



## **WFUMB Position Paper:**

**How to perform a safe ultrasound examination and clean equipment in the context of COVID-19**

1 **WFUMB Position Statement: How to perform a safe ultrasound examination and clean equipment in**  
2 **the context of COVID-19**

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13 **Table of contents**

14 **Introduction**

15 **Scope and background**

16 **Purpose**

17 **Properties and spread of SARS-CoV-2 (COVID-19)**

18 **Scheduling of patients**

19 **Standard and transmission- based precautions for COVID-19**

20 **Triage of patients**

21 **Protecting the Patient and Ultrasound Providers**

22 **Preparing and Cleaning the Ultrasound Room**

23 **Ultrasound equipment disinfection**

24 **Transducer cleaning**

25 **Specific recommendations regarding ultrasound gel**

26 **Recommendations for safe scanning**

27 **References**

28

29 **Scope and background**

30 On 11 March 2020, the World Health Organization (WHO) formally declared the SARS-CoV-2 also known  
31 as COVID-19 outbreak, a pandemic. This has impacted the way that healthcare facilities operate globally  
32 to ensure patient and practitioner safety and to minimize all risks associated with infection transmission.

33 Ultrasound is a safe and essential tool for the diagnosis of a variety of medical conditions and for patient  
34 care. Bedside lung ultrasound has been invaluable in the critically ill (Lichtenstein 2014, Soldati, et al.  
35 2020) and, specifically, for diagnosis of pneumonia in COVID-19 patients (Gorbalenya, et al. 2020).

36 Ultrasound is increasingly used within the point of care setting, as chest CT is not often available in the  
37 emergency departments (Poggiali, et al. 2020). Ultrasound may also be used for longitudinal monitoring  
38 of affected patients (Peng, et al. 2020). However, the ultrasound unit can be a potential vector in the  
39 transmission of an infection (Skowronek, et al. 2016, Westerway and Basseal 2017) and previous surveys  
40 have indicated a gap in knowledge of basic infection prevention measures in ultrasound (Westerway, et

41 al. 2019). Due to the highly contagious nature of COVID-19 and given the proximity necessary to perform  
42 an ultrasound examination, it is essential to take all safety precautions when undertaking routine clinical  
43 activity.

44 There have been several national and international guidelines for general precautions in infection  
45 prevention in ultrasound. Several have been published (Kanagala, et al. 2011, Hoyer, et al. 2016,  
46 Abramowicz, et al. 2017, Basseal, et al. 2017, Nyhsen, et al. 2017, Liu, et al. 2018, Muller, et al. 2018) but  
47 some societies have developed and published cleaning guidelines on their websites, but not in peer  
48 reviewed journals (for example, American College of Emergency Physicians(Acep 2018) [ASEP], American  
49 College of Radiology [ACR], International Society of Ultrasound in Obstetrics & Gynecology [ISUOG]  
50 [https://www.isuog.org/resource/isuog-safety-committee-position-statement-safe-performance-of-](https://www.isuog.org/resource/isuog-safety-committee-position-statement-safe-performance-of-obstetric-and-gynecological-scans-and-equipment-cleaning-in-the-context-of-covid-19.html)  
51 [obstetric-and-gynecological-scans-and-equipment-cleaning-in-the-context-of-covid-19.html](https://www.isuog.org/resource/isuog-safety-committee-position-statement-safe-performance-of-obstetric-and-gynecological-scans-and-equipment-cleaning-in-the-context-of-covid-19.html) , and the  
52 American Institute of Ultrasound in Medicine [AIUM],  
53 [https://www.aium.org/accreditation/Guidelines\\_Cleaning\\_Preparing.pdf](https://www.aium.org/accreditation/Guidelines_Cleaning_Preparing.pdf) ). More recently, specific  
54 guidance documents for COVID-19 have also been published on various websites (for instance ISUOG,  
55 see above and AIUM [https://aium.s3.amazonaws.com/covid19/Covid19\\_Quick\\_Guide\\_PUPP.pdf](https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_PUPP.pdf) and  
56 [https://aium.s3.amazonaws.com/covid19/Covid19\\_Quick\\_Guide\\_UTEG.pdf](https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_UTEG.pdf) ). There are also national  
57 and international guidelines for the performance of routine or targeted ultrasound investigation (Acep  
58 2009, Asum 2014-2020, Dietrich, et al. 2017, Aium 2018, Aakjær Andersen, et al. 2019, Scor/Bmus  
59 2019). The decision as to what constitutes an elective or an emergency examination is to be made  
60 locally and is not the goal of this document, rather it is intended to serve as guidance on infection  
61 control when performing ultrasound examinations in the context of the current COVID-19 pandemic.  
62 This statement has been written on behalf of the WFUMB Safety Committee as official guidance with  
63 collaboration of experts from various affiliated Federations. Whilst this statement ensures that a

