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## COVID-19 and Surgery Edition

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# COVID-19 pandemic and surgery

## *Pandemia COVID-19 y cirugía*

Through history there have been several pandemics that have changed humanity and the way individuals relate to each other. On March 11, 2020, the World Health Organization declared the SARS-CoV-2 pandemic, which has changed the way we live. We had to cancel scheduled surgeries, transform operating rooms, and make them available for COVID-19 positive patients. On the other hand, there were fewer staff in the wards, family visits were limited, and the way of giving reports was changed. In addition, the entire healthcare team has to provide support in COVID areas.[1,2]

For the time being, scheduled surgery was allowed for oncologic patients.[2] Regarding truly emergency surgeries, it is recommended to operate incarcerated hernias with loop compromise, intestinal perforations, ischemia, appendectomies, acute cholecystitis with cholangitis, and anastomosis leaks.[3] Among the procedures that can and should wait, there are uncomplicated intestinal occlusions, non-acute cholecystitis, and diverticular disease when it responds to medical management, to name a few. We also had to change informed consents. Now more than ever, it is essential to be very familiar with the ever-changing guidelines of the General Health Law.

Since SARS-CoV-2 is transmitted by aerosols –which is more than proven–, it is important to use personal protective equipment, keep a "healthy" distance, and always wear a face mask. We have already been doing this in surgery, but now all procedures should be handled as suspicious until proven otherwise. Even so, testing is not as sensitive or as fast as we surgeons would like. To work in that no-man's land, we must wear full protective gear.[4,5]

From one day to the next, teaching took a turnaround, both at undergraduate and postgraduate levels, and the same occur with teaching programs for our associates. By taking advantage of virtual resources, we have been able to continue with part of the established programs, which are in a constant adaptation.

This special issue, dedicated to SARS-CoV-2, deals with many of the problems we are already seeing. The articles contained herein will also give us a glimpse of issues to come. I highly recommend reading them.

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SPECIAL ARTICLE

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# Role of medical societies in the SARS-CoV-2 health contingency

## *Papel de las sociedades médicas en la contingencia sanitaria SARS-CoV-2*

Guillermo Ramos-Gallardo,[*,‡] Lázaro Cárdenas-Camarena,[*] Arturo Ramírez-Montañana,[*] Jesús Cuenca-Pardo,[*] Carlos Oaxaca-Escobar,[*] Héctor Durán-Vega[*]

**Keywords:**
Medical societies, learning, quarantine, contingency, SARS-CoV-2, COVID-19.

***Palabras clave:***
*Sociedades médicas, enseñanza, cuarentena, contingencia, SARS-CoV-2, COVID-19.*

**ABSTRACT**

The SARS-CoV-2 virus contingency represents a challenge for society in all countries, and Mexico is no exception to this problem. The country has medical societies at the forefront with the academic capacity to prepare for the care of the population. Medical societies play an important role in the preparation and updating of their members. It is recommended that a committee be formed in each one of them that can follow up on the pandemic and the needs that they may have according to their specialty or branch of medicine. It is important to have a program to support members, especially in the acquisition and use of protective equipment (respirators, protective eyewear, face shields, among others). And to establish protocols and recommendations that can be evaluated to plan future actions aimed at providing better care to the population and reducing the possibility of contagion.

***RESUMEN***

*La contingencia por el virus SARS-CoV-2 representa un reto para la sociedad en todos los países, México no es la excepción a este problema. El país cuenta con sociedades médicas a la vanguardia y con la capacidad académica para poder preparar la atención de la población. Las sociedades médicas desempeñan un papel importante en la preparación y actualización de sus agremiados. Se recomienda la formación de un comité en cada una de ellas que sea capaz de dar seguimiento a la pandemia y a las necesidades que puedan tener en particular según la especialidad o rama de la medicina. Contar con un programa de apoyo a miembros, sobre todo en la adquisición de equipos de protección (respiradores, lentes de protección, caretas, entre otros). Establecer protocolos y recomendaciones que puedan evaluarse para establecer a futuro acciones dirigidas a dar una mejor atención a la población disminuyendo la posibilidad de contagios.*

Mexican medicine is going through an unprecedented stage in the last 100 years. The new SARS-CoV-2 virus belongs to the subfamily of coronaviruses (CoV) of the *Coronaviridae* family, and specifically to the beta genus (betacoronavirus), whose outbreak began in China and spread rapidly throughout the world.[1] As we have seen in recent weeks, it represents a challenge for humanity. Health services are overwhelmed with little capacity to respond. Medical, nursing, and all health personnel are on the front line, often without adequate equipment, worried about catching the disease and infecting their families, lacking protocols to provide adequate care to patients, and exposing staff to outbreaks of the disease within health units.

