AVUM EXPERT CONSENSUS FOR

# COVID-19 IN PREGNANCY

- **COVID-19** GUIDELINES AND CONSIDERATIONS IN PREGNANCY
- PRACTICAL GUIDELINES FOR PRENATAL CARE AND OBSTETRIC ULTRASOUND DURING **COVID-19** PANDEMIC
- GUIDE FOR RADIOLOGICAL IMAGING IN **COVID-19**
- QUICK GUIDE FOR LUNG ULTRASOUND IN PUI FOR **COVID-19**
- GUIDE FOR SAFE OBSTETRIC ULTRASOUND PRACTICE DURING THE **COVID-19** PANDEMIC

**Click in the title of your preference**

AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

## BOARD OF DIRECTORS (2019-2021)

**Jonel Di Muro**
President

**Sandra Payares**
President

**Gerardo Salamalé**
Former President

## NATIONAL DIRECTORS

**Patricia González Álvarez**

**Carlos Lugo León**

**Daniel Márquez**

**María Ninoska Quijada**

**Jesús Alejandro Veroes**

## CONSULTING BOARD

**Juan Pérez Wulff**
President

## IN COLLABORATION WITH

**Kenny Araujo**

**Víctor Ayala**

**Alice Barrios**

**Rafael Cortés**

**Susana De Vita**

**Rodrigo Fernandez**

**Vanessa Méndez Barrios**

**Alexandra Rivero**

## GRAPHIC DESIGN

**Marluyn Duran**
@malu_duran_design

# PROLOGUE

In times of crisis, humanity has always been able to prepare, address and seek the common good as quickly and efficiently as possible.

The COVID-19 pandemic has resulted in an impressive spread of scientific communications. This mimics the rapid global extent of the disease itself.

As a valued member of the scientific community in Latin America, AVUM wants to participate in this movement and present a handbook with guidelines for the use and application of various imaging modalities in pregnancy during this time of need.

The topics we are going to discuss are subject to the constantly evolving epidemiology of the COVID-19 pandemic. The content will include COVID-19's etiology, pathogenesis, natural history and presentation spectrum reported in pregnant patients. We will discuss the risks behind possible vertical and horizontal transmission, as well as guidelines for diagnosis, with special emphasis on imaging, where chest x-rays, CT scans and lung ultrasound play an important role. We also aim to establish guidelines for management and follow-up of pregnant patients, including a model for routine prenatal care, and proper care of PUI (person under investigation) and confirmed COVID-19 pregnant patients. We are also going to discuss the current recommendations to protect both patients and frontline healthcare workers.

We present a simple, easy-to-read, digitally accessible and updated format that is directed to generalists, obstetricians and radiologists in the frontlines of our labor and delivery departments. We recommend to stay updated as the world fights this invisible threat.

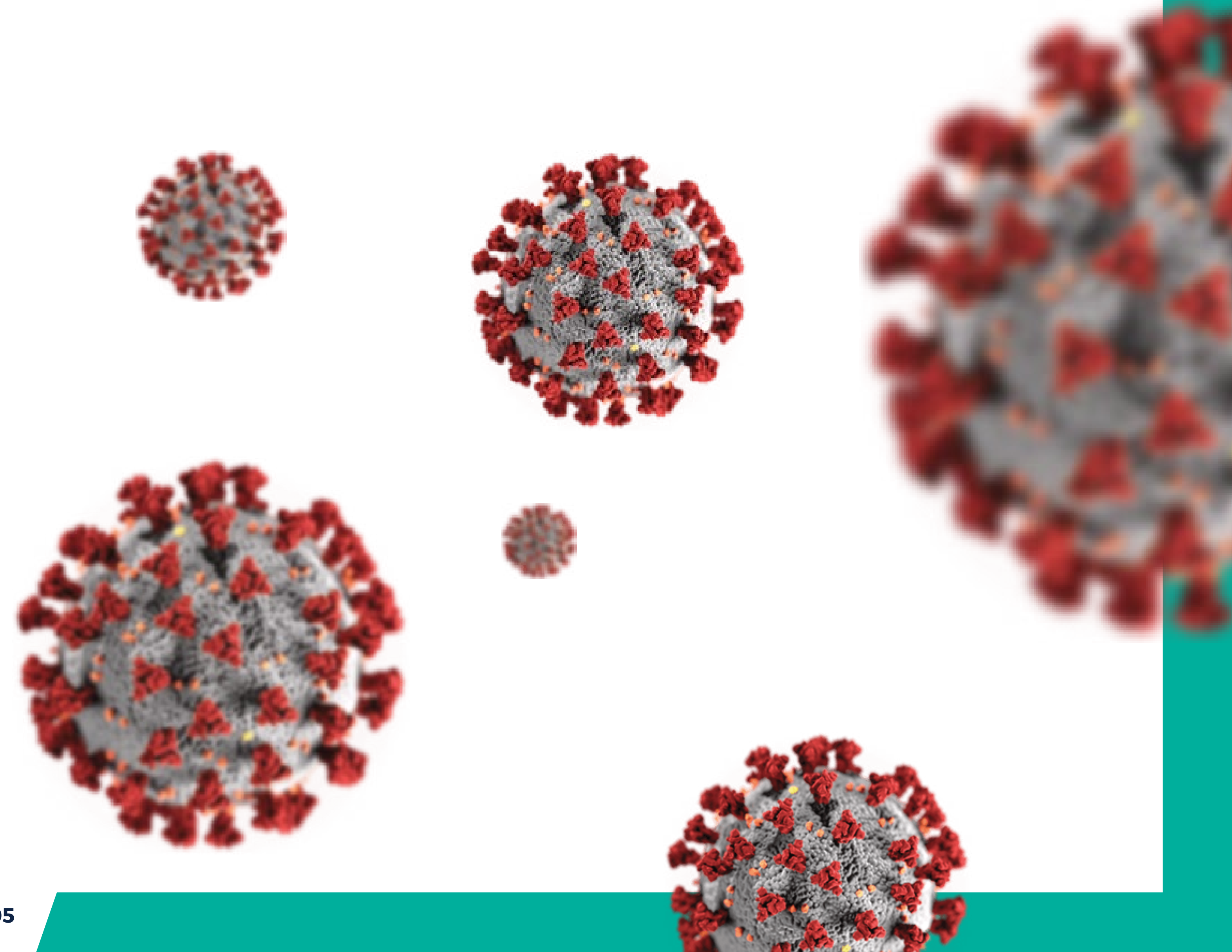
**Dr. Jonel Di Muro**
**President AVUM 2019-2021**

# INDEX

# INTRODUCTION

The recent emergence of the COVID-19 pandemic, as it was declared by the World Health Organization (WHO) on March 11th, 2020[1], poses a challenge worldwide as it affects not only the physical and emotional life of the diseased, but also impacts the public health system along with every aspect of our modern day society. The pandemic could potentially collapse every nation's health system, due to rapid spread of the disease in the communities. This leads to an incalculable amount of demand for human resources, putting a strain on the material, economical, and logistical capacity of any society and nation.

AVUM, in line with the strategies developed by other scientific authorities, convened the formation of a specialized task force to carry out a systemic review of the most recent COVID-19 literature. The main objective of this task force is to develop a manual with guidelines aimed at providing necessary information to the healthcare workers in our frontlines, who take care of our pregnant patients, which stand today as a vulnerable population.



## THE NUMBERS OF COVID-19

### Epidemiology

During the G20 summit of March 26th 2020, the WHO Director-General declared that the COVID-19 pandemic is accelerating at an exponential rate. The first 100,000 cases occurred in 67 days. The second cluster of 100,000 cases developed in 11 days, followed by the third and fourth in 4 and 2 days, respectively.

On December 1st 2019, a case-series from Wuhan (capital of the Hubei province in central China) involving pneumonia of unknown etiology, served as the world's introduction to the novel virus SARS-Cov2 (severe acute distress syndrome coronavirus 2), causing the disease termed COVID-19. After almost 4 months, more than 60,000 cases are reported daily, amounting to approximately 50,000 deaths worldwide thus far. With the exception of Antarctica, every continent has been affected. The most affected ones being North America, Europe and Asia. Currently, the largest number of cases are reported in the United States, followed by Italy, Spain and mainland China. In South America, the first case was reported in Ecuador in February 2020. The low prevalence in this region is influenced by the low migration flow, and the under-reported cases because of low availability of diagnostic testing.

There are epidemiological resources available online, which are updated daily. The following are the most widely used:

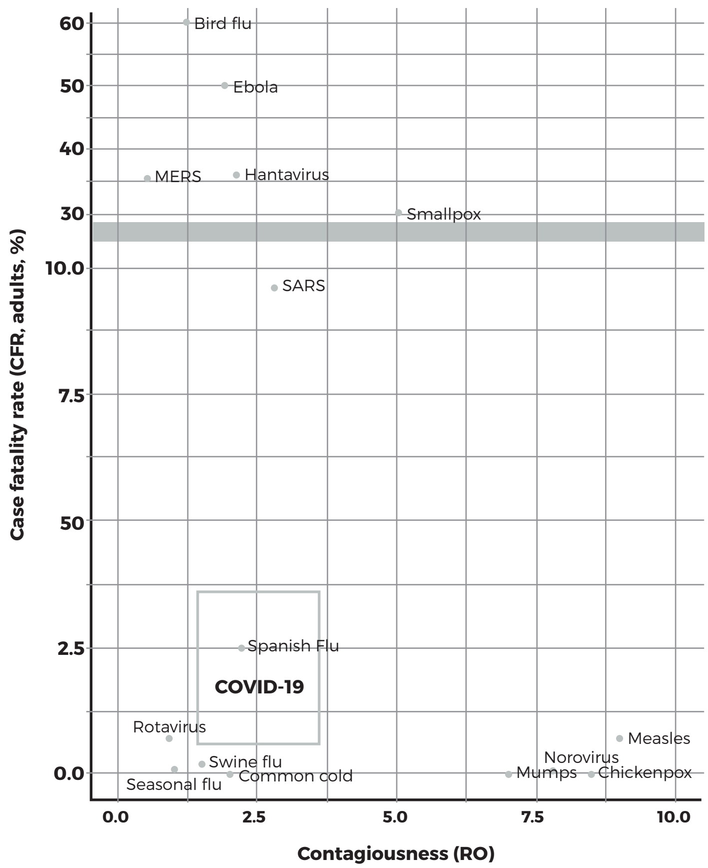
OMS. https://experience.arcgis.com/experience/685d0ace521648f8a5beeeee1b9125cd

Johns Hopkins Coronavirus Resource Center. https://coronavirus.jhu.edu/map.html

In Venezuela, as of April 3rd 2020, there are 153 confirmed cases of COVID-19 and 7 deaths. The most affected entities are the states of Miranda and Capital District.
The clinical guidelines from all of the major global societies and agencies (WHO,[1] CDC,[2] ISUOG,[3] MFM/AJOG,[4] ACOG,[5] SMFM,[6] RCOG, and others), about the management of the pregnant population during the COVID-19 pandemic prioritize recommendations regarding the following: transmission prevention (protecting or isolating the patient and healthcare providers), appropriate sampling/diagnosis, and clinical/practical guidelines and its consequences during pregnancy.
The first retrospective case-series, involving 9 patients, did not find evidence of vertical transmission or greater susceptibility/predisposition of the pregnant population compared to their non-pregnant counterparts.[8] Despite a possible vertical transmission case reported in JAMA[10], a recent review states that it is not currently possible to confirm vertical transmission during pregnant or lactation. The report also highlights the increased immunological susceptibility and severity progression seen in pregnancy. [9]
The leading experts in a joint WHO commission investigated 147 asymptomatic pregnant patients[1], along with 82 PUI (Person Under Investigation) and 64 confirmed cases. Severe presentations were seen in 8% of the cases, with 1% reported as critical cases. There was no increased risk of disease severity; vertical transmission was not assessed.[11]

A case-series of 38 patients, showed no cases of severe pneumonia or maternal deaths, as well as no evidence of vertical transmission. This falls in line with other recent international epidemiological reports of respiratory diseases from other coronaviruses. [12]

When the trends are analyzed, a wide and variable spectrum is noted in relation to the percentage of severe cases and transmission risk. It lies slightly above the Spanish Flu, with a mortality ranging from 1 to 4% and a moderate contagiousness of up to 4 times per confirmed case. An extreme demographic variant can be highlighted in Italy, currently with 10% mortality rate. COVID-19's fatality rates have been lower than MERS, SARS, Ebola and Avian influenza, while being more contagious than those during their respective pandemics. [13]




Fatality and Contagiousness of COVID19[13]

Following the guidelines of the WHO, CDC and global societies[1-7], the classification of cases in pregnant women adhere to the same definitions used in the general population.

| SUSPECTED | LIKELY/PROBABLE | CONFIRMED |
|---|---|---|
| Symptomatic<br>No other etiology<br>Epidemiological history | Suspected case with non-conclusive laboratory results | Confirmed by laboratory testing<br>Independent testing center |

## THE SOCIAL AND ECONOMIC IMPACT[14]

The pandemic's impact on global economies has reached incalculable numbers. This is inherent to the preventative measures established by governments, like isolation and quarantine. This measures prevent transmission, but in turn largely decrease the workforce, causing the halt of all businesses productivity. The economic impact is shown below in a figure by the World Economy Forum. The International Monetary Fund foresees a drop in the growth of the world's economy between 0.1-0.2%. This impact will be greater in developing countries, which in turn, may affect their health system's response to the pandemic, and ultimately increase their population's susceptibility to complications and more severe cases.
The established measures to reduce transmission have had polarizing effects in society. Ranging from solidarity and collaboration to face a common struggle, to food shortages, and severe anxiety. There has been increasing reports of alcohol consumption and domestic violence. In Gingzhou (Hubei Province in China), cases of domestic violence tripled compared to the same period last year.
The individual social, economic, and psychological impact in the pregnant population is still unknown. However, it could be implied that it is not particularly different from the rest of the general population.

## ECONOMIC IMPACT OF COVID-19.

DOMINO EFFECT
Initial fall of economic activities that impact SMEs around the globe.
This affects the self-employed and less well-paid population in the general economy.

Adapted from IMF webpage.[14]

## REFERENCES

1. OMS sitio web. Reportes epidemiológicos y guías interinas para profesionales de salud. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

2. CDC. Interim Considerations for Infection Prevention and Control of Coronavirus Disease 2019 (COVID-19) in Inpatient Obstetric Healthcare Settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/inpatient-obstetric-healthcare-guidance.html

3. ISUOG Interim Guidance on 2019 novel coronavirus infection during pregnancy and puerperium: information for healthcare professionals. https://www.isuog.org/clinical-resources/coronavirus-covid-19-resources/research-and-journal/interim-guidance-coronavirus-pregnancy-puerperium.html doi: 10.1002/uog.22013

4. Boelig RC, Saccone G, Bellussi F, Berghella V, MFM Guidance for COVID-19, American Journal of Obstetrics & Gynecology MFM (2020), doi: https://doi.org/10.1016/j.ajogmf.2020.100106.

5. ACOG. Advisory on Novel Coronavirus 2019 (COVID-19) including an algorithm to aid in assessment and management of pregnant patients with suspected or confirmed COVID-19. https://www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2020/03/novel-coronavirus-2019

6. SMFM. Coronavirus (COVID-19) and Pregnancy: What Maternal-Fetal Medicine Subspecialists Need to Know. https://s3.amazonaws.com/cdn.smfm.org/media/2267/COVID19-_updated_3-17-20_PDF.pdf

7. RCOG. Coronavirus (COVID-19) Infection in Pregnancy. Version 4.1. Published Thursday 26 March 2020 https://www.rcog.org.uk/globalassets/documents/guidelines/2020-03-26-covid19-pregnancy-guidance.pdf

8. Chen H, Guo J, Wang C, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 2020; 395: 809–15.

9. Dashraath P, Jing Lin Jeslyn W, Mei Xian Karen L, Li Min L, Sarah L, Biswas A, Arjandas Choolani M, Mattar C, Lin SL, Coronavirus Disease 2019 (COVID-19) Pandemic and Pregnancy, American Journal of Obstetrics and Gynecology (2020), doi: https://doi.org/10.1016/ j.ajog.2020.03.021.

10. Dong L, Tian J, He S, et al. Possible Vertical Transmission of SARS-CoV-2 From an Infected Mother to Her Newborn. JAMA Letters. March 26, 2020. https://jamanetwork.com/ on 03/27/2020 doi:10.1001/jama.2020.4621

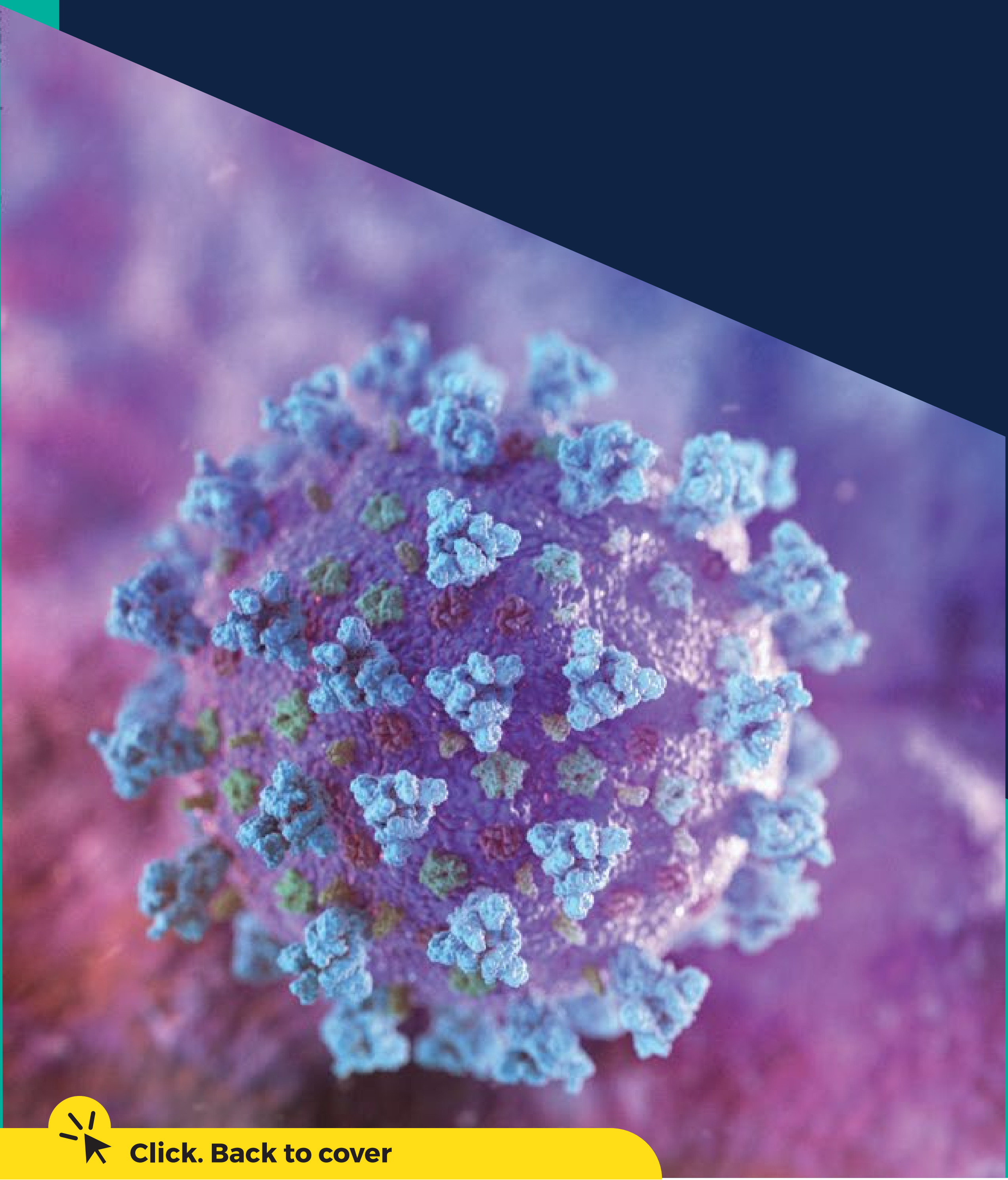
11. World Health Organization. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). Available from: https://www.who.int/docs/default-source/coronaviruse/who-china-jointmission-on-covid-19-final-report.pdf

12. Schwartz D. An Analysis of 38 Pregnant Women with COVID-19, Their Newborn Infants, and Maternal3 Fetal Transmission of SARS-CoV-2: Maternal Coronavirus Infections and Pregnancy Outcomes. https://www.archivesofpathology.org/doi/pdf/10.5858/arpa.2020-0901-SA