64 consistent approach to infection prevention and safe ultrasound practices are implemented during the  
65 COVID-19 pandemic, there may be some operational and organizational differences at the local level.

## 66 **Purpose**

67 This statement provides guidance on equipment cleaning and safe performance of ultrasound  
68 examination within the context of COVID-19. It is relevant to all practitioners (sonographers, physicians  
69 and allied health professionals) utilizing ultrasound for diagnostic imaging during the COVID-19  
70 pandemic (such as obstetrics, gynecology, point of care ultrasound, accident and emergency medicine,  
71 pediatrics, critical care and cardiology). It has been written to protect both patients and healthcare  
72 workers, particularly when scanning suspected or confirmed COVID-19 patients.

73 As the evidence base for COVID-19 is rapidly evolving, this document is current at time of publication  
74 and further updates may be provided as new evidence emerges.

## 75 **Properties and spread of SARS-CoV-2 (COVID19)**

76 Severe acute respiratory syndrome coronavirus 2, SARS-CoV-2 (Gorbalenya, et al. 2020), a small lipid  
77 based enveloped virus belonging to the coronavirus family is least resistant to inactivation by common  
78 disinfectants used in low level disinfection (see guidelines on Center for Disease Control, CDC (Cdc 2015)  
79 and Environmental Protection Agency, EPA websites). The structure of these viruses includes a lipid  
80 envelope, which is easily disrupted by most disinfectants such as 62–71% ethanol, 0.5% hydrogen  
81 peroxide or 0.1% sodium hypochlorite within 1 minute. Other biocidal agents such as 0.05–0.2%  
82 benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective. The virus is involved in  
83 human to human transmission of the COVID-19 pandemic (Chan, et al. 2020, Yuen, et al. 2020) and  
84 there are increasing reports of asymptomatic carriers of the disease (Bai, et al. 2020, Holshue, et al.  
85 2020). As such, ultrasound practitioners need to implement appropriate infection prevention measures  
86 not only with confirmed but also suspected COVID-19 patients.

87 The transmission of COVID-19 is thought to occur mainly through respiratory droplets which are  
88 generated by coughing and sneezing and via contact with contaminated surfaces. Once infected  
89 droplets have landed on surfaces, their viability depends on the type of surface and temperature  
90 (Kampf, et al. 2020). Survival on dry inanimate surfaces such as metal, glass, plastic (and ultrasound  
91 systems) is, as far as is known, between 48 and 96 hours (Nyhsen, et al. 2017, Kampf, et al. 2020).  
92 However, SARS coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human  
93 coronaviruses (HCoV) have been shown to persist on fomites for up to 9 days (Kampf, et al. 2020) and  
94 this is an important consideration for ultrasound equipment used in all clinical settings.

95 Furthermore, viral RNA has been found in stool samples from infected patients (Holshue, et al. 2020)  
96 and this is a vital aspect to consider for any ultrasound practitioners involved in transrectal ultrasound  
97 or scanning infants within the pediatric setting.

#### 98 **Scheduling of patients (general recommendations)**

99 Non-essential examinations should be deferred or cancelled to minimize exposure of an at-risk group of  
100 patients to potential COVID-19 contact in the hospital environment. Acute situations may require  
101 immediate point-of-care or other ultrasound examinations, for example, acute abdomen or motor  
102 vehicle accident, or for obstetrics and gynecology, pregnancy of unknown location/bleeding in early  
103 pregnancy. All patients and visitors should be screened using standardized checklists for symptoms of  
104 acute respiratory infection, significant travel history, occupation, contacts, etc., consistent with  
105 recommendations of local authorities. Ideally, triage should have been undertaken before the patient  
106 arrives to the ultrasound unit.