Therefore, the pandemic represents a challenge in every sense. The medical profession in Mexico is grouped in different medical societies. It is a duty to belong to them to continue with medical training, collaborate in the discussion of clinical cases, expertise in complicated cases, safety in procedures by promoting seminars, congresses and medical practice guidelines.

According to the National Regulatory Committee of Medical Specialties Councils (CONACEM) there are 47 medical specialties in our country, which have societies, colleges and/or associations at both national and state level.

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At the beginning of the contingency in the case of the association that gathers the plastic surgeons of the country, it was proposed to make a survey to know the diagnosis of the 18 plastic surgery schools that offer training in the country.

The purpose was to find out if they were working in a converted hospital, if they had already cared for patients with respiratory problems, and if they had enough equipment to carry out their activities. At that time, we observed that most of the hospitals were reconverted into COVID hospitals or were in the process of reconversion. Most of the members in training were supporting the care of patients with respiratory problems. They expressed that needed support for having more protective equipment to be able to carry out their activities.

As a medical association we planned to collaborate with the help of a foundation, so we launched a campaign to raise resources and thus obtain protective equipment. To date, we have been able to support more than 900 frontline physicians and their nursing staff *(Figures 1A-C and 2)*.

Medical societies are fundamental, as is knowing the needs that their members may have. The contingency represents a challenge in terms of logistics, planning, and organization. Each country, state and city will experience this problem differently.[2] In the case of our country, the biggest challenge we faced was to send the equipment and guarantee that it would arrive where it was needed, so we decided to send it to a place other than the hospital, understanding the lack of equipment and the possibility that it might be stolen or lost.

Another challenge we faced was that residents or physicians in training changed or reassigned their usual activities to their training to attend the pandemic, being relocated to facilities other than their usual ones. The decision was made to have contact with the chief residents of the 18 programs through message groups (chats) to know in real time what they might need to support the population during the contingency.

Surveys have also been conducted periodically to learn about any needs that might arise, as well as mental health questionnaires to offer support with respect to the physical or mental tension (stress) that had been generated.[3] The responses to the questionnaire are linked to support pages that use social networks to guide health personnel towards deactivation activities after the workday, especially in those centers that treat patients


***Figure 1: A-C.*** *Program of the Mexican Association of Plastic, Aesthetic and Reconstructive Surgery with the GIN Foundation to send protective equipment to teaching hospitals around the country.*


***Figure 2:*** *Academic event organized to raise funds to support the shipment of protective equipment to health personnel.*

with COVID, and especially intubated patients. Health personnel are at risk not only physically, but also mentally when faced with difficult situations in all aspects, especially when they are overwhelmed in the number of beds, special care, and deaths.[4]

A relevant role in the contingency has been the scheduling of extraordinary sessions to provide information and updates on the subject. The main objective has been to provide information on how we should work during the contingency, as well as guidelines for the proper use of protective equipment when care for a patient in and out of the operating room.[5,6] It is undoubtedly difficult to have guidelines that can be molded to the letter for every medical or surgical team.

An important limitation is access to diagnostic tests, so it is suggested to think that every patient is infected until proven otherwise.

Each specialty will have to develop its own protocols and recommendations for both COVID and non-COVID patient care.[7] Likewise, the correct use of protective equipment is undoubtedly essential to protect the healthcare team and avoid contagion to, if not within, the equipment *(Figures 3A-C)*.

As a medical society, we observed that the most requested material was respirators, especially for emergency care in the specialty, since not knowing the patient's condition, caution should be taken with procedures that may generate aerosols. As a medical society, we must reinforce proper hand washing and the constant use of 70% alcohol-based gels.[8]

One of the most important measures to control the spread of the pandemic is social isolation.[9] The correct implementation of these measures in medical offices, clinics, and operating rooms is essential to control a possible outbreak within our teams. We must not forget to avoid shaking hands, kissing, or hugging, to promote hand hygiene in the office and the proper use of masks.

Until proven otherwise, every patient can be a carrier of the virus, so we must be aware of it. When providing health services, it is essential the continuous use of masks, gloves and promoting a healthy distance with the patient.