13. Thomas-Rüddel D, Winning J, Dickmann P, et al. Coronavirus disease 2019 (COVID-19): update for anesthesiologists and intensivists. Anaesthesist March 24 2020. https://doi.org/10.1007/s00101-020-00758-x

14. Reporte para el sitio web del FMI. This is the human impact of covid-19 and how businnes can help. Disponible en https://www.weforum.org/agenda/2020/03/this-is-the-human-impact-of-covid-19-and-how-business-can-help/ disponible en https://www.imf.org/es/Topics/imf-and-covid19

# COVID-19 GUIDELINES AND CONSIDERATIONS IN PREGNANCY



AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

Click. Back to cover

## VIROLOGY

Coronaviruses were first identified as human pathogens in the 1960s, when they were isolated from samples from the respiratory tract of adults with flu-like symptoms. They belong to the order of Orthoviridae, in the Coronaviridae family. The latter owe their name to their spicules that give them a solar crown appearance. (fig.1)

## SARS-CoV-2

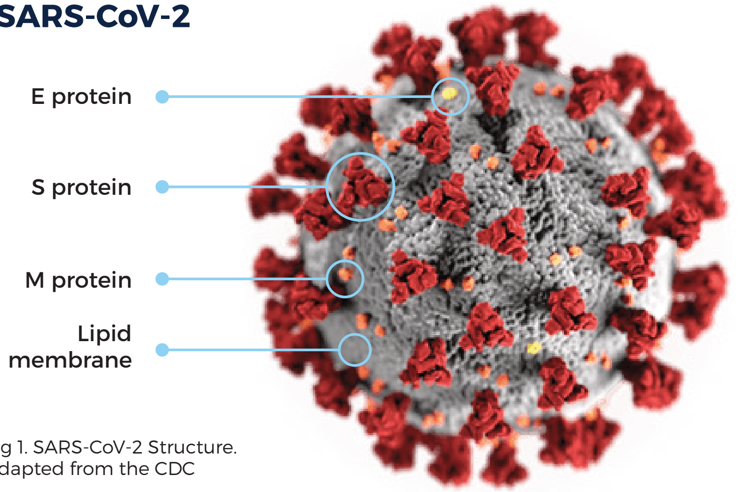



Fig 1. SARS-CoV-2 Structure. Adapted from the CDC

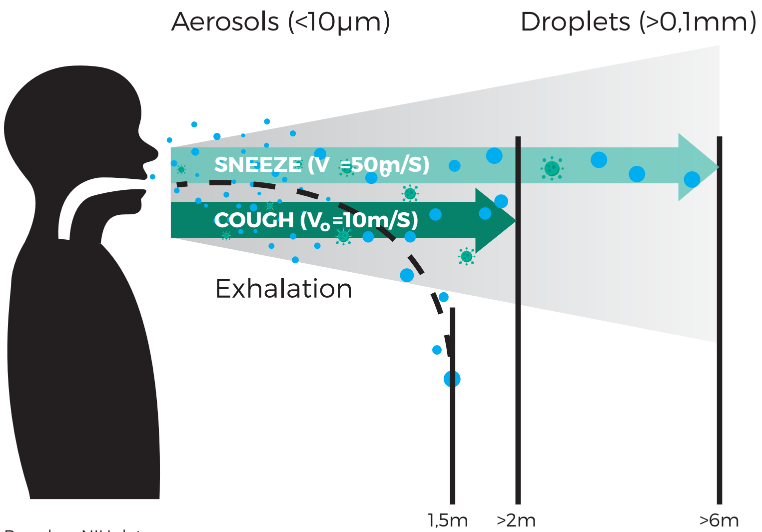
## THERE ARE SEVEN KNOWN TYPES OF HUMAN-PATHOGENIC CORONAVIRUS:

| | |
|---|---|
| **229E** (alpha coronavirus) | **OC43** (beta coronavirus) |
| **NL63** (alpha coronavirus) | **HKU1** (beta coronavirus) |
| **MERS-CoV** (beta coronavirus – causes Middle East Respiratory Syndrome ) **(MERS)** | **SARS-CoV** (beta coronavirus – causes Severe Acute Respiratory Syndrome) **(SARS)** |
| **SARS-CoV-2** (new coronavirus, causes COVID-19 disease (fig 1) | |

The first four (HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU1) are very common and some of them, along with rhinoviruses and others, are related with the common cold. This is the reason why it is estimated that a very high proportion of the population has developed immunological responses against them. SARS-CoV, MERS-CoV and SARS-CoV-2, are associated with severe respiratory disease.[1,2]

## TRANSMISSION

The virus colonizes airways and oropharynx, and is released into respiratory secretions through droplets when an infected person coughs, sneezes or speaks. These droplets can infect others if they come in direct contact with mucous membranes. Droplets usually do not travel more than six feet (two meters) and recent studies suggest that they may remain in the air. Patient are more contagious when they are symptomatic. It may be transmissible before symptoms appear, but it is believed not to be a common occurrence.[2] (Fig. 2)




Based on NIH data
Institutes of Health (NIH)

Fig. 2 Range of Respiratory Droplets

Multiple studies have found viral shedding in faeces, so it is necessary to consider faecal-oral transmission with possible contamination in toilets and sinks; this mode of transmission warrants further investigation. Another mode of transmission is by touching a surface or object that has the virus and then touching the mouth, nose or eyes; however, it is not believed that this is the main way in which the virus spreads.

The survival of SARS-CoV-2 on different surfaces virus is widely variable. (Fig. 3)

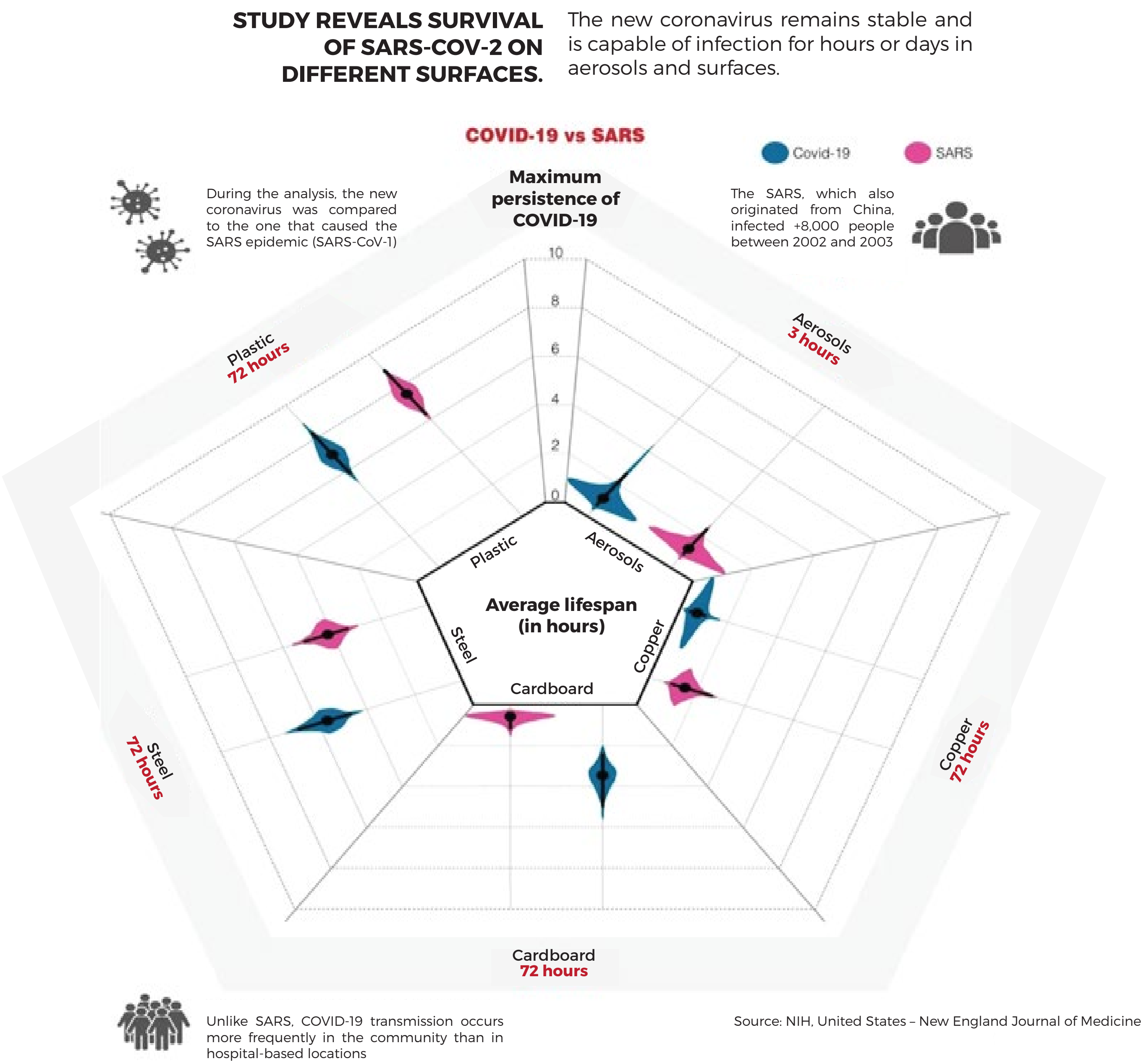



Fig. 3. Survival of SARS-CoV-2 on different surfaces.

## PATHOPHYSIOLOGY

SARS-CoV-2 is a new RNA betacoronavirus with 72% molecular similarity to SARS-CoV. Molecular modelling revealed that SARS-CoV-2 has a strong interaction with the angiotensin-converting enzyme 2 (ACE2). While ACE2 expression is predominantly within type 2 alveolar cells, the receptor is also present at several extrapulmonary sites throughout the digestive tract, including the oral cavity.3 Therefore, patients with COVID-19 would manifest a spectrum of symptoms in both the respiratory and gastrointestinal tract.[4,5] (fig.4)

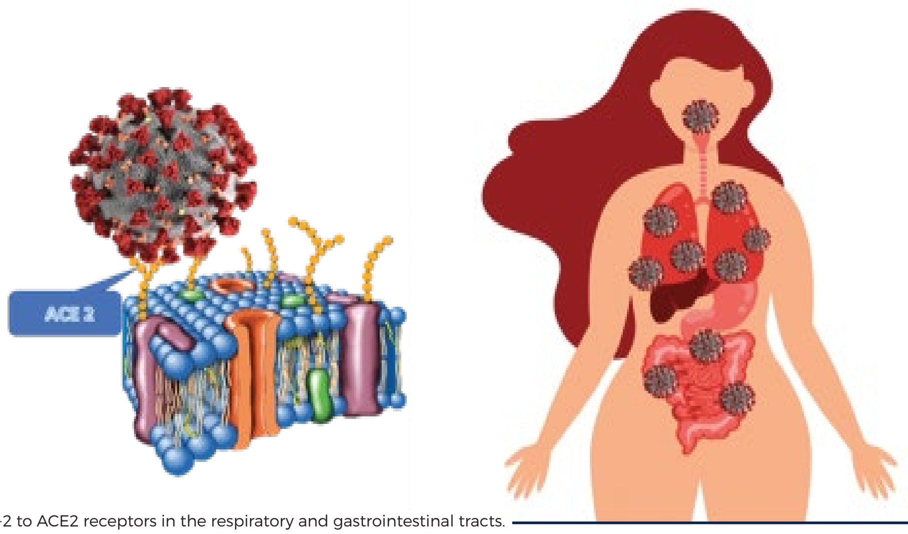



Fig. 4. Link of SARS-CoV-2 to ACE2 receptors in the respiratory and gastrointestinal tracts.

T helper (Th) lymphocytes release cytokines that help regulate immune responses and inflammation. Th-1 cytokines are microbicides and pro-inflammatory. These include gamma interferon (IFN- γ), interleukin (IL) 1α, IL-1β, IL-6, and IL-12. Conversely, Th-2 cells release anti-inflammatory cytokines, like IL-4, IL-10, IL-13 and Transforming Growth Factor beta (TGF-β). (fig. 5)

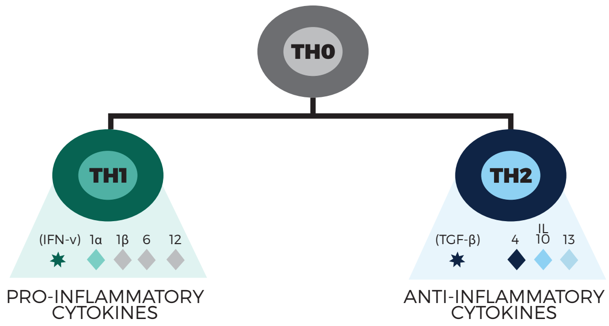



Fig. 5 T-helper cells and their cytokines

Simultaneous activation of Th-1 and Th-2 cells has been demonstrated in COVID-19 patients, resulting in the presence of IFN and IL-1, as well as IL-4 and IL-10.14 Furthermore, increased levels of IL-6 (predominantly Th-1 response) are associated with higher risk of lung damage and overall mortality in COVID-19 patients..[6] (fig. 6)

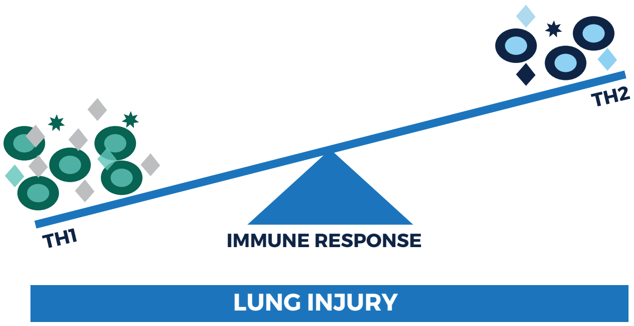



Fig 6. Immune response and lung damage in COVID19 patients

These cytokines are likely made by highly inflammatory macrophages, who play an important role in the cytokine storm. Total lymphocyte count, specifically CD4+ and CD8+ T cells, were slightly decreased in moderate cases, and significantly decreased in severe cases. This shows that the cytokine storm is associated with the severity of COVID-19, likely through increased lung damage, and T cell depletion and dysfunction. 21 (fig. 7)

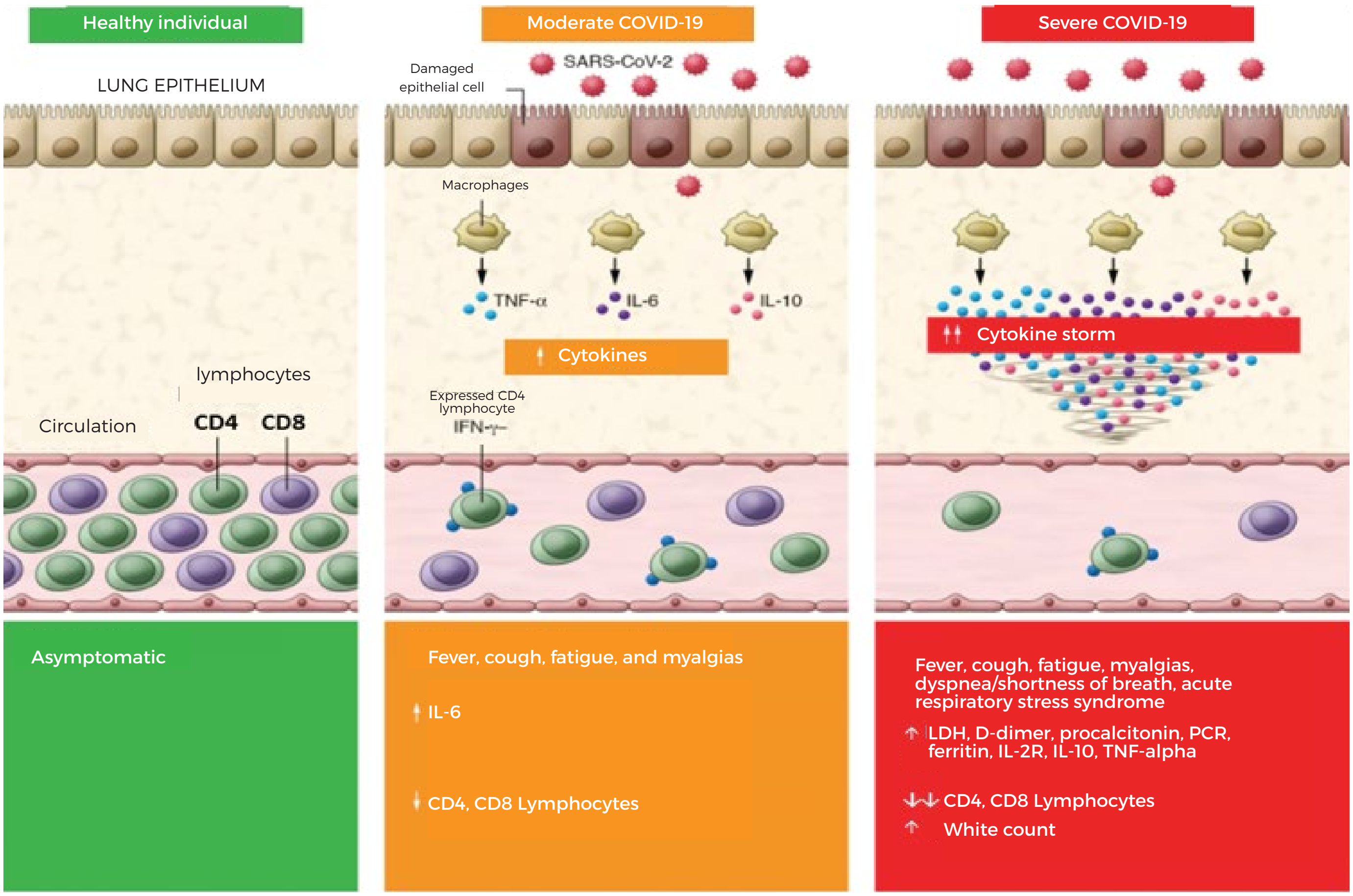



Fig.7. Cytokine storm and Lymphopenia: association with COVID-19 severity.

Savannah F. Pedersen, Ya-Chi Ho. SARS-CoV-2: A Storm is Raging. J Clin Invest. 2020. https://doi.org/10.1172/JCI137647.