107

#### 108 **Standard and transmission-based precautions for COVID-19**

109 Aspects that should be considered when planning to perform an ultrasound in a clinical care setting in  
110 the context of COVID-19 are:

- 111 • Triage of patients to routine (delay is possible) or emergent examination.
- 112 • How to protect the patient and ultrasound providers (physicians, sonographers, allied  
113 professions).
- 114 • How to prepare and clean the ultrasound room and equipment.

115 NOTE: It is evident that some of these recommendations may not be applicable to all practices.  
116 Furthermore, it is understandable that some may not be achievable in some locations.

#### 117 **Triage of patients**

118 Generally, this must be determined by local facilities/authorities (see above). Some scientific societies  
119 may already have such recommendations, published or in press at the time of this document  
120 preparation(Boelig, et al. 2020).

#### 121 **Protecting the patient and ultrasound practitioner**

122 Preventing transmission of infection requires all healthcare practitioners to implement both standard  
123 and transmission-based precautions, regardless of suspected or confirmed COVID-19. Standard  
124 precautions for COVID-19 as outlined by the Centers for Disease Control and Prevention in 2020 include:

- 125 1) Ultrasound practitioners with specific health problems that place them at greater risk (as  
126 detailed by local occupational health guidelines) are to be excluded from performing  
127 ultrasound.
- 128 2) Ensure the ultrasound practitioners has undergone infection control training and fit testing  
129 for respirators, if required (for example N95 and FFP3)

- 130 3) In order to reduce the risk of transmission, it is important to (i) respect the time of  
131 scheduled visits, (ii) widen the appointment intervals in order to prevent crowding in the  
132 waiting room and (iii) space the seats to at least 6 feet (2 meters) apart.
- 133 4) Limit the number of visitors in the examination room to a maximum of 1, preferably with no  
134 children. During the pandemic, it is reasonable not to allow trainees or students to  
135 participate. Encourage use of alternative mechanisms for patient and visitor interactions  
136 such as video-call applications on cell phones or tablets.
- 137 5) If the status of a patient is confirmed as COVID-19 infected, it would be preferable to scan at  
138 the end of the clinic list so that the equipment and room will undergo vigorous cleaning and  
139 disinfection (see below).
- 140 6) Hand hygiene: All ultrasound practitioners should perform hand hygiene before and after all  
141 patient contact, contact with potentially infectious material (e.g. linen from patient room),  
142 and before and after removing personal protective equipment (PPE) including gloves. Hand  
143 hygiene should be performed using an alcohol-based hand rub (60-95% alcohol) or washing  
144 hands with soap and water for at least 20 seconds. If hands are visibly soiled, use soap and  
145 water before the alcohol-based hand rub. Latex-free disposable gloves should be used  
146 during the ultrasound examination and changed after each patient.
- 147 7) Scanning should, as much as possible, be performed with one (clean) hand and transducer  
148 and having the other hand semi-clean but in contact with the keyboard. Applying gel would  
149 be with the semi-clean hand dispensing clean gel (see below) with post procedure thorough  
150 cleaning of the gel bottle using a low-level disinfectant (LLD). See details on gel use below.
- 151 8) If required to scan patient in an isolation room, ultrasound practitioners, as all attending  
152 medical staff, should don personal protective equipment (PPE, respirator, goggle, face



153 protective shield, surgical gown and gloves) prior to entry of isolation room, where the level  
154 of PPE is set by institutional guidelines.

155 9) Personal protective equipment (PPE): Any reusable PPE (e.g. gowns) must be properly  
156 cleaned and decontaminated. Specific PPE recommendations when caring for *a patient with*  
157 *suspected or confirmed COVID-19 infection* include:

158 a) Respirator or facemask: As ultrasound practitioners are in close contact with patients, surgical  
159 facemasks are essential to offer protection. These must be put on before entry into the patient room or  
160 care area. N95 respirators or respirators that offer a higher level of protection should be used instead of  
161 a facemask when performing or present for an aerosol-generating procedure, particularly for use in the  
162 intensive care unit. It is important to perform hand hygiene after removal of the respirator or facemask.

163 b) Eye protection (for ultrasound practitioners in the critical care setting): This includes goggles or  
164 a disposable face shield that must be put on when entering the patient room or care area. Reusable eye  
165 protection (e.g., goggles) must be cleaned and disinfected according to manufacturer's reprocessing  
166 instructions prior to re-use. Disposable eye protection should be discarded after use. An individual risk  
167 assessment should be carried out prior to/at the time of providing care to the patient.