The operating room represents a risk, so all medical societies should promote sessions to learn the proper use of protective equipment and identify the risk involved in performing a procedure in terms of its location, type of anesthesia and the risk that the patient carries of acquiring the disease before or after the surgical event.

As we all know, patients over 60 years of age with comorbidities such as obesity, hypertension, diabetes, immunocompromised, or pregnant women represent a higher risk in case of performing a surgical procedure.[10] The type of procedure, approach and duration of the procedure should be considered in each treatment. We must not forget that there is a risk of infection. It has been observed that mortality increases when surgery is performed during the pandemic, so the initial recommendation is to perform only emergency surgeries, especially at the time of highest virus transmission.

We know that this will delay the care of patients with less urgent problems,[11] so it is essential to know the transmission of the virus in the locality, the possibility of postponing the procedure by evaluating it, the isolation that the patient may have before or after surgery, the availability of tests or imaging studies prior to the procedure, especially the protocols in the operating room where the proper use of protective equipment is valuable to maintain the safety of the team and avoid a possible contagion.

Every association, society or medical school is suggested to consider the following points to


***Figure 3: A-C.*** *Sending protective equipment by the surgeons for Mexico work force to the hospitals that are providing care to the population during the contingency.*

be able to work during the contingency, since at this moment we do not know how it will manifest itself in our population:

- Organize a group or committee capable of preparing the society's activities during the contingency, which may be of an assistance nature, for example, to help with the purchase of protective equipment.
- Have academic sessions and activities to train members to attend to emergencies and consultations that may arise during the contingency. The proper use of protective equipment is essential to prevent possible contagion. Remember that the use of masks and hand hygiene are essential since it is not possible to know the status of each patient.
- Develop protocols for medical and surgical care at the time the health authority indicates to be able to return to work avoiding the possibility of any contagion.
- Encourage the use of telemedicine, virtual sessions, all electronic means of communication that could avoid physical contact. Taking advantage of these tools is useful to maintain contact with colleagues, since isolation and/or social distancing can often affect assertive communication.

Undoubtedly, we are living a unique moment in society and in medicine. It is a tragic and difficult event for everyone, especially for the first line of care. We will have new protocols and guidelines that will invite a deep analysis of the situation with a possibility of change and improvement in our society and healthcare system.

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SPECIAL ARTICLE

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# Recommendations in general surgery during and after the crisis

## *Recomendaciones en cirugía general durante y después de la crisis*

Juan Roberto Torres-Cisneros,* Abilene Cirenia Escamilla-Ortiz‡

**Keywords:**
SARS-CoV-2, COVID-19, surgery, personal protective equipment, laparoscopy.

***Palabras clave:***
*SARS-CoV-2, COVID-19, cirugía, equipo protección personal, laparoscopia.*

**ABSTRACT**

In recent months the world has changed; now life revolves around the pandemic caused by SARS-CoV-2, this translates, above all, in uncertainty and fear. In the Mexican Association of General Surgery, we are concerned about safeguarding the integrity and health of our patients, as well as that of professionals and associates. What used to be known as Patient Safety, now also includes safety for health professionals. Major healthcare systems around the world have been overwhelmed when doctors and nurses become infected or die. Surgeons are going to be right in the middle of the problem, given that we must continue to care for the lives of our patients, as well as the need to perform emergency interventions and resolve oncology patients' issues. So, we make recommendations for emergency procedures, both surgical and endoscopic, use of personal protective equipment, and give advice for laparoscopic surgery for patients with or without COVID-19.

***RESUMEN***

*El mundo ha cambiado en los últimos meses, ahora la vida gira alrededor de la pandemia causada por SARS-CoV-2, ésta se traduce, sobre todo, en incertidumbre y temor. En la Asociación Mexicana de Cirugía General estamos preocupados por salvaguardar la integridad y salud de nuestros pacientes, al igual que la de los profesionales de la salud y asociados. Lo que antes se manejó como Seguridad del Paciente, ahora incluye también la seguridad para los profesionales de la salud. Los principales sistemas de salud en el mundo se han visto rebasados cuando médicos y enfermeras se contagian o fallecen. Los cirujanos nos vamos a encontrar de lleno en el problema, dado que tenemos que seguir atendiendo la vida de nuestros pacientes, así como la necesidad de realizar intervenciones de urgencias y resolver pacientes oncológicos. Por lo que hacemos las recomendaciones de procedimientos de urgencia, tanto quirúrgicos como endoscópicos, uso del equipo de protección personal, consejos para cirugía laparoscópica tanto para pacientes con COVID-19 o sin éste*

The world seems to have changed in recent months; it no longer revolves around the Sun, now life revolves around a viral pandemic, COVID-19, caused by SARS-CoV-2, which continues to evolve and generate damage to health and economy globally. This pandemic translates, above all, into uncertainty and fear, both among the general population and physicians.