## CLINICAL FEATURES

### Incubation period

The average incubation period is 5.1 days. Almost 2.5% of patient develop symptoms in 2.2 days and 97.5% within 11.5 days of infection.7 It seems reasonable to recommend a 14-day quarantine for exposures. However, in the long term, this incubation period could not cover all cases. This is reflected on 1% of patients who complete the 14-day quarantine, and develop symptoms after they return to their daily routine. [7-10] (fig. 8)

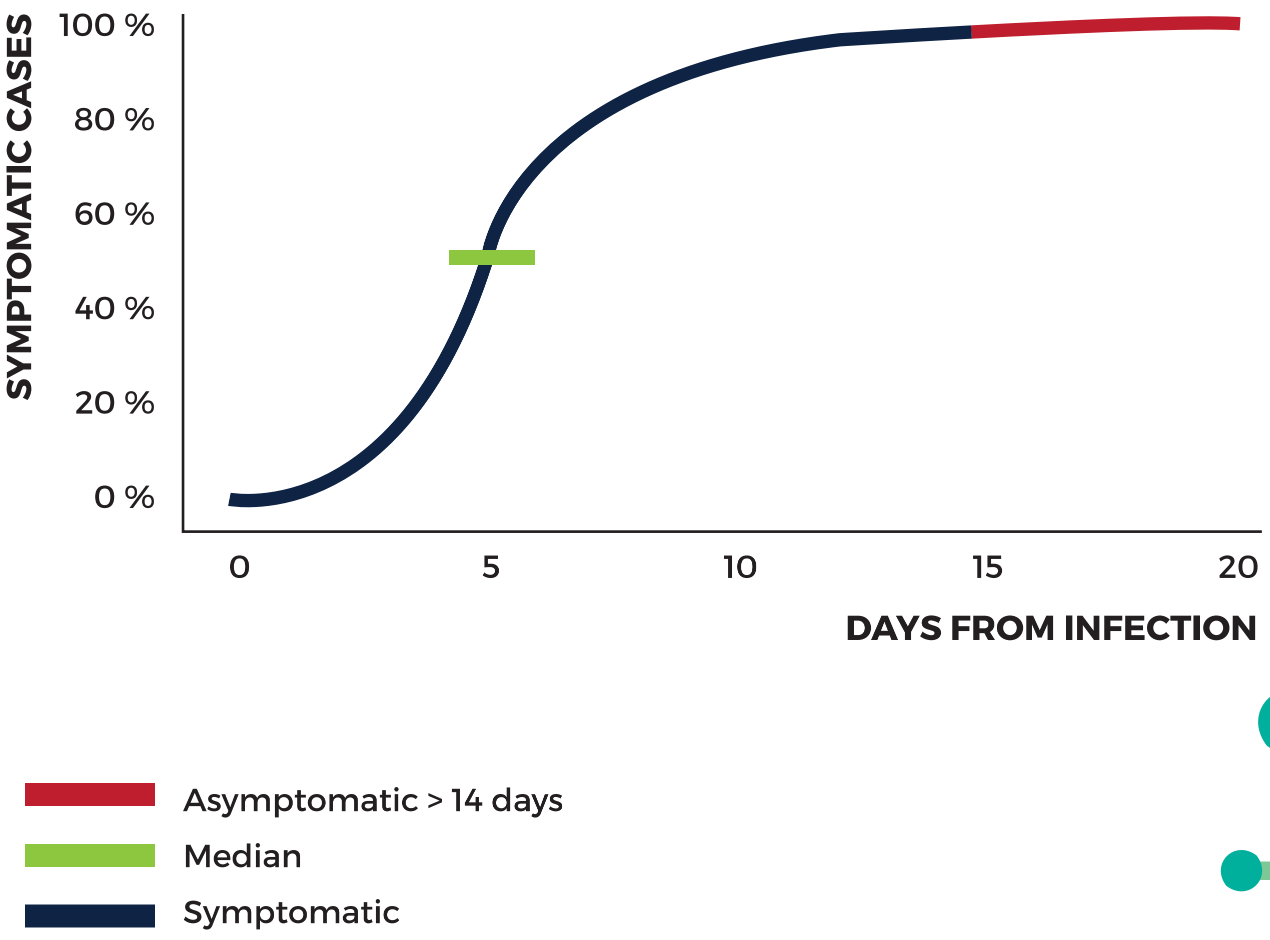



Fig. 8. COVID-19 Incubation Period

Lauer et al, annals of Intemal Medicine, 2020

## Spectrum of clinical manifestations in COVID-19

Most infections are self-limited. The population over 65 years old and those with underlying medical conditions, tend to have more severe presentations of COVID-19.11 Approximately 80% of cases are mild and self-limited. Almost 14% have severe presentations, with lung injury seen in more than 50% of these cases. The latter results in tachypnea > 30 bpm, hypoxemia ,and PaO2/FiO2 ratio < 300 within the first 24-48 hours from the onset of symptoms. Five percent of cases culminate in respiratory failure, shock and multi-organ failure. Overall mortality ranges from 2.3 to 5%. 12 (fig. 9, 10, 11)

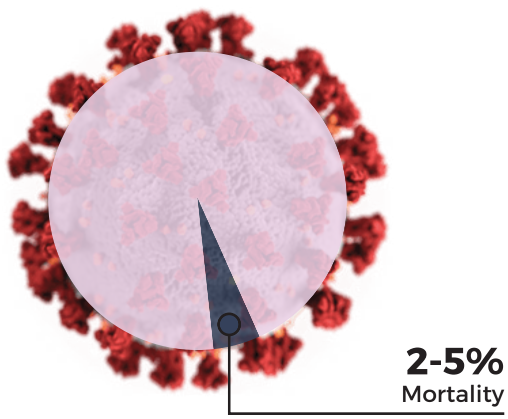



Fig 9. COVID-19 Mortality

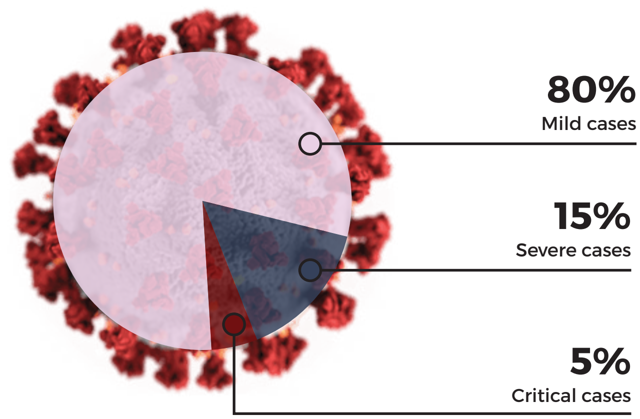



Fig 10. COVID-19 Severe cases

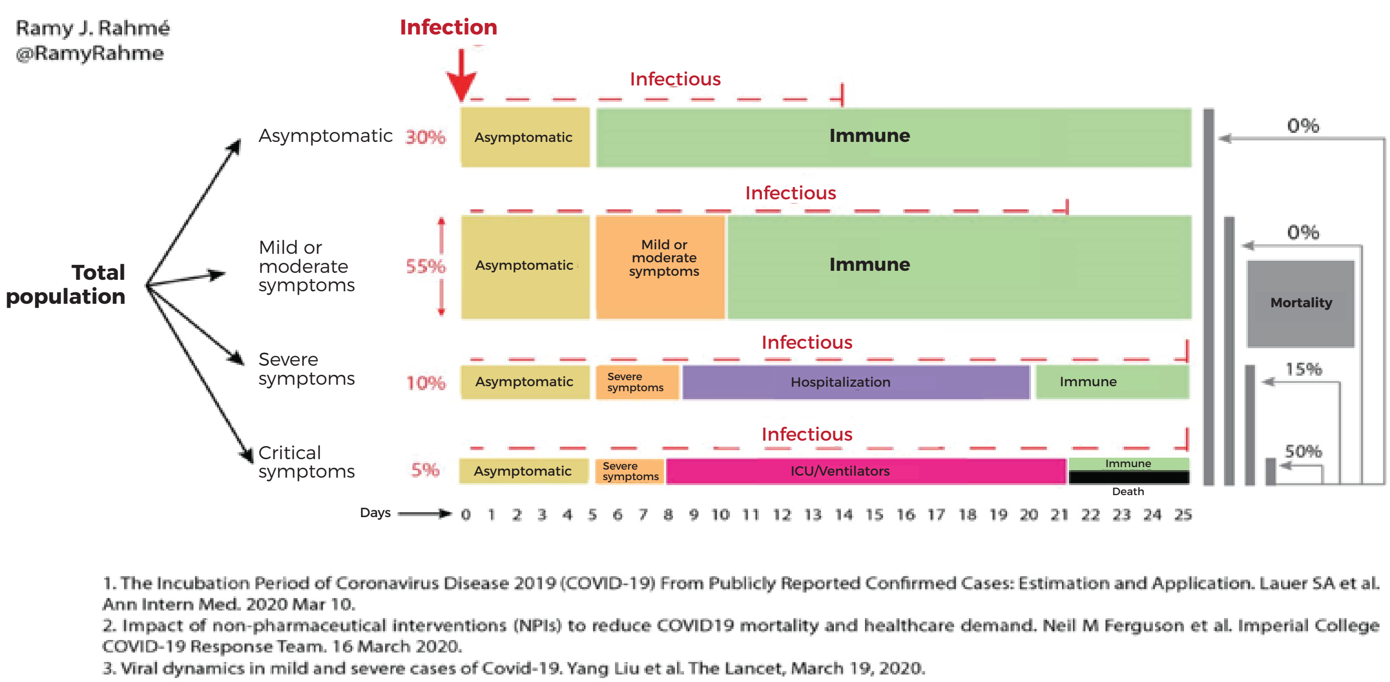



Fig 11. Natural history of COVID-19

## Symptoms

The COVID-19 pneumonia case reports from Wuhan, show that the most common symptoms are: fever (88-94%), fatigue (38-40%), dry cough (39-67%), myalgias (14.9-20%), and dyspnea (18.7-25%). (fig.12)

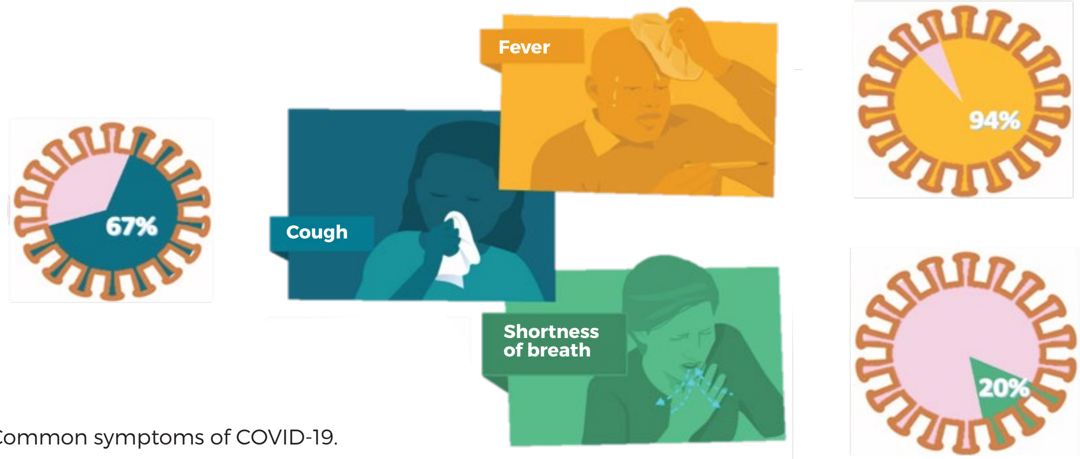



Fig. 12. Common symptoms of COVID-19.

Pneumonia appears to be both, the most common and severe manifestation of the disease. In this group of patients, dyspnea developed, on average, after 5 days of symptoms onset. Acute respiratory distress syndrome developed in 3.4% of patients.12, 13 Other symptoms reported include: headache, anosmia, ageusia, sore throat, rhinorrhea, and GI symptoms. The onset and duration of symptomatology may vary depending on the severity of the disease. (fig. 13)

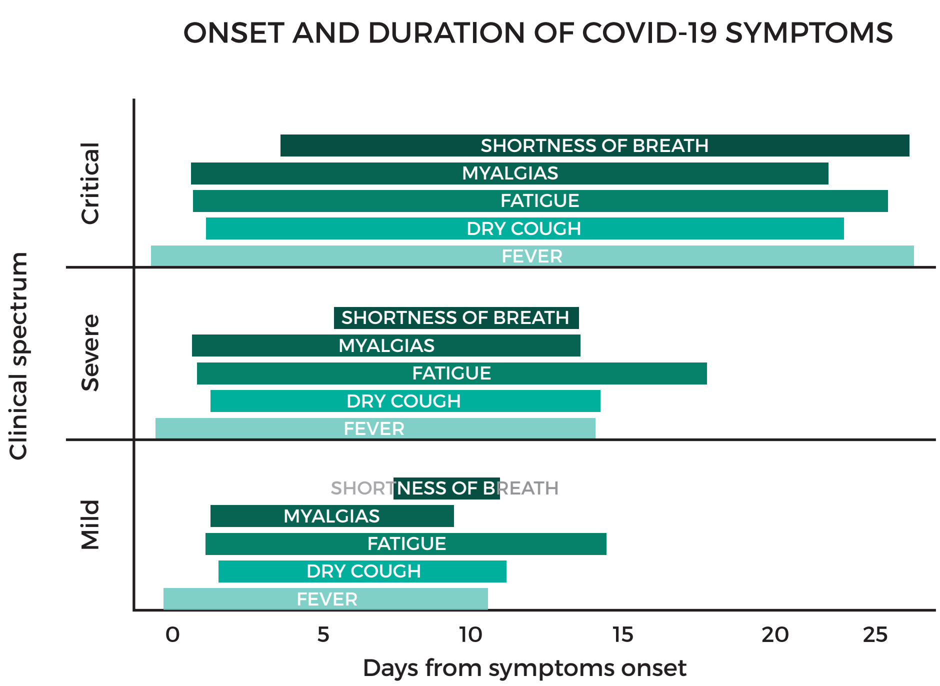
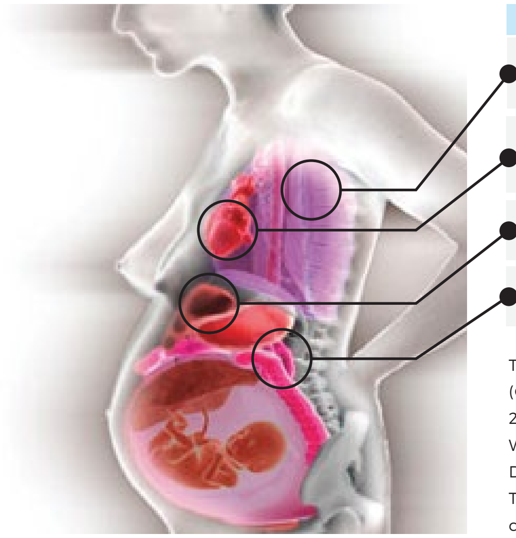



Fig. 13. Dr. Victor Ayala. Based on data reported by Chen, T. Qi and L. Liu et al., COVID-19 symptom onset and duration.

## LABORATORY FINDINGS

In patients with COVID-19, laboratory parameters, rather than being used for diagnosis, are used as markers for severity, prognosis and monitoring of possible complications. Of note, there has been no evidence of different laboratory findings between pregnant and non-pregnant patients. (Fig. 14)

Findings on chest imaging on COVID-19 patients with respiratory compromise, have a particular pattern. It is currently being used for follow-up and as a gauge of severity in complicated patients.



| Finding | Frequency | Comments |
|---|---|---|
| Lung Imaging | Abnormalities seen depend on severity (refer to COVID-19 Radiological Imaging Guide) | No findings seen on CXR in 40% of patients |
| Troponin | Increased in 12% of cases | More frequent in ICU patients. Associated with severity and cardiac injury |
| AST/ALT and bilirubin | Increased in 22-38% of cases | More frequent in ICU patients. Unclear significance. |
| Serum creatinine | Increased in 12-18% of cases | Associated with severity, especially when > 1,2 mg/dL |

Thomas-Rüddel D, Winning J, Dickmann P, Ouart D, Kortgen A, Janssens U, Bauer M. Coronavirus disease 2019 (COVID-19): update for anesthesiologists and intensivists March 2020. Der Anesthesist. Published on line: 24 march 2020.

W. Guan, Z. Ni, Yu Hu, W. Liang, C. Ou, J. He, L. Liu, H. Shan, C. Lei, D.S.C, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. The New England Journal of Medicine. April 2020

Tomado: Centro de Coordinación de Alertas y Emergencias Sanitarias. Dirección General de Salud Pública. Manejo clínico del COVID-19: atención hospitalaria. Ministerio de Salud España. Febrero 2020.

| Finding | Frequency | Comments |
|---|---|---|
| Leukopenia and lymphocytopenia | Present in 32-86% of cases | Frequent finding in COVID-19. Low levels are associated with increased severity and slow recovery |
| Thrombocytopenia | Present in 36,2% of cases | Associated with increased severity, especially when under 150.000/mm3 |
| LDH | Increased in 21-76% of cases | Associated with increased severity and prognosis |
| Lactate | Undetermined | Associated with septic shock when over 2 mmol/L |
| Procalcitonin | Significant increase in <10% of cases | Likely linked to coinfection, not strictly related to COVID-19 |
| D-dimer* Ferritin | Increased | Used as severity criteria and prognosis |
| PCR | Increased | Used as severity criteria and possible coinfection |

*Consider physiological increase seen during pregnancy

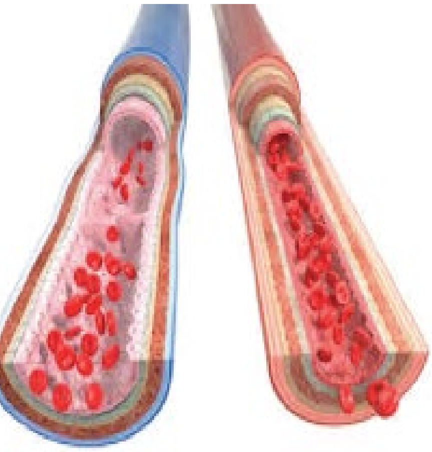


Fig. 14. Dr Jesús Veroes. Based on data reported by Thomas-Rüddel et al. Common laboratory and imaging findings in COVID-19

## PREGNANCY PHYSIOLOGIC CHANGES AND COVID-19

Physiologic respiratory changes during pregnancy, related to both hormonal and anatomical mechanisms, results in a decrease of total lung capacity at the expense of decreased residual volume (RV), functional residual capacity (FRC) and expiratory reserve volume (ERV). This, alongside with the physiologic attenuation of Th1 cell-mediated immune response, and the increasingly dominant Th2 mediated response, contribute to a theoretical increase in infectious morbidity. These changes leaves the pregnant population especially susceptible to intracellular pathogens such as viruses.[5,14] (fig. 15)

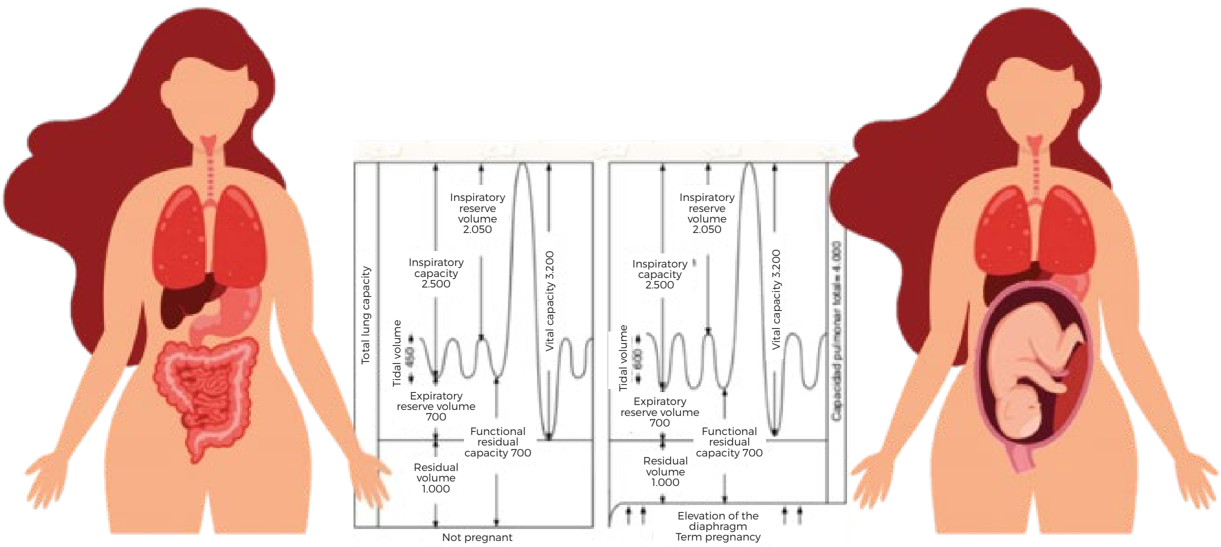



Fig. 15. Physiologic respiratory changes during pregnancy.

Studies have shown that pregnancy increases influenza-related pathology through multiple mechanisms influenced by changes in levels of prostaglandins and progesterone. These include: interrupted viral elimination, increased pulmonary expression of IL-6, IL-1 and G-CSF. However, in COVID-10, an early adaptive immune response dominated by a Th2 predominant response has been described. The latter favors anti-inflammatory cytokines (IL-4 and IL-10), which can predict a spectrum of milder presentations in pregnant women described in epidemiological studies.[15-7] (fig. 16)

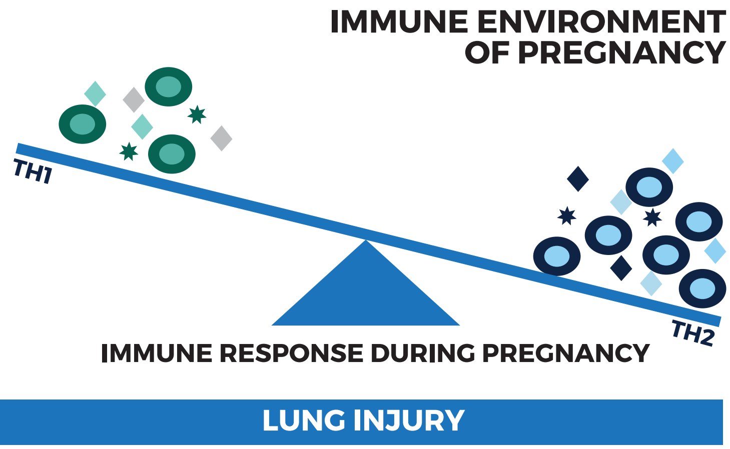



Fig. 16. Immune response during pregnancy.

Current data does not suggest an increased risk of abortion or early pregnancy loss in COVID-19 pregnant patients. Previous results in SARS-CoV and MERS- CoV infected women, did not show a clear causality link with these complications. It is highly unlikely that COVID-19 infection causes congenital birth defects due to the lack of evidence for vertical transmission.