168 c) Gloves: Wearing clean, non-sterile gloves upon entry into the patient room or care area is  
169 essential for all ultrasound practitioners. Once the ultrasound examination is complete, remove and  
170 discard gloves when leaving the patient room or care area and immediately perform hand hygiene.

171 d) Gowns: Wearing a clean isolation gown upon entry into the patient room or care area is  
172 essential. Reusable gowns should be discarded in a dedicated container for linen and laundered.  
173 Disposable gowns should be discarded after use. If there are shortages of gowns, they need to be  
174 prioritized for aerosol-generating procedures and high contact patient care activities that provide  
175 opportunities for transfer of pathogens to the hands and clothing.

176 e) Donning and Doffing Training: Workers who need to use protecting clothing and equipment must be  
177 trained on how to put it on, use/wear it, and take it off correctly, including in the context of their current  
178 and potential duties. Training material should be easy to understand and available in the appropriate  
179 language and literacy level for all workers. Information may be found on the European Centre for  
180 Disease Prevention and Control (ECDC) and the Occupational Safety and Health Administration (OSHA)  
181 websites ( <https://www.ecdc.europa.eu/en/publications-data/disinfection-environments-covid-19> and  
182 <https://www.osha.gov/SLTC/covid-19/controlprevention.html#health> ).

### 183 **Preparing and Cleaning the Ultrasound Room**

184 **Note: protective eyewear and gloves should be used when cleaning and disinfecting any equipment**  
185 **and hand hygiene is essential after removing protective wear.**

- 186 • The ultrasound room should be cleaned thoroughly each morning and all content should be  
187 wiped with a compatible low-level disinfectant, LLD, recommended by the CDC and EPA, such as  
188 quaternary ammonium compounds (see below). Items for disinfection include monitors, computer  
189 keyboard and mouse, stretcher rails, gel container, door handles, cabinet knobs, light switches, chairs  
190 and counter tops. Extra attention should be given to high touch surfaces which should be cleaned  
191 vigilantly.
- 192 • Unnecessary accessories in the room should be removed and, where possible, individually  
193 stored in the cabinets.
- 194 • Fabric covered chairs should be replaced with hard surface chairs that can be wiped.
- 195 • The patient bed or couch should be wiped by an LLD prior to replacing the disposable paper  
196 cover.

197 • The disposable paper cover should be removed with gloved hands and folded and disposed of  
198 immediately at the end of each exam.

199 • At the end of the day, soiled linen should be handled double-gloved and disposed of in the  
200 appropriate container. The room and equipment should undergo terminal cleaning using an LLD. Hands  
201 are to be washed for 20 seconds afterwards.

## 202 **Preparing and Cleaning of Ultrasound Equipment**

203 **Note: protective eyewear and gloves should be used when cleaning, disinfecting or sterilizing any**  
204 **equipment and hand hygiene is essential after removing protective wear.**

205 • If feasible, it is recommended to have one (or more) dedicated machine(s) for patients with  
206 suspected or confirmed COVID-19 patients.

207 • Equipment should be cleaned using LLD with agents recommended by the CDC and EPA (see  
208 websites). This includes the ultrasound equipment monitor and user interface (e.g. keyboard, knobs,  
209 track ball, touch screen, etc.). In emergency medicine, primary care and critical care, handheld  
210 ultrasound instruments are often used for COVID-19 infected (and other) patients due to ease of  
211 transport and seemingly easier methods to keep clean, secondary to simpler user interface. If possible,  
212 keep the whole device and phone in a sterile transducer cover sleeve, available commercially. An  
213 example of how to place the transducer and ultrasound instrument in a sheath can be found on the  
214 Butterfly website. The hardware should be cleaned with LLD and transducers should be cleaned and  
215 disinfected as detailed below.

216 • If available, equipment covers, such as for the ultrasound scanner console, will enhance the  
217 workflow, as LLD of mechanical keyboards and console controls is time-consuming. It is important to

218 note that if the cover is contaminated, it must be cleaned, and the presence of a cover does not  
219 preclude the need for cleaning the equipment at regular intervals.