The time will surely come when we will return to daily life. How long will it take? We do not know yet, it will depend on many variables, but it will leave its mark on us. Even more difficult times await us, and we will have to be prepared by knowing our viral enemy, knowing our environment, with education for all and seeking to get out of the contingency in the best possible way.

In the Mexican Association of General Surgery, we are concerned about safeguarding the integrity and health of our patients, as well as that of health professionals and associates. What was previously handled as patient safety, now also includes safety for health professionals. Major healthcare systems around the world have been overwhelmed when doctors and nurses become infected. Surgeons are going to be right in the middle of the problem, given

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that we must continue to care for the lives of our patients, as well as the need to perform emergency interventions and resolve oncology patients' issues. Likewise, we are going to have to operate on COVID-19 positive patients and, if necessary, we will have to go down to the front line to work and help in services other than our usual activities are performed.

We are concerned about preventing the surgeon and health personnel in general from becoming second victims, as has happened in other countries. At the same time, we will have to provide the best possible health care, with the quality and humanism that characterize us. Concerned about taking care of the health personnel, always attending to our vocation of service and without incurring in omissions or irresponsibility.

As always, we as surgeons, are obliged to provide timely and high-quality surgical care that achieves the best results for patients. But if surgical teams are not adequately protected against transmission of the virus during the COVID-19 outbreak, the ability of our health systems to provide the necessary care will collapse as more and more physicians become ill or are forced to quarantine themselves.

## THE CONSIDERATIONS OF THE AMERICAN COLLEGE OF SURGEONS ARE AS FOLLOWS:[1-3]

- Educating surgeons and other healthcare workers about prevention.
- Social distance and hand hygiene as key preventive measures.
- Most viral infections will come to the hospital from the community.
- Test as many people as possible: healthcare professionals, surgeons, and patients.
- Cancel **all** elective procedures in patients with a functional or vital prognosis that is not significantly worse than after a two-month delay in treatment.
- Cancel **all** procedures and consultations. Implement remote counseling solutions.
- Use the hospital ethics committee to support decisions to be made during critical stages.
- Prohibit family visits. Technology can be used to keep them informed and in contact with their loved ones.
- Create two separate COVID-negative and COVID-positive areas in the Intensive Care Unit (ICU), operating rooms, and hospitalization areas.
- Personal protective equipment (PPE) should be used by all healthcare personnel in positive and suspected patients going to surgery, bearing in mind that at some point supplies will be in short supply.
- When the virus is very prevalent in the community, it will be ideal to have patients sampled before surgery.
- There is insufficient data on the surgical outcome of COVID-positive patients.
- Move quickly and act before you see the virus in your hospital. If you don't, it will be too late.

## RECOMMENDATIONS OF THE MEXICAN ASSOCIATION OF GENERAL SURGERY (AMCG)[4-8]

The information provided should not be considered as rigid guidelines and is not intended to supplant clinical judgment. Nor is the information intended to preclude consensus regarding institutional and local approaches to treatment guidelines. There is great uncertainty surrounding this evolving pandemic and a great deal of regional variability. In this highly variable environment, information changes rapidly. As such, the AMCG recommends:

1. **Defer all elective surgical procedures (non-urgent surgeries):** Hospitals and surgical centers should assess the medical needs of their patients and their real-time logistical and infrastructural capacity. The risk to the patient should include an additional assessment of the actual risk of proceeding, versus delay, including the possibility that a delay of 8 weeks or more may be necessary to exit the acute contagious phase, although not the COVID-19 setting.
   It is important to recognize that the decision to cancel or proceed with a surgical procedure must be made in the context of strict medical considerations, but also according to local and national logistics.

2. **Defer non-urgent endoscopy:** there may be an increased risk of viral exposure during airway endoscopic procedures. When necessary, strict use of PPE should be considered for all equipment, against gross droplets, and aerosols. This includes, at a minimum, N95 masks and face shields.
3. **For emergency surgery** that must be performed, we recommend taking into consideration the possibility of contamination of instruments.