Cases of preterm delivery have been reported in COVID-19 patients. In many cases, prematurity may be a result of labor induction to preserve maternal health. However, extensive studies in pregnant women with other types of viral pneumonias (SARS-CoV and MERS-CoV) have shown an increased risk of preterm birth, intrauterine growth restriction, and non-reassuring fetal status.[18]

At a molecular level, the expression profile of the ACE2 receptor is lower in early maternal-fetal interface cells, compared to the Zika virus tyrosine kinase (AXL) receptor (ZIKV), which is associated with increased risk of congenital defects. This has not been observed in patients with SARS-CoV-2. This ACE2 receptor expression provides a mechanism for vertical transmission that should be considered in future research.[19]

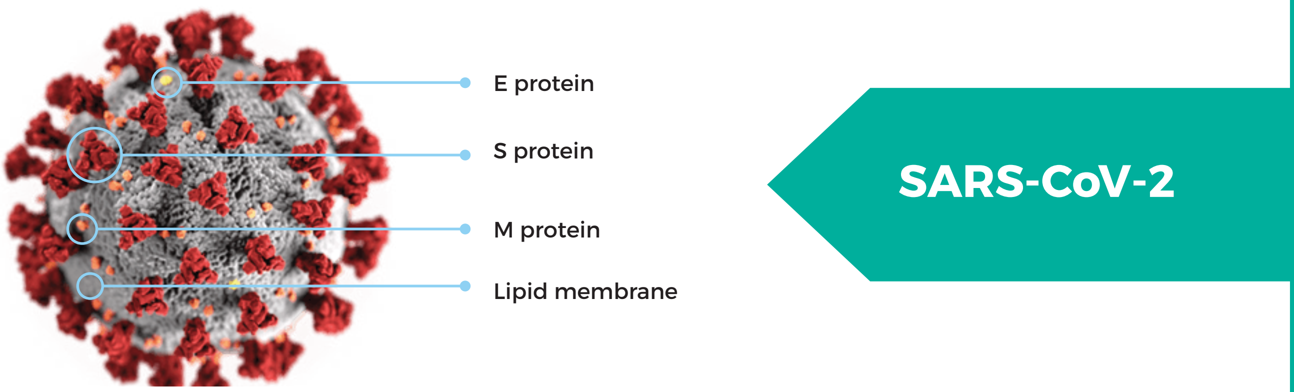
Given the limited number of causes, we can conservatively extrapolate from the current evidence the following:

- Pneumonia in pregnant patients does not appear to be more severe than in other populations.
- There is no evidence of vertical transmission of SARS-CoV-2 in women who acquire the infection during the third trimester.
- Perinatal SARS-CoV-2 may have adverse effects in newborns.[20]

## MICROBIOLOGIC DETECTION OF COVID19

### Nucleic acid test of SARS-CoV-2

The nucleic acid test or reverse transcriptase polymerase chain reaction (RT-PCR) is the preferred method for detecting SARS-CoV-2.22 RT-PCR specifically amplifies the following: the E gene, which encodes a wrapping protein; the N gene, which encodes nucleocapsid protein; and the RdRp gene, that encodes the enzyme that copies the RNA transcriptase which copies the virus. Amplified genes are then detected by fluorescence intensity. [23,24] (fig. 17)



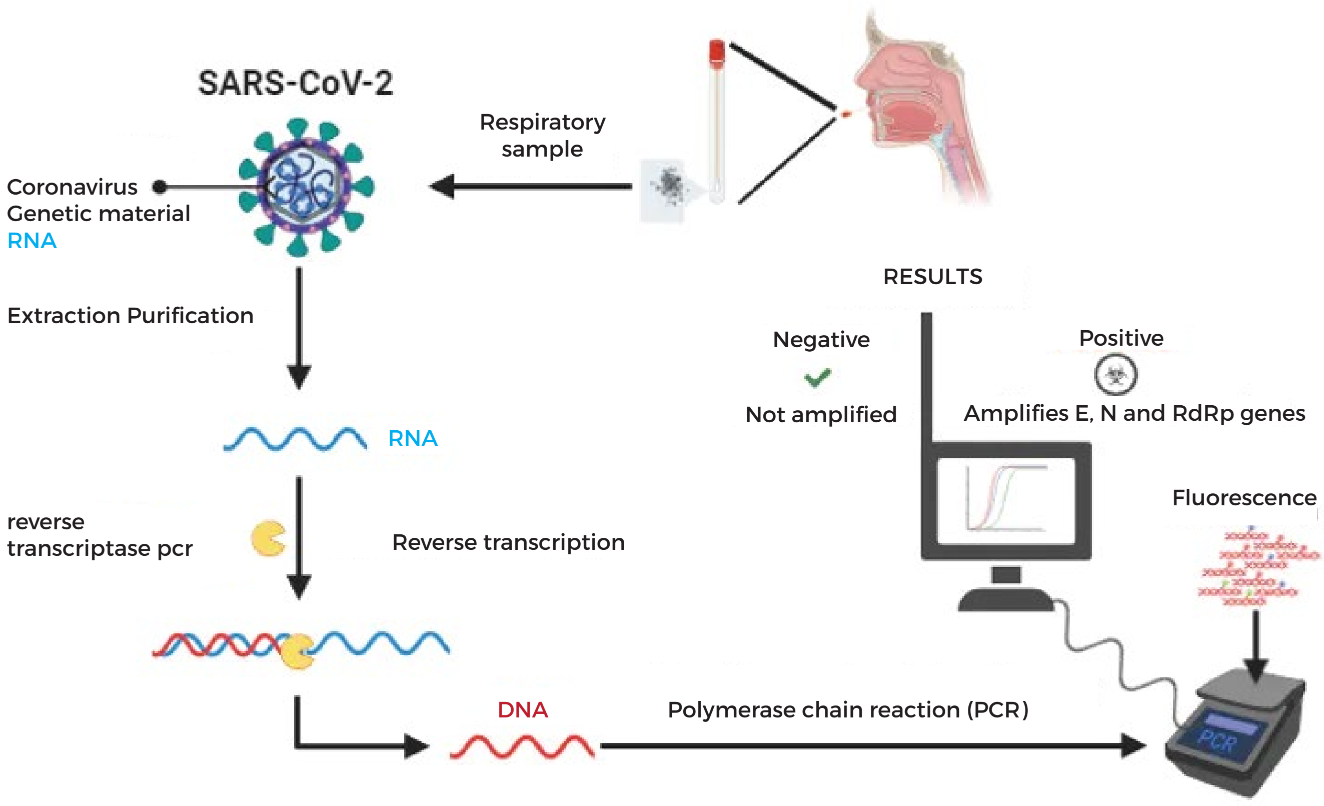



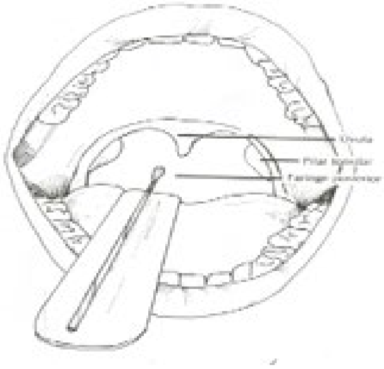

Fig. 17. Viral structure of SARS-CoV-2 and RT-PCR detection.
Created by: biorender.com

## SAMPLING

Sample collection requires appropriate timing, method and technique to improve detection sensitivity. Sample sites/types include: upper airway samples (pharyngeal, nasal, and nasopharyngeal swabs), lower airway samples (sputum, airway secretions, bronchoalveolar washing fluid), blood, stool, urine, and conjunctival secretions.[25] (fig. 18).

**Nasopharyngeal swab**

**Oropharynx swab**



**Conjunctival swab**

**Bronchoalveolar washing**

Fig. 18. Sampling for SARS-CoV-2 detection

There are false negatives during the first three days since onset of symptoms for nasopharyngeal swabs. In these cases, treat the patient as positive and repeat in 72 hours (protocol at Hospital Universitario Ramon y Cajal, in Madrid, Spain).26 Always consider a cause for poor quality samples, inadequate transport and absence of viral shedding. There are symptomatic cases with obvious chest CT findings, with positive tests only after 8 days since onset of symptoms. This suggests that some cases can be initially isolated to the lower respiratory tract. In critical patients, samples of the lower respiratory tract should be obtained, especially in those with a prior negative upper respiratory sample. The sensitivity of RT-PCR ranges from 60-70% in the nasopharyngeal exudate, to 93% in bronchoalveolar washings.[27]

## SERUM ANTIBODY TESTING

SARS-Cov-2 specific antibodies appear only after infection. Detection methods include immunochromatography, ELISA, chemiluminescence immunoassay, etc. The antibody titer in the recovery phase is 4 times higher than the acute phase. It can be used as a diagnostic criterion for suspected patients with negative RT-PCR.28-30

IgM and IgG are detectable after 3-7 days and 12 days since onset of symptoms, respectively. The viral load decreases gradually as the serum antibodies increase. The sensitivity of SARS-CoV-2 IgM reaches 70.2% with a 96.2% specificity. The sensitivity of the IgG is 96.1% with a specificity of 92.4%. It should be noted that IgM, unlike IgG, is not able to cross the placental barrier.[28-30]

## COVID-19 IgG/IgM Rapid Test (blood, serum, plasma)

Primary or secondary infections can be detected in 10-20 minutes using chromatographic immunoassay for qualitative detection of SARS-CoV-2 IgM and IgG. This test has an IgG sensitivity of 97.4% and specificity 99.3%; while IgM counts with a 86.8% sensitivity and 98.6% specificity. The results can be interpreted as: positive (any color tone in the IgG and/or IgM test line regions); negative (a color line on the control strip, and no lines in the IgG and IgM regions); or invalid (no tone in control line).[24] (fig. 19)

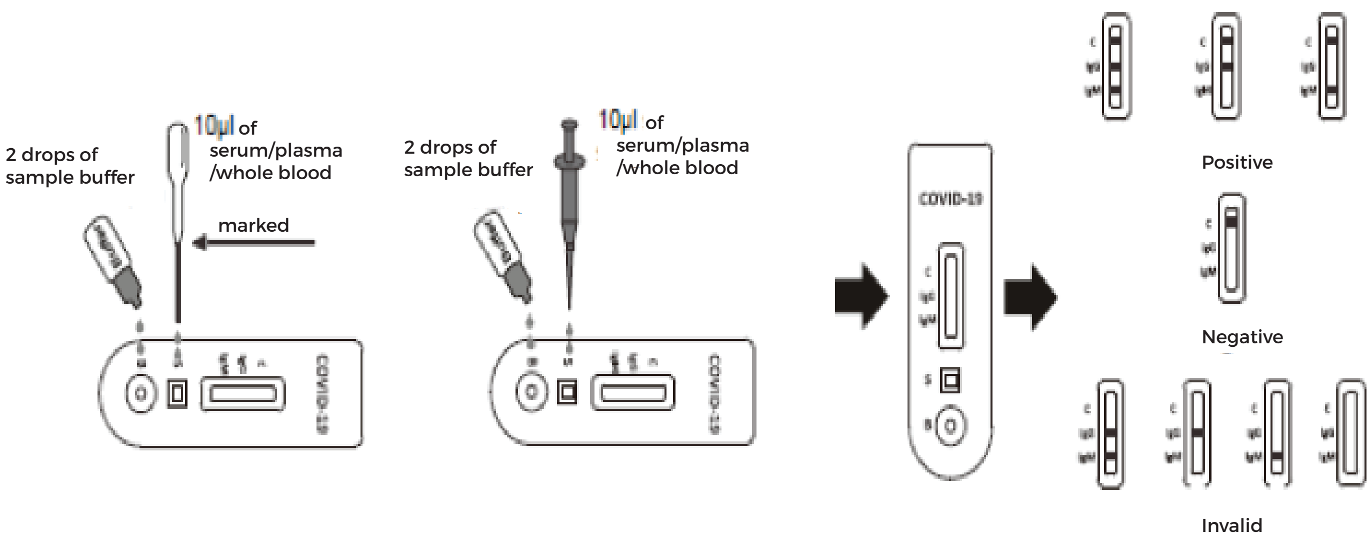



Fig. 19. COVID-19 IgM/IgG Rapid Test

## REFERENCES


1. National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases
2. Dr. Tinku Joseph, Dr. Mohammed Ashkan Moslehi. International Pulmonologist's Consensus On COVID-19
3. Chen Y, Guo Y, Pan Y, Zhao ZJ. Structure analysis of the receptor binding of 2019-nCoV. Biochem Biophys Res Commun. 2020 Feb 17. PMID:32081428
4. Xu H, Zhong L, Deng J, et al. High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. Int J Oral Sci 2020; published online Feb 24.
5. Pradip Dashraat, Wong Jing Lin Jeslyn. Coronavirus Disease 2019 (COVID-19) Pandemic and Pregnancy. Department of Obstetrics & Gynaecology, National University Hospital, Singapore Yong Loo Lin School of Medicine, National University of Singapore
6. Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. Intens Care Med 2020; published online Mar 3. DOI:10.1007/s00134-020-05991-x
7. Lauer SA1, Grantz KH1, Bi Q1, Jones FK1, Zheng Q1, Meredith HR1, Azman AS1, Reich NG2, Lessler J1.The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. Ann Intern Med. 2020 Mar 10. doi: 10.7326/M20-0504.
8. Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. N Engl JMed 2020.
9. Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med 2020
10. Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to person transmission: a study of a family cluster. Lancet 2020; 395:514.
11. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA 2020.
12. W. Guan, Z. Ni, Yu Hu, W. Liang, C. Ou, J. He, L. Liu, H. Shan, C. Lei, D.S.C. Hui, B. Du, L. Li, G. Zeng, K.-Y. Yuen, R. Chen Clinical Characteristics of Coronavirus Disease 2019 in China.
13. J. Chen, T. Qi and L. Liu et al., Clinical progression of patients with COVID-19 in Shanghai, China, Journal of Infection
14. Nelson-Piercy C. Respiratory disease. In: Handbook of Obstetric Medicine. Boca Raton, FL: CRC Press; 2015:63-84.
15. Littauer EQ, Esser ES, Antao OQ, Vassilieva EV, Compans RW, Skountzou I. H1N1 influenza virus infection results in adverse pregnancy outcomes by disrupting tissue-specific hormonal regulation. PLoS Pathog 2017;13e1006757-e1006757

## REFERENCES

**16.** Thevarajan I, Nguyen THO, Koutsakos M, et al. Breadth of concomitant immune responses prior to patient recovery: a case report of non-severe COVID-19. Nat Med 2020; published online Mar 16. DOI: 10.1038/s41591-020-0819-2

**17.** Chen H, Guo JMS, Chen W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 2020; published online Feb 12.

**18.** Goncé A, López M, Hernández S, Palacio M, Figueras F. Protocolo: Coronavirus (covid-19) y Embarazo. Protocols Medicina Materno Fetal – hospital Clínic Barcelona. 17/3/2020

**19.** Qing-Liang Zheng, Tao Duan, Li-Ping Jin. Single-cell RNA expression profiling of ACE2 and AXL in the human maternal–Fetal interface. Clinical and Translational Research Center, Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine, Shanghai 201204, China

**20.** Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia - Zhu - Translational Pediatrics [Internet]. [citado 6 de marzo de 2020]. Disponible en: http://tp.amegroups.com/article/view/35919/28274

**21.** Savannah F. Pedersen, Ya-Chi Ho. SARS-CoV-2: A Storm is Raging. J Clin Invest. 2020. https://doi.org/10.1172/JCI137647.

**22.** https://www.ebmedicine.net/topics/infectious-disease/COVID-19/Espanol.

**23.** Zhejiang University School of Medicine (FAZHU). Handbook of COVID-19. Prevention and Treatment. China. Marzo 2020.

**24.** http://en.biotests.com.cn/

**25.** Centro de Coordinación de Alertas y Emergencias Sanitarias. Dirección General de Salud Pública. Prevención y control de la infección en el manejo de pacientes con COVID-19. Ministerio de Salud España. Febrero 2020

**26.** 10.- Centro de Coordinación de Alertas y Emergencias Sanitarias. Dirección General de Salud Pública. Enfermedades Infecciosas Hospital Universitario Ramon y Cajal. Salud Madrid. España. Marzo 2020

**27.** Centro de Coordinación de Alertas y Emergencias Sanitarias. Dirección General de Salud Pública. Manejo clínico del COVID-19: atención hospitalaria. Ministerio de Salud España. Febrero 2020.

**28.** W. Guan, Z. Ni, Yu Hu, W. Liang, C. Ou, J. He, L. Liu, H. Shan, C. Lei, D.S.C, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. The New England Journal of Medicine. April 2020

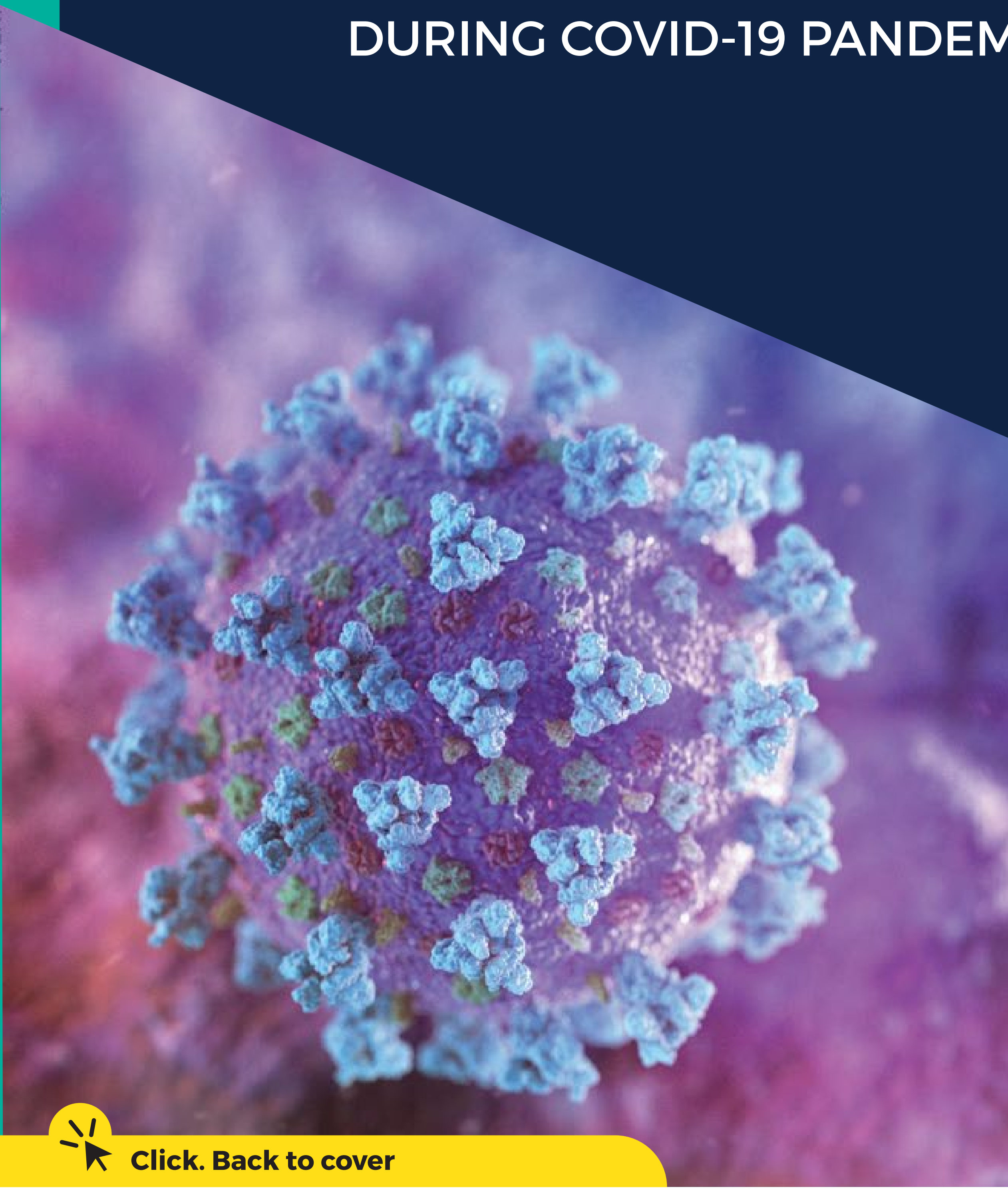
**29.** Thomas-Rüddel D, Winning J, Dickmann P, Ouart D, Kortgen A, Janssens U, Bauer M. Coronavirus disease 2019 (COVID-19): update for anesthesiologists and intensivists March 2020. Der Anesthesist. Published on line: 24 march 2020.