220 • Reduce the number of transducers connected to the ultrasound machine to a minimum. All  
221 other transducers should be individually stored safely in a clean closed cabinet and brought out as  
222 needed.

223 • Ultrasound transducers and cables should be cleaned (see “Transducer cleaning”) and this  
224 should also be performed after each scan.

### 225 **Transducer cleaning and disinfection**

226 Reusable medical devices are classified into 3 categories based on the Spaulding Classification system  
227 depending on the procedure and risk. They include non-critical, semi-critical and critical (also referred to  
228 as low-risk, medium-risk and high-risk).

229 a) Non-critical devices are ultrasound transducers that come into contact with intact skin.  
230 Examples include transducers used for transabdominal, MSK, vascular, lung ultrasound etc. As the risk of  
231 infection transmission is low, ultrasound transducers can be cleaned and disinfected using a low- or  
232 intermediate level disinfection, which will denature most bacteria, some fungi and some viruses, such as  
233 COVID-19, influenza A and human immunodeficiency virus (HIV).

234 b) Semi-critical devices are ultrasound transducers that come into contact with non-intact skin,  
235 blood, body fluids and mucous membranes. Examples include vaginal, esophageal, rectal ultrasound  
236 transducers and those used in interventional procedures that are at risk of contact with body fluids. As  
237 the risk is higher for infection transmission, ultrasound transducers must be cleaned and disinfected  
238 using a high-level disinfection method. A single-use transducer cover is mandatory.

239 c) Critical devices are ultrasound transducers that are used for invasive procedures (e.g. needle  
240 guidance during biopsies, aspirations, drainages) and where there is a risk of blood or body fluid  
241 exposure. These transducers must undergo sterilization, if compatible, or, if not, HLD, as per medical  
242 facility guidelines. Use of sterile transducer covers is mandatory.

243 Reprocessing ultrasound transducers requires 2 steps, cleaning, followed immediately by disinfection.  
244 Any product used for cleaning or disinfection must be compatible with the ultrasound equipment as  
245 determined by the ultrasound equipment manufacturer. Certain products may damage ultrasound  
246 equipment or transducers and invalidate warranties. It is also essential to follow the instructions for use  
247 to ensure the entire process has been successful e.g. maintaining 'wet' contact time for chemical  
248 disinfection, accurate time for a soak solution etc.

249 Furthermore, is important to wear gloves for cleaning and disinfection of ultrasound transducers and  
250 hand hygiene upon removal of gloves.

251 In the context of COVID-19, the normal practices of high-level disinfection are not changed i.e.  
252 endocavitary transducers still require cleaning followed by HLD. The only change in the context of  
253 COVID-19 is that all external probes must undergo cleaning followed by low level disinfection to  
254 denature any presence of SARS-CoV-2 e.g. transducers used for transabdominal scanning, lung  
255 ultrasound or in the pediatric or emergency department setting. It is important to note that the low  
256 level disinfectant for COVID-19 is approved for use on ultrasound transducers and has proven viricidal  
257 efficacy.

## 258 **1. Cleaning**

259 This is an important first step since any remaining gel can act as a barrier to the disinfectant thus  
260 diminishing its efficacy. The US Center for Disease Control and Prevention (CDC) defines cleaning as:  
261 "the removal of foreign material (e.g., soil, and organic material) from objects and is normally

262 accomplished using water with detergents or enzymatic products.” Ineffective cleaning prior to  
263 disinfection can limit the effectiveness of the chemical disinfection.

264 Current recommendations for cleaning transducers are as follows (steps to be performed with  
265 disposable gloves)

266

- a. Disconnect the transducer
- b. Remove the transducer cover (where applied) and dispose of in clinical waste
- c. Rinse the end of the transducer with tap water to remove any residual gel or debris
- d. Clean the transducer with a damp gauze pad or other soft cloth and a small amount of mild nonabrasive liquid soap (approved for use on medical instruments) to thoroughly cleanse the transducer. Consider the use of a small brush especially for the crevices and areas of angulation depending on the design of your particular transducer.
- e. Rinse with tap water
- f. Clean all other parts of the transducer (including handle, connector and electrical cord) that cannot be immersed with a low-level disinfectant wipe
- g. Dry with cloth/towel (residual water can dilute chemical disinfectant, if this is the preferred method)

267

## 268 **2. Disinfection**

269 Always be sure to refer to your facility’s infection control policies and protocols, as well as the  
270 transducer manufacturer’s Instruction for Use and Labels for Use. As disinfection technology is rapidly  
271 evolving, it is essential to check with the manufacturer what level the technology offers (low,  
272 intermediate or high). This document recommendations are the most current. As mentioned above,  
273 high-level disinfection is recommended for endocavitary but not abdominal transducers on intact skin.  
274 Specific product instructions must be consulted. Disinfection methods include manual and automated  
275 systems which can be either chemical or light based.

