therefore caution should be observed if alcohols are used as disinfectants. Bleach or sodium hypochlorite solution has an offensive odor and should be prepared afresh each time because of its limited stability. Hydrogen peroxide is a very good disinfectant but is not feasible due to its high cost.

Table 4: Types of disinfectants used in Ultrasound Clinics; their advantages and disadvantages

<i>Types of disinfectants</i>	<i>Advantages</i>	<i>Disadvantages</i>
Quaternary ammonium compounds	Low cost	Respiratory irritant Limited virulence against non-enveloped viruses
Alcohols (60-80%)	Low cost	Flammable Rapid evaporates, therefore, time compliance over a large surface is low
Bleach / hypochlorite solutions	Low cost Non-flammable	Offensive odor Poor stability needs to be prepared fresh every day
Hydrogen peroxide	Detergent properties with	High cost

added cleaning ability Non-flammable

Additional Recommendations

1. COVID-19 Awareness Campaign

a. Training of Staff:

The doctors should take the lead to give awareness and training to nurses and other paramedical through lectures, internet resources, and electronic media highlighting the importance of triage for COVID-19, detection of patients with suspected or early symptoms of COVID-19.

b. Donning and Doffing Technique:

The hospital or clinic staff should be trained in the proper use of personal protective equipment including putting on (donning) and putting off (doffing) the personal protective suits. The training of the ultrasound assistant and staff should be in their local language so that they comprehend and completely understand the technique.²²

c. Awareness Posters in Waiting Area

Various colored posters should be posted in the waiting area to keep the patients and staff informed about COVID-19, early symptoms, and protective measures such as safe-distancing, hand hygiene, and coughing and sneezing etiquettes, etc.

d. COVID-19 Awareness Brochures

Awareness brochures of COVID-19 must be placed at the reception counter and offered to the patients for reading.

2. Developing liaison with COVID-19 Isolation Facility

A close liaison should be established with the nearest COVID-19 isolation/quarantine facility so that any suspected COVID-19 case can be immediately referred.

3. Availability of Handwashing Facility in the Waiting Area

A hand-washing facility must be provided in the waiting area with liquid soap dispenser and step-wise instructions of handwriting displayed by the side.

4. Contingent Measures

Every morning before the start of the day all the staff members must enter the clinic area after passing through the triage. If any of the staff members is found suspicion of having COVID-19, has developed

symptoms or gives a history of recent contact with COVID-19 positive individual, should be isolated immediately and referred to COVID-19 isolation center and all his/her contacts sent for home quarantine. An alternate contingent, the back-up plan must be in place to continue uninterrupted ultrasound services.

Conclusion

COVID-19 pandemic has brought significant challenges to the medical community including physicians who are engaged in providing diagnostic ultrasound services to the community. As no vaccine or cure is currently available to fight with this virus; physicians need to learn 'how to live' with the virus. Appropriate preventive measures at multiple levels are required to be adopted by the ultrasound physicians to provide safe and uninterrupted ultrasound service to their patients.

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