**30.** Dong L, Tian J, He S, et al. Possible Vertical Transmission of SARS-CoV-2 From an Infected Mother to Her Newborn. JAMA Letters. March 26, 2020. https://jamanetwork.com/ on 03/27/2020 doi:10.1001/jama.2020.4621

AVUM EXPERT CONSENSUS FOR

**COVID-19 IN PREGNANCY**

# PRACTICAL GUIDELINES FOR PRENATAL CARE AND OBSTETRIC ULTRASOUND DURING COVID-19 PANDEMIC



AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

Click. Back to cover

The introduction of prenatal care was a major advance in the care of pregnant women. It played a key role in substantially reducing perinatal morbidity and mortality over the last century.[1]

In 1929, the UK Ministry of Health issued a memorandum on prenatal clinic recommendations, stating that women should be seen first at 16 weeks gestation, then at 24 and 28 weeks, fortnightly from then until 36 weeks, followed by weekly visits until delivery.[2]

In 2011, Nicolaides proposed a new model, one which would improve the outcome of pregnancy by reversing the prenatal care pyramid to introduce large-scale and systematic monitoring. This would be based on a comprehensive genetic evaluation at 110 to 136 weeks gestation; followed by a visit around 20 weeks to assess fetal anatomy, growth and complications assessment (such as preeclampsia and preterm delivery). Then another visit at 37 weeks to check for maternal-fetal well-being and determine timing and mode of delivery. This is repeated at 41 weeks for those still pregnant.[1]

Another approach is that proposed by WHO, which describes prenatal control in an early, periodic, comprehensive, and wide fashion. The consultation schedule serves a basic prenatal care model, spread over four visits: one at 8-12 weeks, followed by 24-26 weeks visit, then a 32 weeks visit, ending with a 36-38 weeks visit. Guidance on each visit includes specific evidence-based interventions for health pregnant women, with the relevant classifications and referral of high risk cases.[3]

In the current context of the COVID-19 pandemic, the International Foundation for Maternal Fetal Medicine proposed a reduced model of prenatal care consultations for three patient groups: low-risk, high-risk and patients with COVID-19 infection.[4]

All pregnant women must follow and abide by the provisions on social distancing and prevention measures. This means that prenatal care must be coordinated in faithful compliance with quarantine, avoiding departures from home through telemedicine and video consultations.[4]

Telemedicine would address the recommendations expressed in the WHO Prenatal Control Guide: Good Experiences.5 It would also guide the order and review of prenatal work-ups according to the gestational age, and train patients on the prevention and signs and symptoms of COVID-19 infection.

### TELEMEDICINE VISIT

1. Nutrition counseling
2. Common pregnancy symptoms
3. Prenatal laboratory tests by gestation age
4. COVID-19 prevention and symptoms
5. Precautions

### COVID-19 PRECAUTIONS

1. Fever
2. Cough
3. Shortness of breath
4. Headache, visual or olphactory disturbances
5. Epigastralgia
6. Decreased fetal movements
7. Uterine activtiy
8. Vaginal bleeding
9. Leakage of fluid
10. Urinary symptoms

Recommend review at: https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/anc-positive-pregnancy-experience/en/

Low-risk patients would include those with an optimal course, without epidemiological factors or notable obstetric history. These patients should attend to their first evaluation between 11 and 136 weeks gestation for the detection of aneuploidies, stratification of risk for hypertensive disorders of pregnancy, and cervical cancer screening.

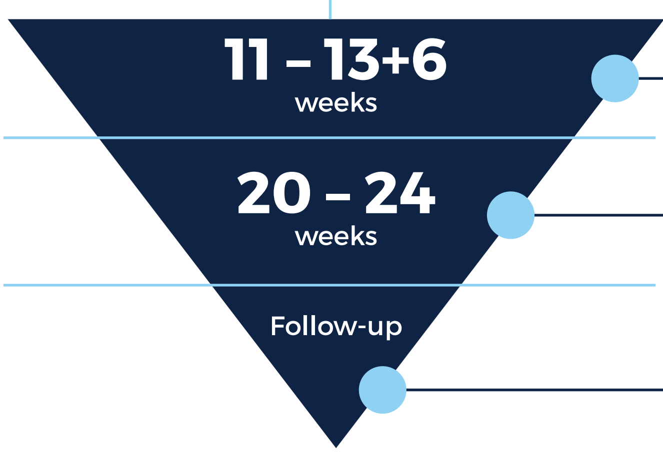
## PRENATAL CARE MODEL FOR COVID-19 NEGATIVE PATIENTS

### Low risk

(Infection prevention)
Patient that don not qualify for strict/close follow-up
Counseling for alarm symptoms

### High risk

(follow-up according to risk)
Perinatal morbidity and mortality increased
Prenatal care adapted to pathology




Genetic screening US, blood test genetic screening, cervical cancer and PIH screening
Stratify risk level

Anatomy scan, PTL risk stratification/screening, placental location
Metabolic screening
Reassess risk level

At the end of quarantine, labor or alarm symptoms

**US:** ultrasound / **PIH:** pregnancy-induced hypertension / **PTL:** preterm labor

Herrera M. Coronavirus Covid – 19 y embarazo: update guía de FIMMF. Fundación Internacional de Medicina Materno Fetal. Videoconferencia presentada el 23 de marzo 2020 disponible: http://vimeo.com/400488176

This would be followed by a visit between 20 and 24 weeks, at which time an anatomy ultrasound is performed; preterm delivery screening, placental location, and risk stratification are completed as well. If the patient remains low-risk, she must remain at home in accordance to the conditions established by the pandemic and will go for a consultation again only for delivery, if precautions/alarm symptoms arise, or the quarantine measures end.

## ANATOMY ULTRASOUND

### THORAX

- Four chamber view
- LVOT/RVOT
- Three vessel view

### HEAD

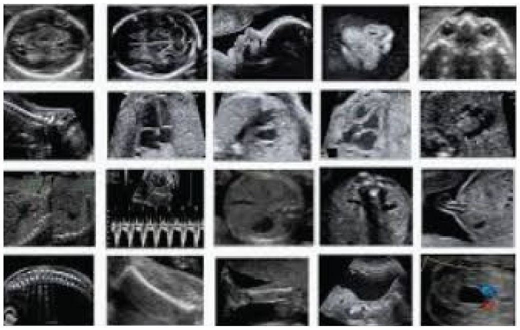
- BPD/HC
Atrium/cavum septum pellucidum
Posterior fossa Filtrum

### EXTREMITIES

- Femur length
- Confirm extremity count, hands and feet

### ABDOMEN

- AC
- CI
- Kidneys
- Bladder



### SPINE

- Transverse view
- Sagittal view

### AMNIOTIC FLUID

- MVP

### CERVICAL LENGTH

- Not performed routinely in low risk patients
- May be performed abdominally. CL < 35mm must be assessed with transvaginal probe
- Routine for high risk patients
- To rule out accreta, low-lying placenta or placenta previa

### PLACENTA

- Transvaginal assessment to rule out accreta, low-lying placenta or placenta previa

Adaptado de: https://s3.amazonaws.com/cdn.smfm.org/media/2272/Ultrasound_Covid19_Suggestions_(final)_03-24-20_(2)_PDF.pdf

High-risk patients will comply with the first two visits described above, followed by obstetric surveillance with a frequency that would be individualized to the pathology and/or base condition. According to the WHO classification, these high-risk patients include those with associated hypertensive disorders, gestational diabetes, IUGR, multiple pregnancy, congenital malformations, immunological disease, among others[3,5]

This model takes into account the morbidity and mortality generated by hypertensive disorders, preterm delivery and cervical cancer. It also highlight the role of genetic and anatomy assessment during pregnancy. The risk of these pathologies statistically exceeds the risk of the current virus-related mortality, justifying the patient's exit from their home during the pandemic.

## ULTRASOUND FOLLOW-UP ON PATIENTS WITH COVID-19

Based on a scant amount of evidence and cases reports during the pandemic, the effect of the SARS-CoV-2 on the fetus remains uncertain. Since 2002-2003, evidence gathered from the MERS and SARS-CoV-1 pandemics did not show any convincing or statistically significant evidence linking the infections with increased malformations or pregnancy loss.[7]

Currently, there is no evidence of vertical transmission or intrauterine COVID-19 infection. It is considered hypothetical and unlikely that there are congenital alterations by the virus during fetal development. However, given that the pandemic is still evolving, we propose the following guidelines to document and follow-up the experiences to refute or confirm cases of fetal anomalies or vertical transmission, using evidence-based medicine.[7]

### MODERL FOR ULTRASOUND MONITORING IN NON-SEVERE COVID-19 POSITIVE PREGNANT PATIENTS

**POSITIVE TEST**

**NO SEVERITY CRITERIA**

1. Home quarantine (14 days)
2. Telephone monitoring (2-4 days)
3. Antenatal testing for fetal well-being
4. Growth ultrasound + AFI

**HOME QUARANTINE**

**FOLLOW-UP AFTER RECOVERY**
These evaluations must be performed after 14 days of recovery, 3 days asymptomatic with **NEGATIVE SEROLOGY**

**1st trimester**

**11-13+6 week ultrasound – aneuploidy**

**screening: UA Doppler**

- Increased risk of pregnancy loss
- No increased risk of aneuploidies
- No increased risk of congenital malformations

**2nd trimester**

**PTD screening:** cervical length (CL)*

**Anatomy ultrasound** (see attachement)

**Fetal echocardiography****

**Cardiac function** (TEI index)

**Fetal neurosonography****
(Not associated with increased congenital malformations)

**Maternalfetal hemodynamic profile**
(Refer to IUGR Follow-up Model)

**Discard uteroplacental insufficiency**

**IUGR¶**

**Oligohydramnios** (MVP)

**3rd trimester**

**Antenatal testing** per pathology

**Ultrasound of fetal neurodevelopment**

**Maternalfwtal hemodynamic profile**

**Discard uteroplacental insufficiency**

**IUGR¶**

**Oligohydramnios** (MVP)

*There are higher reported incidences of preterm birth in pregnant women with COVID-19, with iatrogenic or spontaneous etiology being uncertain, however there are reports of preterm birth, premature membrane rupture and spontaneous fetal engagement.
https://www.rcm.org.uk/media/3780/coronavirus-covid-19-virus-infection-in-pregnancy-2020-03-09.pdf

**Given the neurotrophic potential of COVID-19 which uses synaptic transmission of nerve endings. The latter, along with the SARS-CoV and MERS-CoV experience in which the disruption of the blood barrier is described, as well as viral myocarditis, it is intended to thoroughly evaluate the central nervous system and fetal heart in order to corroborate or rule out findings in the face of limited evidence.
https://pubs.acs.org/doi/pdf/10.1021/acschemneuro.0c00122 https://www.medrxiv.org/content/10.1101/2020.03.19.20034124v1.full.pdf

¶ In the context of IUGR with estimated fetal weight greater than 3% and normal umbilical artery doppler, evaluation of the Doppler hemodynamic profile is suggested (see US IUGR Tracking Model) every 2 to 3 weeks. For the IUGR of early installation or abdominal circumference (AC) less than 3%, the growth pattern echo is considered every 3 weeks.

**https://s3.amazonaws.com/cdn.smfm.org/media/2272/Ultrasound_Covid19_Sugges**

# MODEL FOR ULTRASOUND FOLLOW-UP IN THE SETTING OF INTRAUTERINE GROWTH RESTRICTION

**PEG:** Pequeño para edad gestacional
**PFE:** peso fetal estimado
**ACM:** arteria cerebral media
**Aut:** arteria uterina
**CTGp:** Registro cardiotocográfico patológico
**UA-AEDV:** flujo diastólico ausente en arteria umbilical
**UA-REDV:** flujo diastólico ausente en arteria umbilical
**DV-REDV:** Flujo diastólico reverso en el ductus venoso

## Follow-up schedule

| | |
|---|---|
| **SGA:** EFW < p3 or <p10 with normal Dopplers | **every 2-3 weeks** |
| **FGR stage I:** EFW <p3 or EFW <p10 (MCA PI <p5, UtA PI >p95, or CPR <p5) | **every 1-2 weeks** |
| **FGR stage II:** EFW <p10 + (UA AEDV or reverse AoI) | **every 2-4 days** |
| **FGR stage III:** EFW <p10 + (UA REDV, DV-PI >p95) | **every 24-48 hours** |
| **FGR stage IV:** EFW <p10 (DV reverse flow cCTG <3 ms, FHR decelerations) | **every 12-48 hours** |

**ELECTIVE CESAREAN SECTION**

### FGR stage IV

- DV reversed EDV (persisting 12h apart) or pathological CTG (reduced STV or deceleration pattern)

→ **26 WEEKS**

NO ↓

### FGR stage III

- DV absent EDV (persisting 6-12h apart)
- DV pulsatility index > 95th centile (persisting 6-12h apart)
- UA reversed EDV (persisting 6-12h apart)
- Dicrotic venous pulses (persisting 6-12h apart)

→ **30 WEEKS**

NO ↓

### FGR stage II

- UA absent EDV or AoI reversed diastolic velocities (both persisting 12h apart)

→ **34 WEEKS**

NO ↓

**LABOR INDUCTION**

### FGR stage I

- EFW < 3rd centile or CPR < 5th centile or MCA pulsatility index < 5th centile (both persisting 12h apart) or mean UtA pulsatility > 95th centile

→ **37 WEEKS**

NO ↓

### SGA

- EFW < 3rd centile or <10th with normal Dopplers

→ **40 WEEKS**

https://medicinafetalbarcelona.org/protocolos/es/patologia-fetal/cir-peg.pdf cerebroplacental ratio will be performed on all visits.

## REFERENCES

**1.** Nicolaides K. A model for a new pyramid of prenatal care based on the 11 to 13 weeks' assessment. Prenat Diagn 2011; 31: 3–6.

**2.** Organización Mundial de la Salud. Recomendaciones de la OMS para los Cuidados durante el parto, para una experiencia de parto positivo. Suiza, 2018.

**3.** Protocolos de atención. Cuidados prenatales y atención obstétrica. Ministerio del Poder Popular para la Salud. Venezuela. UNICEF, OPS, OMS, UNFPA. Marzo 2014.

**4.** Herrera M. Coronavirus Covid – 19 y embarazo: update guía de FIMMF. Fundación Internacional de Medicina Materno Fetal. Videoconferencia presentada el 23 de marzo 2020 disponible: http://vimeo.com/400488176

**5.** Organización Mundial de la Salud. Recomendaciones de la OMS sobre la atención prenatal para una experiencia positiva del embarazo. Washington, D.C; 2018. Disponible: https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/anc-positive-pregnancy-experience/en/

**6.** SMFM. Ultrasound Covid-1.. Disponible: https://s3.amazonaws.com/cdn.smfm.org/media/2272/Ultrasound_Covid19_Suggestions_(final)_03-24-20_(2)_PDF.pdf

**7.** RCOG.org.UK. COVID-19. Disponible: https://www.rcm.org.uk/media/3780/coronavirus-covid-19-virus-infection-in-pregnancy-2020-03-09.pdf

**8.** ACS Chemical Neuroscience. Evidence of the COVID-19 Virus Targeting the CNS: Tissue. Distribution, Host–Virus Interaction, and Proposed Neurotropic Mechanisms. Disponible: https://pubs.acs.org/doi/pdf/10.1021/acschemneuro.0c00122

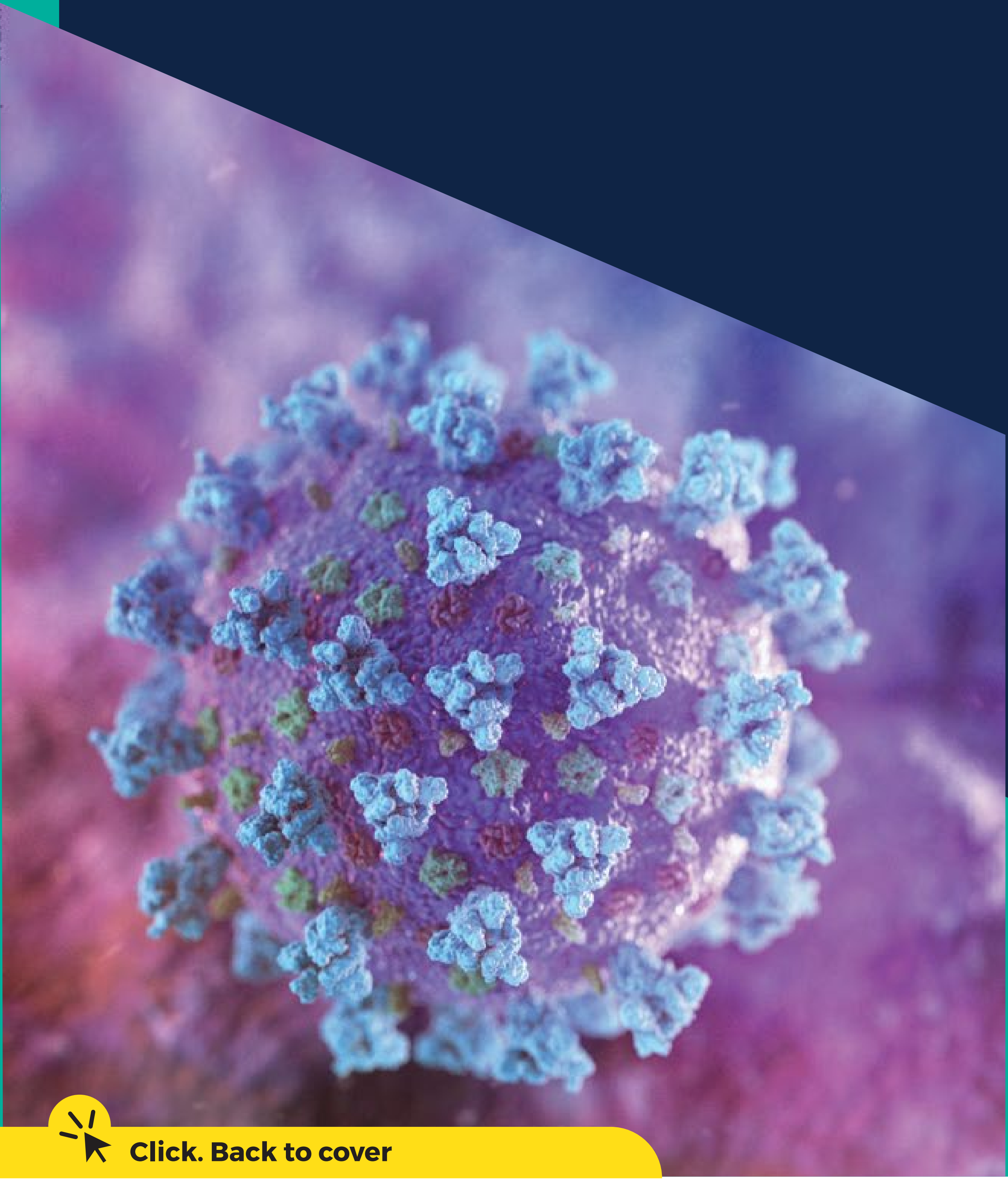
**9.** Kun-Long Ma, et al. COVID-19 Myocarditis and Severity Factors：An Adult Cohort Study. Disponible: https://www.medrxiv.org/content/10.1101/2020.03.19.20034124v1.full.pdf

**10.** Medicina Fetal Barcelona. Protocolo en patología fetal. Disponible: https://medicinafetalbarcelona.org/protocolos/es/patologia-fetal/cir-peg.pdf

AVUM EXPERT CONSENSUS FOR

COVID-19 IN PREGNANCY

# GUIDE FOR RADIOLOGICAL IMAGING IN **COVID-19**



AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

Click. Back to cover

## IONIZING RADIATION IN PREGNANCY

In obstetric practice, it is often necessary to expose pregnant women to ionizing radiation. In the event that a chest x-ray is needed in a patient with respiratory symptoms, the study should not be delayed because of pregnancy. Concerns arises from the amount of photonic radiation received by the embryo or fetus and its consequences. The radiation dose absorbed can be expressed in different units of measurement: [1]

| Unit of measurement of ionizing radiation absorbed by a material[1] | | Unit of measurement of ionizing radiation absorbed by living matter (hazard)[1] | |
|---|---|---|---|
| American | International System | American | International System |
| rad | Gray (Gy) | Rem | Sv |
| 100 ergs/gr irradiated | 1 Joule(J)/kg irradiated | Roentgen Equivalent Man | Sievert |
| 1 Gy = 100 rad | | 1 Sv = 1 Gy = 100 rad | |

With ionizing radiation doses less than 50 mGy (5 rads), there is no evidence of increased risk of fetal abnormalities, mental retardation, growth restriction, or pregnancy loss.[2] Exposure depends on the study performed:

| CONVENTIONAL RADIOLOGY | | COMPUTERIZED TOMOGRAPHY (CT) | |
|---|---|---|---|
| IMAGING STUDY | DOSE (mSV-rad) | IMAGING STUDY | DOSE (mSV-rad) |
| CHEST XRAY (CXR AP) | 0,01 mSv – 0,001 rad | CHEST CT | 0,06 mSv – 0,006 rad |
| ABDOMEN XRAY | 2 – 5 mSv – 0,2 – 0,5 rad | ABDOMEN CT | 8 mSv – 0,8 rad |
| | | HEAD CT | 0,005 mSv – 0,0005 rad |

Cuartero E. et al. Radiology and pregnancy, a delicate situation always present: Electronic Presentation. Spanish Society of Medical Radiology. 2010.