276 a. Chemical “wet” disinfection:

277

- 2.4-3.2% glutaraldehyde products (such as "Cidex," "Metricide," or "Procide").
- Non-glutaraldehyde agents (such as Cidex OPA (o-phthalaldehyde), Cidex PA (hydrogen peroxide & peroxyacetic acid).
- Approved multistep disinfectant wipes containing chlorine dioxide, used extensively in the UK and Australia (Tristel Duo®)
- 7.5% Hydrogen Peroxide solution works by producing destructive hydroxyl free radicals.

278

279 A very large number of disinfectants are available throughout the world. Various ultrasound

280 manufacturers have clear instructions. See examples in the following table.

281

Canon/Toshiba	<a href="https://global.medical.canon/products/ultrasound/more_information/guideforcleaning">https://global.medical.canon/products/ultrasound/more_information/guideforcleaning</a>
GE	<a href="https://www.gehealthcare.com/products/ultrasound/ultrasound-transducers">https://www.gehealthcare.com/products/ultrasound/ultrasound-transducers</a>
Mindray	<a href="https://www.mindraynorthamerica.com/wp-content/uploads/2019/03/Mindray_M-transducers_disinfection-guide_40369A.pdf">https://www.mindraynorthamerica.com/wp-content/uploads/2019/03/Mindray_M-transducers_disinfection-guide_40369A.pdf</a>
Philips	<a href="https://www.usa.philips.com/c-dam/b2bhc/master/whitepapers/ultrasound-care-and-cleaning/disinfectant-tables-manuals/dt-us.pdf">https://www.usa.philips.com/c-dam/b2bhc/master/whitepapers/ultrasound-care-and-cleaning/disinfectant-tables-manuals/dt-us.pdf</a>
Samsung	<a href="https://samsunghealthcare.com/en/products/uss/RS80A_with_Prestige/Radiology/transducers">https://samsunghealthcare.com/en/products/uss/RS80A_with_Prestige/Radiology/transducers</a>

Siemens	<a href="https://www.siemens-healthineers.com/en-us/ultrasound/ultrasound-transducer-catalog#Care">https://www.siemens-healthineers.com/en-us/ultrasound/ultrasound-transducer-catalog#Care</a>
Zonare/Mindray	<a href="https://www.mindraynorthamerica.com/wp-content/uploads/2019/03/Mindray_Zonare-transducers_disinfection-guide_40368A.pdf">https://www.mindraynorthamerica.com/wp-content/uploads/2019/03/Mindray_Zonare-transducers_disinfection-guide_40368A.pdf</a>

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284

285 b. Automated high-level disinfection:

286

- Antigermix (Germitec, France): the transducer is placed in a closed cabinet and exposed to high-intensity ultraviolet type C radiation. Vaginal, rectal, esophageal transducers
- Astra VR (CIVCO medical, USA): automated disinfection with Cidex OPA and Metricide solutions. Vaginal, rectal, esophageal transducers
- Trophon (Nanosonics, Australia): sonicated hydrogen peroxide mist. Vaginal, rectal, esophageal transducers
- ADVANTAGE PLUS™ Pass-Thru Automated Endoscope Reprocessor (Cantel, USA): automated disinfection with hydrogen peroxide or ortho-phthalaldehyde . Endoscope
- TD100 (CS Medical, USA): automated disinfection with 0.59% Ortho-phthalaldehyde (OPA) or 2.65% glutaraldehyde. Trans-esophageal transducer

287

288 After cleaning, store transducer in a clean closet or its case with foam inset to prevent damage and  
 289 protect from contamination with dirt, if not immediately re-used.