The risk of damage to the fetus depends on: distribution, dose absorbed, and gestational age of fetus over a period of time.[1]

**Radiation-induced teratogenesis: effect according to gestational age and radiation dose**

| | | Effect | Estimated Threshold Dose |
|---|---|---|---|
| Gestational Age | **Before implantation** (0-2 weeks after fertilization) | Death of embryo or no consequence (all or none) | 50 – 100 mGy |
| | **Organogenesis** (2-8 weeks after fertilization) | Congenital anomalies (skeleton, eyes, genitals) | 200 mGy |
| | | Growth restriction | 200 – 250 mGy |
| Fetal Period | **8 – 15 weeks** | Severe intellectual disability (high risk) | 60 – 310 mGy |
| | | Intellectual disability | <25 CI por cada 1000 mGy |
| | | Microcephaly | 200 mGy |
| | **16 – 25 weeks** | Severe intellectual disability (low risk) | 250 – 280 mGy |

Guidelines for diagnostic imaging during pregnancy. ACOG Committee Opinion n° 723. American College of Obstetricians and Gynecologists. October 2017

## RADIOLOGICAL STUDIES IN COVID-19

Radiological tests are playing a key role in the management of patients with COVID-19 infection. There is no consensus on the indications for imaging studies, in either an urgent or follow-up setting.
During the pandemic, the diagnostic studies that have been proven to be more effective for the determination, development, and prognosis of COVID-19-related lung pathologies are: CXR, chest CT and lung ultrasound.

### Recommendations for imaging in COVID-19 suspected cases

The American College of Radiology (ACR), British Society of Thoracic Radiology (BSTR), American Society of Thoracic Radiology (ASTR), and the Canadian Radiology Society, have all made statements about the role of CXR and chest CT for screening, diagnosis and management of patients with suspected or confirmed COVID-19 infection.[3-5]

According to the RTA, the following factors should be taken into account when using imaging studies for suspected or known COVID-19 infections:[4]

- Currently, the CDC does not recommend CXR or chest CT for the diagnosis of COVID-19. Viral testing is the only specific method of diagnosis. Even if radiological findings are suggestive of COVID-19, viral testing is required. However, according to current protocols, the management or initiation of treatment must be individualized.

- The findings in chest imaging in COVID-19 patients are not specific and overlap with other infections, such as influenza, H1N1, SARS, and MERS.

- **CT should not be used as a first-line test to diagnose COVID-19**
- **CT should be reserved for hospitalized and symptomatic patients**
- **Consider portable equipment or outpatient units for CXR**
- **Familiarize yourself with the most common findings in COVID-19 patients**
- **Follow appropriate infection control measures in between patients**

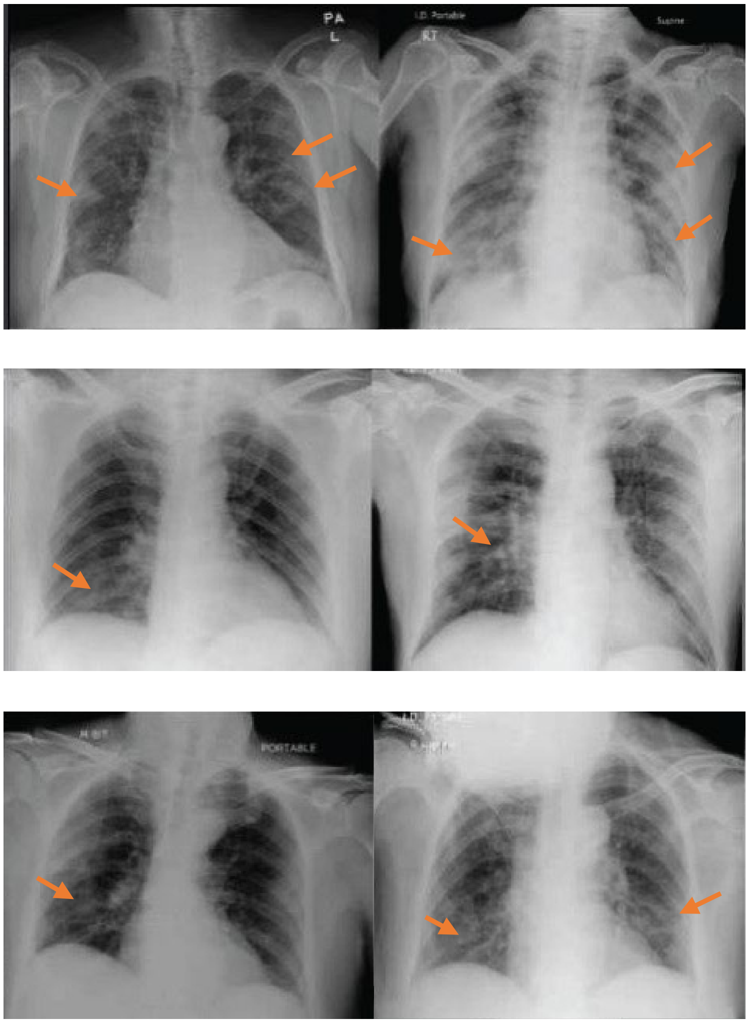
Infection control in health care facilities should be strongly considered while using imaging equipment during the pandemic. It is recommended to limit patient visits, and even perform teleconsultation to advance anamnesis and adequate protection of patients and health personnel. The decontamination of rooms occupied by a patient with suspected or known COVID-19 infection play an important role. Airflow in x-ray or CT rooms should be considered before imaging the next patient. Depending on the air exchange rates, rooms may not be available for up to an hour after taking images of an infected patient.[6]

## ABOUT CHEST IMAGING

### CHEST X-RAY

double projection and portable is the preferred modality. It has a low sensitivity and specificity for patient with suspected pneumonia. Parenchymatous opacity (frosted/ground glass or consolidation) of peripheral distribution and basal predominance suggests COVID-19 pneumonia in an appropriate clinical context. [7, 8]

| Frequent CXR findings in COVID-19 patients |
|---|
| Bilateral consolidations |
| Absence of pleural effusion |




Focos radiodensos con aspecto inflamatorio bilaterales a predominio basal (flechas)

Tomado de: SK Li, YC. Lee. Radiological findings of 2019-nCoV Pneumonia PMH experience. Departament of radiology Caritas Medical Center/Yan Chai Hospital. 10 Marzo 2020..

## RADIOLOGICAL SEVERITY IN COVID-19 PATIENTS

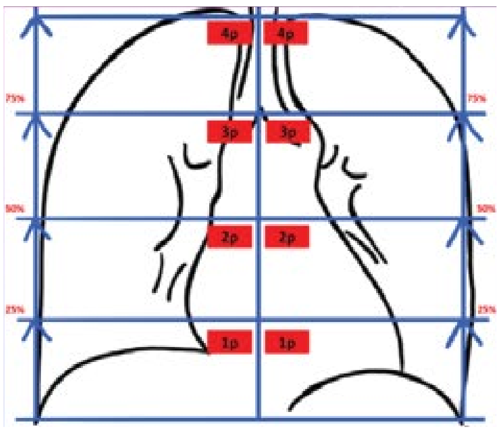
Wong H, Lam H, Fong A et al, realizaron una importante observación del comportamiento de las imágenes radiológicas de tórax y su conducta en el tiempo de evolución de la enfermedad, asociándola con el grado de afectación. [12]

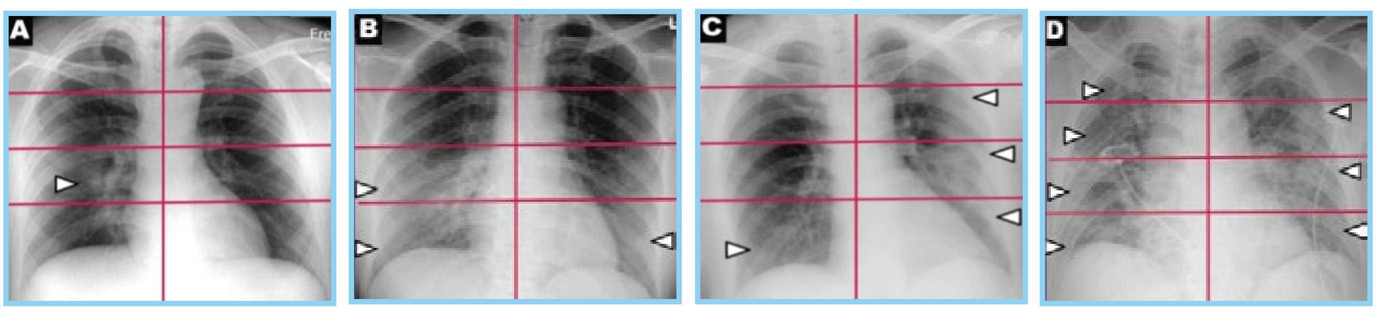
A scale of 0-8 points is used according to the radiological extent of the pulmonary involvement.

**Normal CXR 0 – Maximal severity 8**

Score is obtained from the total score from both lungs. The method for its calculation is the following:

- Divide each lung in 4 quadrants, with the hilum marking the mid-point
- Each quadrant accounts for 25% of the pulmonary parenchyma
- Each lung is score from 0-4 according to the extent of the involvement, looking for opacities and ground glass appearance




**A**
PD=1 (25%) PI=0 TOTAL=1

**B**
PD=2 (50%) PI=1 (25%) TOTAL=3

**C**
PD=1 (25%) PI=3 (75%) TOTAL=4

**D**
PD=4 (>75%) PI=3 (75%) TOTAL=7

Based on the total score obtained, we radiologically classify the lung injury as:

| Normal 0 | Leve 1-2 | Moderada 3-6 | Severa >6 |
|---|---|---|---|

Comments: Peak severity is seen between day 10-12. These findings are radiological, there may be a clinical-radiological mismatch.

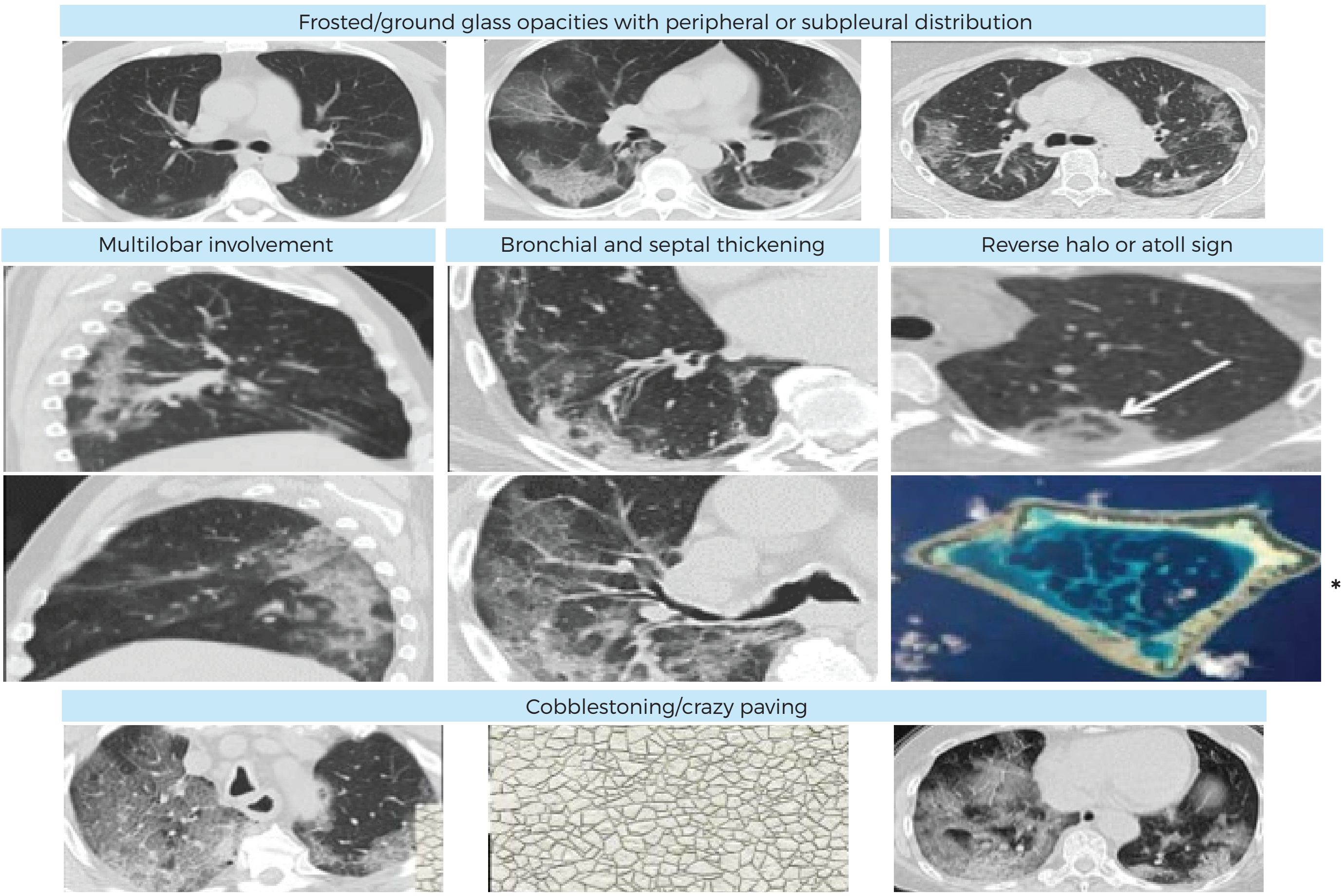
Adapted from: Wong HYF, Lam HYS, Fong AH, Leung ST, Chin TW, Lo CSY, Lui MM, Lee JCY, Chiu KW, Chung T, Lee EYP, Wan EYF, Hung FNI, Lam TPW, Kuo M, Ng MY. Frequency and Distribution of Chest Radiographic Findings in COVID-19 Positive Patients. (2019) Radiology March 2020. Publicación adaptada por: Ureña A, Bártulos A, Suevos C, Herrero M.

## CHEST CT

it is recommended to be performed without contrast. Up to 50% of COVID-19 patients may have normal findings initially. Taking into account the 60-70% sensitivity of RT-PCR, there may be patients with CT findings suggestive of COVID-19, with a negative PCR.9 Initial tomographic abnormalities are described as peripheral and bilateral frosted/ground glass opacities which could be focal or multifocal. As the disease progresses the cobblestoning and consolidation becomes predominant while peaking at 9-13 days. This is followed by a slow clearance in 1 month or more. [7, 9]

| Frequent Chest CT findings in COVID-19 patients | |
|---|---|
| Frosted/ground glass opacities | Multilobar involvement |
| Peripheral or subpleural opacities | Septal thickening |
| Bronchial thickening | Consolidations / Cobblestoning (crazy paving) |
| **Less common findings** | |
| Nodules | Reversed halo sign or atoll sign |
| **Usually absent** | |
| Pleural effusion | Lymphadenopathy |

**CHEST CT FINDINGS IN COVID-19 PATIENTS**

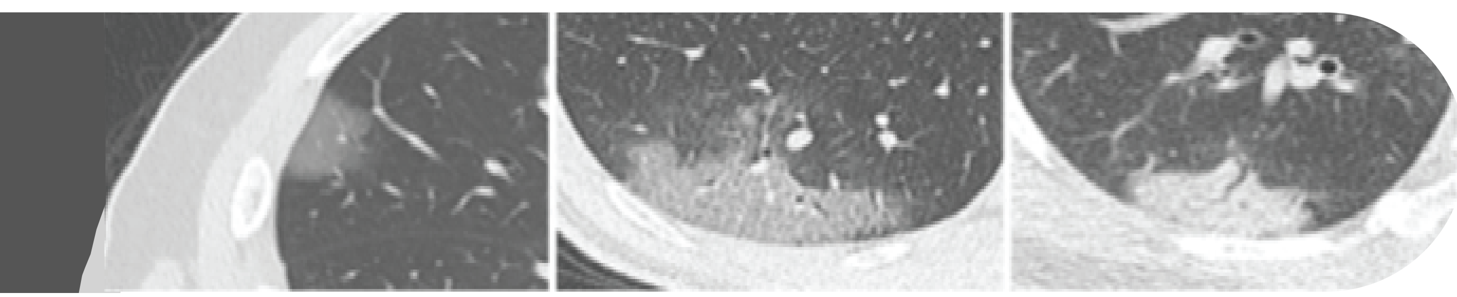



SK Li, YC. Lee. Radiological findings of 2019-nCoV Pneumonia PMH experience. Departamento of radiology Caritas Medical Center/Yan Chai Hospital. 10 Marzo 2020.

A. Bernheim, X. Mei, M. Huang, Y. Yang, Z. Fayad, N. Zhang, et al. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. Radiology 2020.

## TOMOGRAPHIC PROGRESSION OF COVID-19

| 0 a 5 DAYS | 6 a 11 DAYS | 12 a 17 DAYS |
|---|---|---|
| Frosted or ground glass opacities<br>Cobblestoning | Increased extent/coverage of ground/frosted glass opacities | Decreased extent/coverage of ground/frosted glass opacities |
| Consolidation | Consolidation<br>Critical cases: diffuse | |
| Frosted or ground glass opacities | + Consolidation | |
| | Ground/frosted glass<br>+ irregular lines | |
| | | Lung architectural distortion<br>(organizing pneumonia) |



SK Li, YC. Lee. Radiological findings of 2019-nCoV Pneumonia PMH experience. Departamento of radiology Caritas Medical Center/Yan Chai Hospital. 10 Marzo 2020.

## COMPARISON WITH OTHER VIRAL PNEUMONIAS

Viral pneumonias, especially influenza-related, have similar findings to those described in COVID-19 cases. It is essential to confirm the etiology using PCR. [4,6]

| Common features of COVID-19 pneumonia |
| --- |
| Peripheral distribution (80% vs 57%, p<0.001) |
| Frosted/ground glass opacities (91% vs 68%, p<0.001) |
| Bronchovascular thickening (58% vs 22%, p<0.001) |

Tomado de: Manejo en el área de Radiodiagnóstico ante una sospecha de infección COVID-19. SERAM. Disponible en: https://seram.es/index.php/seram-rss/1380-nuevodocumento-informativo-sobre-infeccion-por-coronavirus-cobid-1

## RADIOLOGICAL STUDIES REPORTING

The BSTR published guidelines for radiological reports in patients with COVID-19.5  They classify findings as:

| POSSIBLE | INDETERMINATE | ALTERNATIVE DIAGNOSIS |
| --- | --- | --- |
| Peripheral frosted/ground glass opacities; cobblestoning, diffused alveolar injury, or organized pneumonia pattern. | Non-peripheral frosted glass opacities, fibrosis, pleural effusion, lymphadenopathy. | Lobar pneumonias, tree-in-bud nodule patterns |

Covid-19: BSTI statement and guidance. Disponible en: https://www.bsti.org.uk/standards-clinical-guidelines/clinical-guidelines/covid-19-bsti-statement-and-guidance/

It is also recommended to assess findings severity as mild, moderate or severe. The existence of structural consolidation and distortion are signs of severity.

Considering the use of x-rays and tomography in the child-bearing and pregnant population needs to take into account the risk of its use, and try and minimize the anxiety of patients and healthcare personnel. Safe conditions must be promoted and established to prevent spread and transmission of the disease to exposed healthcare workers.

Follow-up imaging studies for COVID-19 patients should be tailored to each patient and should not be performed routinely. They should be performed only if necessary, being cautious to analyze all the existing variables to provide optimal information and serve as a reference for follow-up visits.

## REFERENCES


**1.** R. Uribe, N. Sáez, J. Carvajal. Estudios de radiodiagnóstico durante el embarazo. Revista Chilena de Obstetricia-Ginecología. V.74 N.2 Santiago 2009.

**2.** International Commission on Radiological Protection (ICRP). N° 84 Ed. SEPR y SAR. Pregnancy and Medical Radiation. 2002.

**3.** Equipo editorial de labmedica en español. Recomendaciones nuevas de imagenología para casos sospechosos de COVID-19. 23 Mar 2020

**4.** ACR, posición sobre covid -19. Disponible en: https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection

**5.** Covid-19: BSTI statement and guidance. Disponible en: https://www.bsti.org.uk/standards-clinical-guidelines/clinical-guidelines/covid-19-bsti-statement-and-guidance/

**6.** Manejo en el área de Radiodiagnóstico ante una sospecha de infección COVID-19. SERAM. Disponible en: https://seram.es/index.php/seram-rss/1380-nuevodocumento-informativo-sobre-infeccion-por-coronavirus-cobid-1

**7.** SK Li, YC. Lee. Radiological findings of 2019-nCoV Pneumonia PMH experience. Departamento of radiology Caritas Medical Center/Yan Chai Hospital. 10 Marzo 2020.