290



291 **Specific recommendations regarding ultrasound gel**

292 Ultrasound gel has been associated with numerous outbreaks and in the context of the COVID-19  
293 pandemic, it is recommended that single-use, non-sterile gel packets are used for any external  
294 ultrasound examination with a probable or confirmed COVID-19 case. Any unused portion should be  
295 discarded. If these are not available, for external scans only, use gel bottles. It is essential that gel  
296 bottles are not 'topped off', refilled or heated. The lid must remain closed and the external gel bottle  
297 must be low level disinfected as per all other ultrasound machine components.

298 For any interventional, internal or critical procedures, as per normal safe scanning recommendation,  
299 only single use, sterile gel packets are to be used.

300

301 **References**

302

- 303 Aakjær Andersen C, Holden S, Vela J, Skovdal Rathleff M, Bach Jensen M. Point-of-Care Ultrasound in  
304 General Practice: A Systematic Review. *Ann Fam Med* 2019;12:61-69.
- 305 Abramowicz JS, Evans DH, Fowlkes JB, Marsal K, terHaar G, Committee WS. Guidelines for Cleaning  
306 Transvaginal Ultrasound Transducers Between Patients. *Ultrasound Med Biol* 2017;43:1076-79.
- 307 ACEP. American College of Emergency Physicians Ultrasound Guidelines: Emergency Ultrasound  
308 Guidelines. *Ann Emerg Med* 2009;53:550-70.
- 309 ACEP. American College of Emergency Physicians (ACEP) Guideline for Ultrasound Transducer Cleaning  
310 and Disinfection. *Ann Emerg Med* 2018;72:45-47.
- 311 AIUM. American Institute of Ultrasound in Medicine (AIUM) practice guideline for the performance  
312 of obstetric ultrasound examinations. *J Ultrasound Med* 2018;37:1587-96.
- 313 ASUM. Australasian Society for Ultrasound in Medicine Standards of Practice.  
314 <https://www.asum.com.au/standards-of-practice/> 2014-2020.
- 315 Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, Wang M. Presumed Asymptomatic Carrier Transmission of  
316 COVID-19. *JAMA* 2020;10.1001/jama.2020.2565:e202565.
- 317 Basseal J, Westerway S, Juraja M, van de Mortel T, McAuley T, Rippey J, 30–40. eaAJUM. Guidelines for  
318 Reprocessing Ultrasound Transducers. . *Australas J of Ultrasound in Med* 2017;20:30-40.
- 319 Boelig R, Saccone G, Bellussi F, Berghella V. MFM Guidance for COVID-19. *Am J Obstet Gynecol* MFM  
320 2020;<https://doi.org/10.1016/j.ajogmf.2020.100106>.

321 CDC. 2015 Immediate Need for Healthcare Facilities to Review Procedures for Cleaning, Disinfecting, and  
322 Sterilizing Reusable Medical Devices. *CDC Health Alert Network*.  
323 <http://emergency.cdc.gov/han/han00382.asp>.

324 Chan KW, Wong VT, Tang SCW. COVID-19: An Update on the Epidemiological, Clinical, Preventive and  
325 Therapeutic Evidence and Guidelines of Integrative Chinese-Western Medicine for the  
326 Management of 2019 Novel Coronavirus Disease. *Am J Chin Med* 2020;1-26.

327 Dietrich C, Goudie A, Chiorean L, Cui X, Gilja O, Dong Y, Abramowicz J, Vinayak S, Westerway S, Nolsøe C,  
328 Chou Y, Blaivas M. Point of Care Ultrasound: A WFUMB Position Paper. *Ultrasound Med Biol*.  
329 2017;43:49-58.

330 Gorbalenya A, Baker S, Baric R, de Groot R, Drosten C, Gulyaeva A, Haagmans B, Lauber C, Leontovich A,  
331 Neuman B, Penzar D, Perlman S, Poon L, Samborskiy D, Sidorov I, Sola I, Ziebuhr J. Coronaviridae  
332 Study Group of the International Committee on Taxonomy of Viruses: The species Severe acute  
333 respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2.  
334 *Nature microbiology* 2020;10.1038/s41564-020-0695-z. Advance online publication.  
335 <https://doi.org/10.1038/s41564-020-0695-z>.

336 Holshue ML, DeBolt C, Lindquist S, Lofy KH, Wiesman J, Bruce H, Spitters C, Ericson K, Wilkerson S, Tural  
337 A, Diaz G, Cohn A, Fox L, Patel A, Gerber SI, Kim L, Tong S, Lu X, Lindstrom S, Pallansch MA,  
338 Weldon WC, Biggs HM, Uyeki TM, Pillai SK. First Case of 2019 Novel Coronavirus in the United  
339 States. *N Engl J Med* 2020;382:929-36.

340 Hoyer R, Adhikari S, Amini R. Ultrasound transducer disinfection in emergency medicine practice.  
341 *Antimicrob Resist Infect Control* 2016;5:12.

342 Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their  
343 inactivation with biocidal agents. *J Hosp Infect* 2020;104:246-51.

344 Kanagala P, Bradley C, Hoffman P, Steeds RP, British Society of E. Guidelines for transoesophageal  
345 echocardiographic probe cleaning and disinfection from the British Society of Echocardiography.  
346 *European journal of echocardiography : the journal of the Working Group on Echocardiography*  
347 of the European Society of Cardiology 2011;12:i17-23.

348 Lichtenstein DA. Lung ultrasound in the critically ill. *Ann Intensive Care* 2014;4:1.

349 Liu R, Nomura J, Tayal V. POLICY STATEMENT Guideline for Ultrasound Transducer Cleaning and  
350 Disinfection. *Annals of Emergency Medicine* 2018;72:1016.

351 Muller T, Martiny H, Merz E, Doffert J, Wustner M, Lessel W, Heynemann H, Enzmann T, Dudwiesus H,  
352 Nuernberg D, Tesch C, Weber MA, Krishnabhakdi S, Heil J, Wree A, Jenssen C. DEGUM  
353 Recommendations on Infection Prevention in Ultrasound and Endoscopic Ultrasound.  
354 *Ultraschall Med* 2018;39:284-303.

355 Nyhsen CM, Humphreys H, Koerner RJ, Grenier N, Brady A, Sidhu P, Nicolau C, Mostbeck G, D'Onofrio M,  
356 Gangi A, Claudon M. Infection prevention and control in ultrasound - best practice  
357 recommendations from the European Society of Radiology Ultrasound Working Group. *Insights*  
358 *Imaging* 2017;8:523-35.

359 Peng Q, Wang X, Zhang L. Findings of lung ultrasonography of novel corona virus pneumonia during the  
360 2019–2020 epidemic. *Intensive Care Med* 2020;doi:10.1007/s00134-020-05996-6.

361 Poggiali E, Dacrema A, Bastoni D, Tinelli V, Demichele E, Mateo Ramos P, Marciano T, Silva M, Vercelli A,  
362 Magnacavallo A. Can Lung US Help Critical Care Clinicians in the Early Diagnosis of Novel  
363 Coronavirus (COVID-19) Pneumonia? *Radiology* 2020;10.1148/radiol.2020200847:200847.

364 ScOR/BMUS. 2019 Society and College of Radiographers and British Medical Ultrasound Society  
365 Guidelines For Professional Ultrasound Practice. 4th ed. edn. London, UK, 1-146.

366 Skowronek P, Wojciechowski A, Leszczynski P, Olszewski P, Sibinski M, Polguy M, Synder M. Can  
367 diagnostic ultrasound scanners be a potential vector of opportunistic bacterial infection? *Med*  
368 *Ultrason* 2016;18:326-31.

369 Soldati G, Smargiassi A, Inchingolo R, Buonsenso D, Perrone T, Briganti DF, Perlini S, Torri E, Mariani A,  
370 Mossolani EE, Tursi F, Mento F, Demi L. Is there a role for lung ultrasound during the COVID-19  
371 pandemic? J Ultrasound Med 2020;<https://doi.org/10.1002/jum.15284>.  
372 Westerway SC, Basseal JM. The ultrasound unit and infection control - Are we on the right track?  
373 Ultrasound 2017;25:53-57.  
374 Westerway SC, Basseal JM, Abramowicz JS. Medical Ultrasound Disinfection and Hygiene Practices:  
375 WFUMB Global Survey Results. Ultrasound Med Biol 2019;45:344-52.  
376 Yuen KS, Ye ZW, Fung SY, Chan CP, Jin DY. SARS-CoV-2 and COVID-19: The most important research  
377 questions. Cell Biosci 2020;10:40.

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380