**8.** A. Bernheim, X. Mei, M. Huang, Y. Yang, Z. Fayad, N. Zhang, et al. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. Radiology 2020.

**9.** M. Chung, A Bernheim, X. Mei, N. Zhang, M. Huang, X. Zeng, et al. CT Imaging Features of 2019 Novel Coronavirus 2019-ncov. Radiology. Abril de 2020;295(1):202-7. 13.

**10.** Guidelines for diagnostic imaging during pregnancy. ACOG Committee Opinion n° 723. American College of Obstetricians and Gynecologists. October 2017

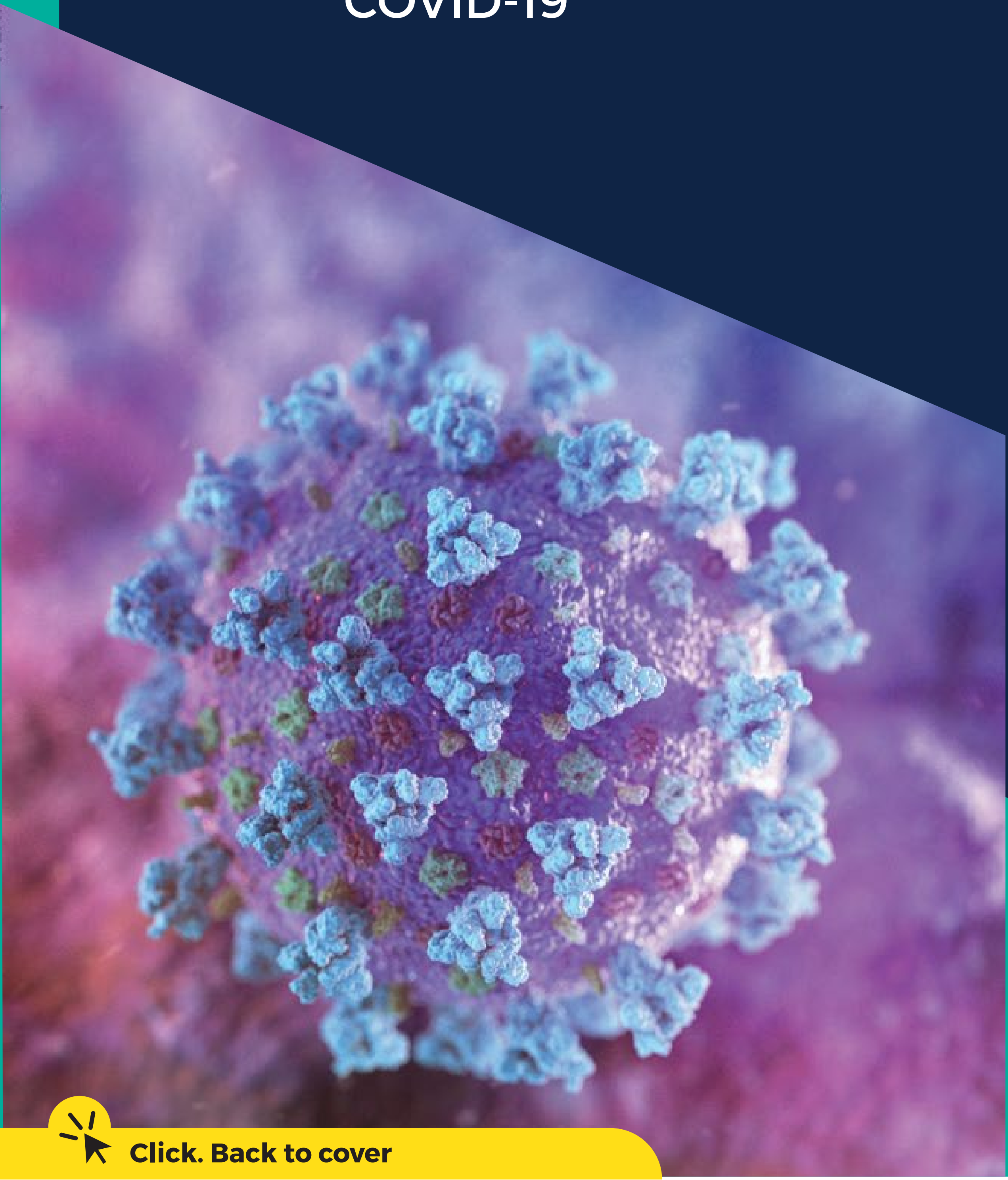
**11.** Cuartero E. et al. Radiología y embarazo, una situación delicada siempre presente: Presentación Electrónica. Sociedad Española de Radiología Médica, 2010.

**12.** Wong HYF, Lam HYS, Fong AH, Leung ST, Chin TW, Lo CSY, Lui MM, Lee JCY, Chiu KW, Chung T, Lee EYP, Wan EYF, Hung FNI, Lam TPW, Kuo M, Ng MY. Frequency and Distribution of Chest Radiographic Findings in COVID-19 Positive Patients. (2019) Radiology March 2020.

AVUM EXPERT CONSENSUS FOR

COVID-19 IN PREGNANCY

# QUICK GUIDE FOR LUNG ULTRASOUND IN PUI FOR COVID-19



AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

Click. Back to cover

The lungs are organs that used to be considered unfit for ultrasound imaging due to its airway composition.[1,2] Dr. Lichtenstein's work was later able to establish the lung ultrasound's (LUS) higher and similar detection rates to pleuropulmonary pathologies to CXR and chest CT, respectively. Lung ultrasound has been included more frequently into practice.[2,3]

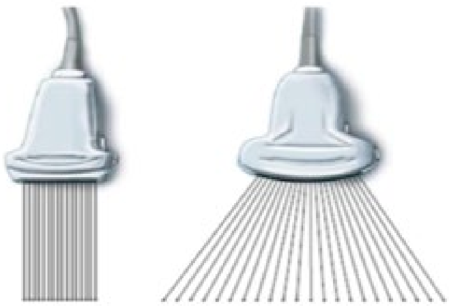
While CXR and chest CT are the main methods used to approach the CVODI-19 population, LUS stands out as a cheaper, faster, and non-radiating method compared to chest CT while keeping similar detection rates. This makes LUS a good option for pregnant patients.[1,4,5]

## TECHNICAL CONSIDERATIONS

### Ultrasound equipment and probes

Any equipment with B and M Mode is suitable for lung ultrasound. Pulse and color Doppler can complement the assessment but are not indispensable. [1,2,5,6]

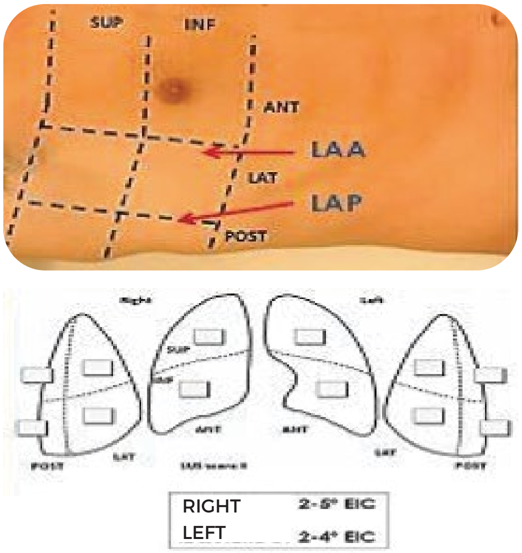
Linear probes or transducers will provide good resolution but decreased depth (5 cm). They will be useful to assess superficial tissues underlying the thorax and the pleural/subpleural space, which have high diagnostic value in COVID-19. On the other hand, convex probes have low frequency and higher depth (10-15 cm) so lung parenchyma can be evaluated.[1,2,5,6]



https://www.google.co.ve/url?sa=i&url=https%3A%2F%2Fmonkeyem.com%2F2017%2F10%2F03%2Fprincipios-basicos-de-ultrasonido-en-laurgencia%2F&psig=AOvVaw0F9BxC3HsEIT_n0OKRvvVs&ust=1586400462909000&source=images&cd=vfe&ved=2ahUKEwjHp-Ox6NfoAhWbTTABHZ7VAR8Qr4kDegUIARCyAQ

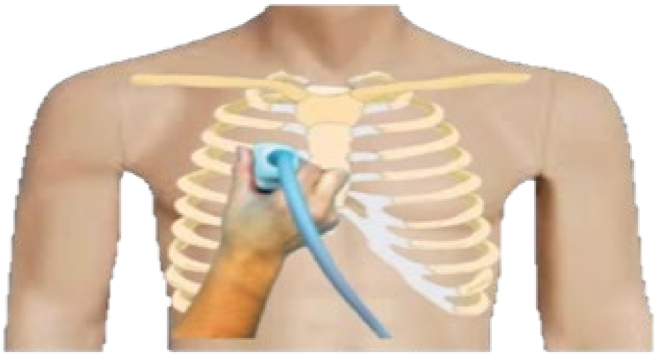
### Survey technique

The survey technique with the probe provides versatility as it can be placed in the same thoracic region as a stethoscope for clinical data. The thorax is divided in 3 divisions: anterior, lateral and posterior (using the anterior and posterior axillary line as a reference) and in turn these regions are divided into upper and lower regions using the breast line as a reference. The anterior division extends from the 2nd to 4th intercostal space (ICS), and from the sternum to the anterior axillary line. The lateral division extends from the anterior axillary line to its posterior counterpart. The posterior division then extends from the posterior axillary line to the paravertebral line (area that needs to be assessed in lateral decubitus or semiseated positions). [1,6]




División del tórax para la práctica del ultrasonido pulmonar tomado de Hirschhaut E. et al

LThe probe's orientation marker should be placed towards the patient's head. When performing a FAST ultrasound, the probe may be placed over the suspected area for a timely diagnosis. Otherwise, we can systematically evaluate the entire ribcage. We must start in the anterior-superior division (2nd ICS to midclavicular line), moving caudally from anterior to posterior, while exploring each ICS.[1,6]



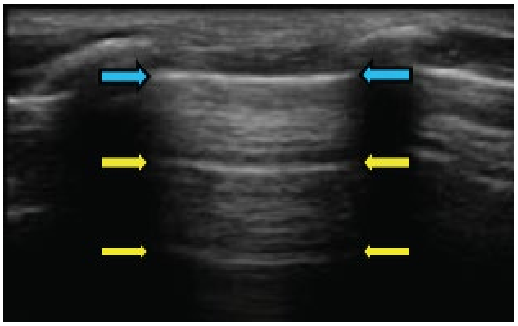
Tomado de: https://anestesiar.org/2016/conocimientos-basicos-en-ecografia-pulmonar-ecocritic-2/

## LUNG ULTRASOUND PATTERNS

1 Dry or aerated lung
2 Wet lung or interstitial pattern
3 Consolidation
4 Pleural effusion

### The dry or aerated lung

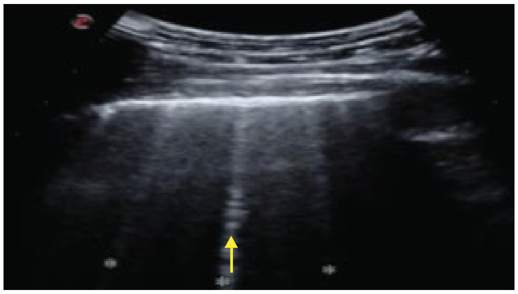
The dry or aerated lung is noted by the presence of A lines (yellow arrows), which are linear, hyperechoic, and thin artefacts that are equidistant from each other. They extend from the pleural line to the thickness of the lung tissue.1-8
The pleural line (blue arrows) is a thin (< 2 mm), linear, hyperechoic, and smooth structure located in the ICS. In this space, lung sliding can be observed as a fine or bright movement. Its presence indicated the integrity of both pleural membranes.[1,8]



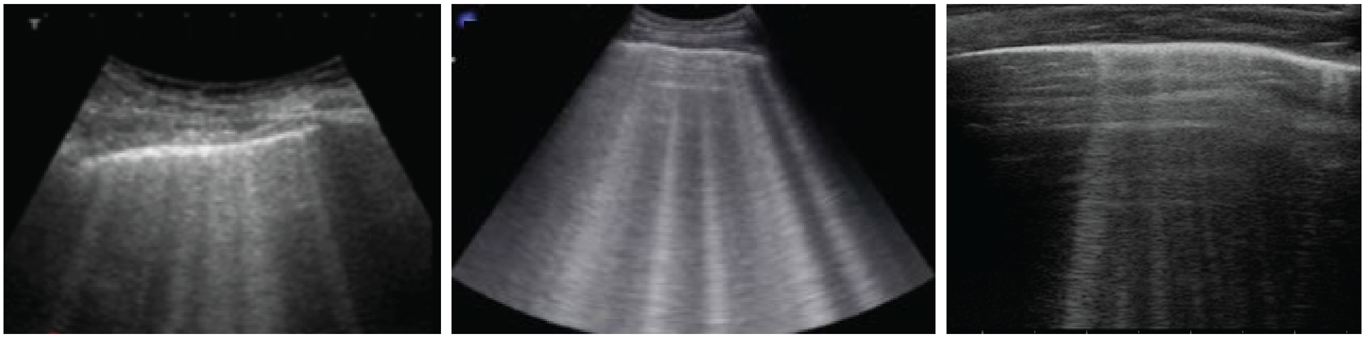
The aforementioned characteristics represent the absence of alterations and indemnity of the air/fluid ratio. When faced with a patient with suspected COVID-19, the presence of pleural lines, lung sliding, and A lines discard lung pathology and leads management towards home isolation with its respective follow-up. [6]

### The wet lung or interstitial pattern

Is characterized by the presence of B lines, which are dynamic, hyperechoic, vertical, well-defined artifacts that start at the pleural lined and extend down 10-20 cm, eliminating the A lines. The presence of less than three B lines (arrow) may be a normal finding.[1-3,6-8,10]



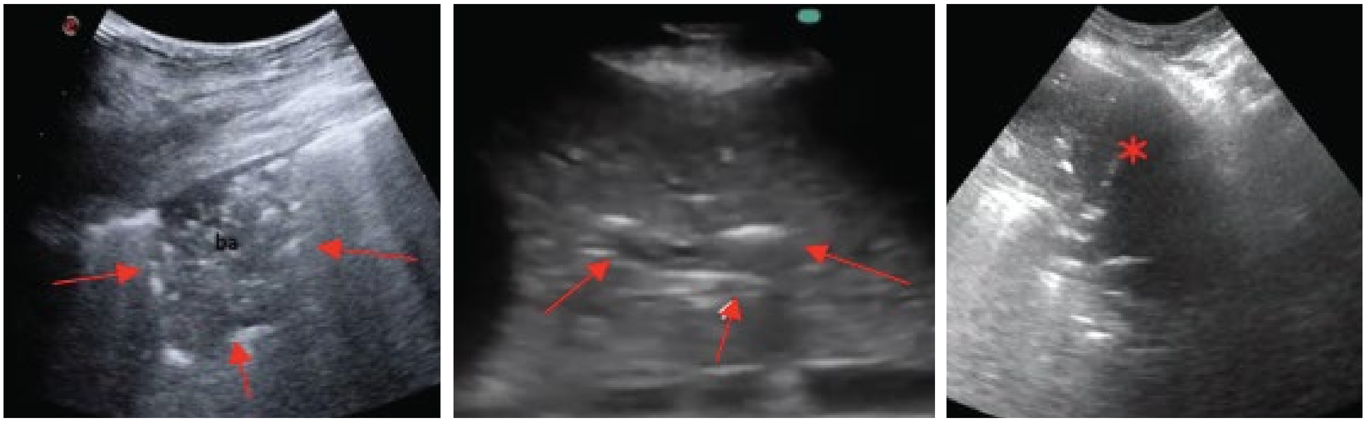
Lung pathology is suggested if there are three or more B lines (by longitudinal approach). It represents pulmonary interstitial injury and loss of the normal lung aeration. As the number of B lines increase in quantity and confluence, so does the degree of pulmonary alteration. This is ultimately seen as the "white lung" present in severe acute respiratory syndrome (ARDS); this is characterized by fusion of B lines and absence of A lines. [1-3,6,7,10-12]



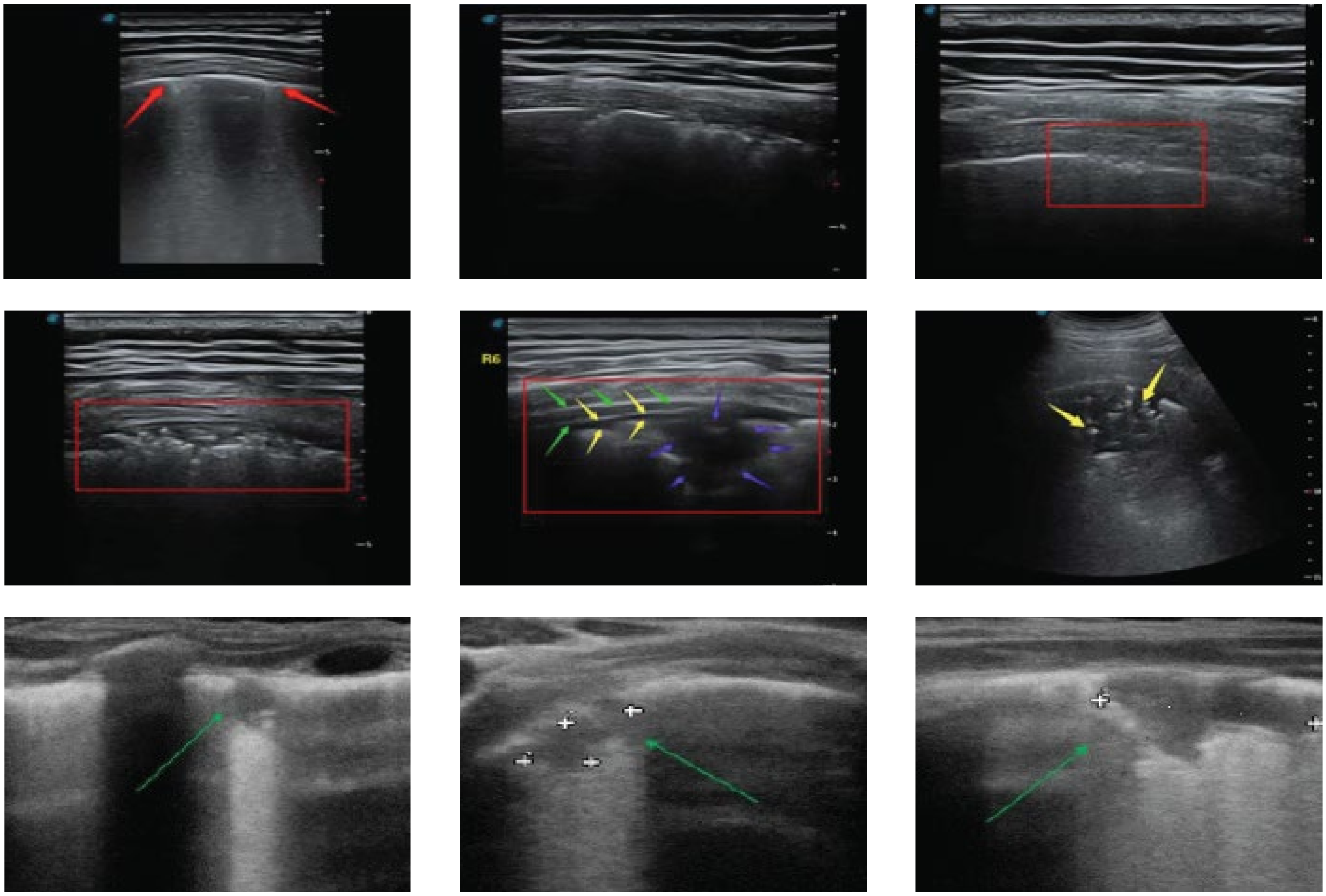
These findings should be correlated with the clinical course in any patient with suspected or confirmed COVID-19 to decide between inpatient or outpatient management. It has been reported that the significant presence of B lines (≥3) in an ICS of an asymptomatic patient suggests lung involvement via loss of normal lung aeriation, which should be monitored every 24-48 hours. [5,6,9]

## The consolidation pattern

Is characterized by a change in lung density, showing spleen/liver-like echogenicity at a subpleural level. It is seen as hypoechoic, usually with irregular borders along the normal aerated tissue. The aerial bronchogram can be seen inside as linear or punctate images. [1-3,6,7,10]

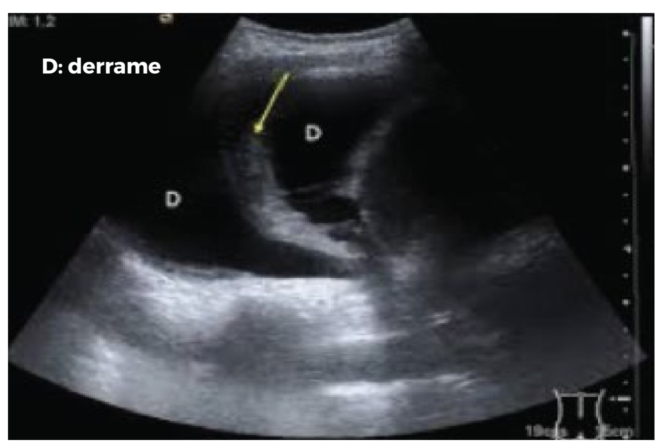



In the early stages of COVID-19, subpleural and hypoechoic nodules may be disrupting the hyperechogenicity of the pleural line. When there is interstitial involvement, subpleural micro-consolidations are present, which is characteristic of early stages of the disease. The consolidations can be seen in late stages, showing compromise of the posterior, lower and declining areas. This compromise is evidenced as absent or negative Dopplers, which are later associated with severe pulmonary involvement, lower recovery rate and reserved prognosis. This may be a useful criteria for diagnosis, prognosis and follow-up of affected patients. [4,6,9,13,14]



## Pleural effusion pattern

Its pattern changes depending on its etiology and contents. Its visualization and recognition is simple. It is identified as an anechoic image around the lung parenchyma, with or without the presence of fine or linear echoes, such as those seen in fibrin deposits.[1-10]



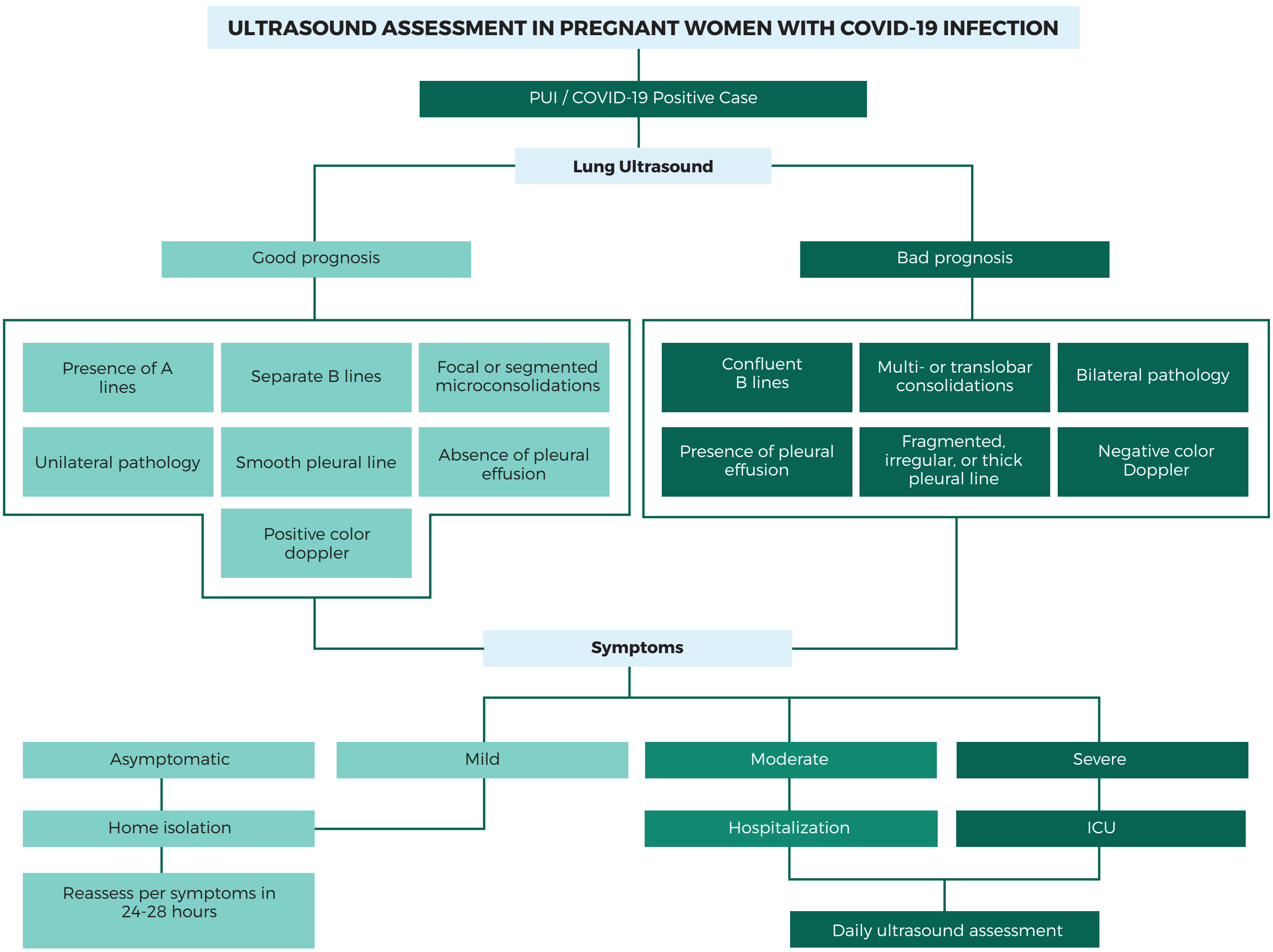

Gravity must be taken into account when assessing the chest cavity. This needs to factored into the patient’s position, and the probe’s orientation towards the declining areas that are more prone to pleural effusion collection. Overall, pleural effusion is rare in COVID-19 patients. [4,6,9,13,14]

Overall, lung lesions/injury have been described in both the posterior/lower areas and peripheral lung tissue. This favors the use of LUS for diagnosis.[4,6,9,13,14]

Summarizing, we can catalog lung lesions and their individual characteristics to help guide the management and prognosis of patients. Please refer to the tables below and the proposed algorithm.

| Good prognosis | Bad prognosis |
|---|---|
| • Unilateral | • Bilateral |
| • Presence of A lines | • Presence of fused B lines |
| • Separate B lines | • Translobar or multilobar consolidations |
| • Focal or segmented microconsolidations | • Pleural effusion (rare) |
| • Smooth pleural line | • Fragmented pleural line |
| • Positive Doppler shift | • Negative Doppler shift |

## SUGGESTED ALGORITHM FOR LUS IN COVID-19 PATIENTS



## REFERENCES

1. Lichtenstein D. Novel approaches to ultrasonography of the lung and pleural space: where are we now?. Breathe. 2017;13(2):100-111.

2. Hirschhaut E, Delgado CJ. Ecografía pulmonar: Ciencia o ficción. Salus Militiae 2016;40:58-72

3. Volpicelli G, Elbarbary M, Blaivas M, Lichtenstein D, Mathis G, Kirkpatrick A et al. International evidence-based recommendations for point-of-care lung ultrasound. Intensive Care Medicine. 2012;38(4):577-591.

4. Boelig R, Saccone G, Bellussi F, Berghella V. MFM Guidance for COVID-19. American Journal of Obstetrics & Gynecology MFM. 2020;:100106.

5. Moro F, Buonsenso D, Moruzzi M, Inchingolo R, Smargiassi A, Demi L et al. How to perform lung ultrasound in pregnant women with suspected COVID-19 infection. Ultrasound in Obstetrics & Gynecology. 2020;.

6. Hirschhaut Schor, E., Delgado Mosquera. Guía rápida ecografía pulmonar COVID-19. Grupo venezolano de ultrasonido pulmonar. Marzo 2020.

7. Saraogi A. Lung ultrasound: Present and future. Lung India. 2015;32(3):250.

8. Arbeid E, Demi A, Brogi E, Gori E, Giusto T, Soldati G et al. Lung Ultrasound Pattern Is Normal during the Last Gestational Weeks: An Observational Pilot Study. Gynecologic and Obstetric Investigation. 2016;82(4):398-403.

9. Poon L, Yang H, Lee J, Copel J, Leung T, Zhang Y et al. ISUOG Interim Guidance on 2019 novel coronavirus infection during pregnancy and puerperium: information for healthcare professionals. Ultrasound in Obstetrics & Gynecology. 2020;.

10. Hirschhaut Schor E, Delgado Mosquera C, Cortes Montero M. Ecografía pulmonar en cardiología: Una ventana para el edema pulmonar. Revista Argentina de Cardiologia. 2019;87(6):485-490.

11. Pachtman S, Koenig S, Meirowitz N. Detecting Pulmonary Edema in Obstetric Patients Through Point-of-Care Lung Ultrasonography. Obstetrics & Gynecology. 2017;129(3):525-529.

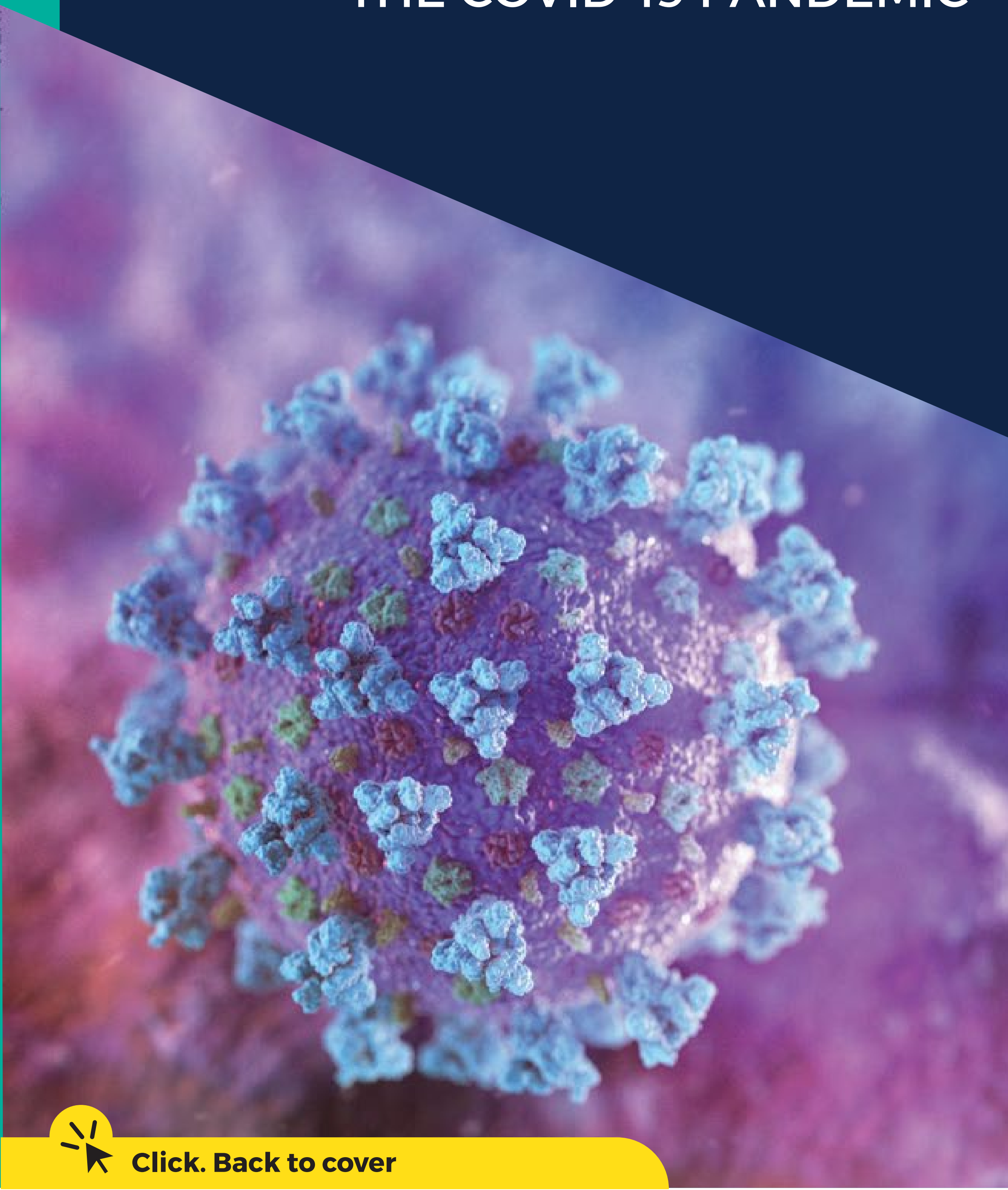
12. Zieleskiewicz L, Lagier D, Contargyris C, Bourgoin A, Gavage L, Martin C et al. Lung ultrasound-guided management of acute breathlessness during pregnancy. Anaesthesia. 2012;68(1):97-101.

13. Yu M, Hu M, Huang Y, Wang S, Liu Y, Zhang Y et al. A preliminary study on the ultrasonic manifestations of peripulmonary lesions of non-critical novel coronavirus pneumonia (COVID-19) . 2020;.

14. Peng Q, Wang X, Zhang L. Findings of lung ultrasonography of novel corona virus pneumonia during the 2019–2020 epidemic. Intensive Care Medicine. 2020;.

AVUM EXPERT CONSENSUS FOR
**COVID-19 IN PREGNANCY**

# GUIDE FOR SAFE OBSTETRIC ULTRASOUND PRACTICE DURING THE COVID-19 PANDEMIC



AVUM
Sociedad Venezolana de Ultrasonido en Medicina

SOVERADI
SOCIEDAD VENEZOLANA DE RADIOLOGÍA Y DIAGNÓSTICO POR IMÁGENES

Click. Back to cover

When performing an ultrasound, it is important to try and limit COVID-19 transmission. This can be achieved with the application of preventive measures related to working-area clean-up and protection of both patient and health personnel.

## PREVENTIVE MEASURES

### Work area

At room temperature, Coronaviruses can remain active on inanimate surfaces for up to 9 days, with an average of 4-96 hours. Therefore, surfaces in the healthcare areas are a potential source of viral transmission. These include medical imaging equipment. [1-3]

**Persistence of COVID-19**


Source: N Van Doremalen, et al, Aerosol an surfaces stability of SARS-Cov compared to SARS-COV-1. NEJM 2020

Cleaning and disinfecting the work area should be done at the start and at the end of each shift with a low-level disinfectant (sodium hypochlorite at 100ppm or mg/L, ethanol, quaternary ammonium or a phenolic/iodoform detergent). Diluting ½ cup (100 mL) of commercial chlorine in 4 liters of water can be effective as well. Floors, doors, furniture and electronic devices should be disinfected.[4]

Frequently used areas or essentials should be cleaned after every patient with the same disinfectant. These include: stretchers, handrails, stirrups, desks, chairs, and door handles. This must be implemented along with hand washing before and after performing the exam.[4-6]

All non-essential accessories must be removed and stored. The cover material for stretchers or cloth pillow covers must be properly replaced by disposable materials.4 It is important to prevent chemical toxicity by avoiding inhalation or direct skin contact with the hazardous disinfectants.
[4,6]

### Ultrasound equipment

It is important to prepare the ultrasound probe correctly. This includes cleaning and disinfecting it.[4-6]

While cleaning your equipment, it should be ensured to remove any residual gel that may interfere with the effectiveness of the disinfectant. Non-abrasive soap solutions (liquid soap) or preparations with quaternary ammonium can be used with a damped paper towel, gauze, or soft cloth. A soft bristle brush comes in handy to clean grooves or sharp angles.[4,5] You should also refer to the manufacturer's maintenance manual.

Disinfection may be performed based on the Spaulding system recommendations for infection transmission risk when using medical equipment. Transabdominal probes are considered "non-critical" or low risk, and can be disinfected with moderately germicidal solutions. High risk or "semi-critical to critical" endocavity probes must be disinfected with high-level solutions.[4-7]

## SPAULDING CLASSIFICATION CATEGORIES[7]

| Type of instrument | NON-ESSENTIAL | SEMI-ESSENTIAL | | ESSENTIAL |
|---|---|---|---|---|
| Level of disinfectant* | **Low** | **Medium** | **High** | **Sterilization** |
| | Ethanol 70-90% | Ethanol 70-90% | Glutaraldehyde 0,5%-2,5% | Glutaraldehyde 0,5%-2,5% |
| | NaOCl (100ppm)† | Phenolic detergent | Chloride release on demand | Ethylene oxide |
| | Phenolic detergent | Iodoform detergent | Hydrogen peroxide 6% | Hydrogen peroxide 6% |
| | Iodoform detergent | | Peracetic acid | Peracetic acid |
| | Quaternary ammonium solutions | | | Steam or heat |

*disinfection category may defer due to a difference in time of exposition
†Up to 1000ppm and exposure time increases disinfection level. Home chlorinated solution (5%) 1:100 (500ppm) should be diluted to prevent equipment damage

After evaluating a suspected or confirmed case of COVID-19, the use of high-level germicidal disinfectants is recommended. During the pandemic, it is suggested that cleaning and disinfecting the ultrasound probes must be performed after each patient. It is recommended to clean the monitors, keyboard, mouse (or trackball), and other accessories at the beginning and at the end of each shift. It is considered good practice to reduce the number of endocavitary and convex probes to just one of each.[4-6]

### Safety for the patient and the sonographer

Every patient that comes to the ultrasound unit must comply with history-taking over the phone and COVID-19 risk stratification. This will reduce the time to perform the actual ultrasound.[8] It is recommended to exclude vulnerable or at-risk healthcare workers.[4-6]

Social distancing must be maintained during the patient's visit, avoiding crowds in the medical facility, and offer proper seating arrangements at least 2 meters apart. Companions will attend only if strictly necessary.[4-6]

The sonographer should wear an appropriate mask or respirator, which can be used during multiple visits. The replacement of the mask would depend on its condition and deterioration. Disposable and latex-free gloves must be used and replaced after each patient. It is preferable to use individual gel packs over the reusable containers. Use of translucent transabdominal probe covers may be considered. It is mandatory to use covers with the endocavitary probes.[4-6] The most experienced sonographer should be used to reduce scan time. Very detailed explanations should be limited. It is important to properly train staff in infection risk protocols and biological waste management.[4-6]

## Safe practice with patients with suspected or confirmed COVID-19

- N95 MASKS OR FFP2/FFP3. CONSIDER USE OF COMPLETE PPE
- IT IS RECOMMENDED TO PERFORM THE US AT THE PATIENT'S HEADBOARD
- USE ONLY ONE EQUIPMENT SET FOR THIS POPULATION (IF POSSIBLE)
- IF PERFORMED DURING A MEDICAL VISIT, PERFORM US AT THE END OF THE VISIT, FOLLOWED BY PROPER DISINFECTION
- DISCARD GLOVES AND PERFORM PROPER HAND WASHING

ISUOG Safety Committee Position Statement: safe performance of obstetric and gynecological scans and equipment cleaning in the context of COVID-19
World Health Organization. Infection prevention and control during health care when COVID-19 is suspected. Interim guidance. [revisado 19/03/2020].

## REFERENCES

1. Wu Y, Guo C, Tang L, et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples. Lancet Gastroenterol Hepatol 2020. Correspondence. https://doi.org/10.1016/S2468-1253(20)30083-2. [revisado 19/03/2020].

2. Kampf, G., Todt, D., Pfaender, S., & Steinmann, E. (2020). Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. Journal of Hospital Infection. doi:10.1016/j.jhin.2020.01.022

3. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. N Engl J Med Correspondence. DOI: 10.1056/NEJMc2004973 [revisado 18/03/2020].

4. ISUOG Safety Committee Position Statement: safe performance of obstetric and gynecological scans and equipment cleaning in the context of COVID-19 https://www.isuog.org/uploads/assets/d03798de-11ff-4037-beecc9c1495d9572/e6f65fb1-f6af-4d94-beb02bb4ea78c0cc/ISUOG-Safety-Committee-statement-COVID19.pdf [revisado 18/03/2020].

5. AIUM. Guidelines for Cleaning and Preparing External- and Internal-Use Ultrasound Transducers Between Patients, Safe Handling, and Use of Ultrasound Coupling Gel. https://www.aium.org/accreditation/Guidelines_Cleaning_Preparing.pdf [revisado 18/03/2020].

6. World Health Organization. Infection prevention and control during health care when COVID-19 is suspected. Interim guidance. [revisado 19/03/2020].

7. McDonnell, G. et al. Disinfection: is it time to reconsider Spaulding? Journal of Hospital Infection 2011;78(3):163–170.

8. SMFM Coding White Paper: Interim Coding Guidance: Coding for Telemedicine and Remote Patient Monitoring Services during the COVID-19 Pandemic. https://s3.amazonaws.com/cdn.smfm.org/media/2270/SMFM_Coding_White_Paper_-_COVID19_Telehealth.pdf