It should be considered that viral dispersion in aerosols occurs both in open and laparoscopic surgery. Even though it may produce more aerosol in laparoscopic surgery, in open surgery it may be more difficult to control by aspiration.

The greatest aerosol production occurs during intubation and extubation of the patient.

Ideally, every patient brought to the operating room should have preoperative COVID-19 testing, if available and practical; especially if it is accessible in your hospitals. Since there can be false negative results, it is suggested that "every patient in the OR should be considered COVID-19 positive until proven otherwise".

It is advisable to perform a CT scan of the abdomen and thorax on all patients who are taken to the operating room, especially if there is abdominal pain, and that this study should not take more than 24 hours to be performed.

## Additional Guidelines for the Management of Non-Emergent Surgery During the COVID-19 Pandemic

4. **Outpatient consultation: all non-urgent consultations** should be cancelled, it is necessary to consider that our patients will be forced to break isolation, move around the city, reach hospitals, be in contact with others, are probably infected but asymptomatic, and that the consultation itself represents a health risk for doctors and patients, even if contamination prevention measures are considered. As an attention to the staff of their work teams, it is also advisable to send home those who are not indispensable, to reduce their presence to a minimum and to establish rotations. Patients with neoplastic pathology (oncology) cases shall be assessed individually and they will be attended considering all preventive measures. The physician/surgeon should wear a mask. Increase the distance with the patient and family for the interview. Recommend that only one family member accompany the patient and proceed to clean and disinfect the consultation areas.
5. **Personal protective equipment (PPE):** this is recommended for all surgical procedures, and especially for all laparotomies, unless they have been shown to be COVID-19 negative (again considering that there may be false negative results), including eye protection. The use of full PPE underneath the surgical garment is mandatory for the protection of health personnel; as it is a little known and complicated procedure it should be preceded by intensive training, thus avoiding exposing health personnel to unnecessary risks. The recommendation at this time is that even two people are needed to carry out the placement and removal of this equipment following a strict list of steps (checklist).

The search for a suitable surgical mask that offers adequate protection is a relevant issue.

## Elements of personal protective equipment (PPE) *(Annex 1)*

6. **Operating room:** the minimum number of personnel necessary should remain in the operating room. All should wear PPE and eye protection. Intubation and extubation should be done in the operating room. If necessary and possible, intubation and extubation should be performed inside a negative pressure or neutral pressure room. Keep in mind that most operating rooms have positive pressure, and this can contaminate the rest of the operating room (OR).
The operating rooms should always be considered as contaminated. *https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information, https://icmanaesthesiacovid-19.org*.

Operating rooms for suspected, suspected or confirmed COVID-19 positive patients should be adequately filtered and ventilated and should be different from those used for other emergent surgical patients.

Only those considered essential personnel will participate in the surgical procedure (within the operating room) and, unless another emergency occurs, there should be no exchange of operating room personnel for any reason. All OR staff members should wear PPE as recommended by national or international organizations, including the World Health Organization (WHO) and Centers for Disease Control (CDC). Appropriate gowns and face shields should be worn. These measures should be taken for all surgical procedures during the pandemic, regardless of known or suspected COVID status. Donning and removal of PPE should be in accordance with CDC guidelines.

Electrosurgical units should be set at the lowest possible setting for the desired effect. The use of monopolar electrosurgery, ultrasonic dissectors, and advanced bipolar devices should be minimized, as they can produce aerosolization and dispersion of particles by vapors. If available, monopolar diathermy pencils connected to smoke evacuators should be used or have the aspirator always close to the electro-coagulated area.

It should be considered that when we perform open surgery, within 5 minutes of activation of the electrosurgical equipment, the concentration of smoke particles in an operating room can rise from 60 thousand to 1 million particles per cubic foot. This turns the operating room into a laboratory with high viral circulation; therefore, ultrafiltration of the operating room is necessary, especially in COVID-19 positive patients.

Surgical equipment used during procedures on COVID-19 positive patients or persons under investigation or suspected of COVID should be cleaned separately from other surgical equipment.

7. **Laparoscopic surgery:** early in the pandemic, the possibility of increased aerosol dispersion during laparoscopic and general anesthesia procedures was considered. Aerosol production by ultrasonic and electrosurgical scalpel may indeed be higher in laparoscopic surgery but may also be easier to control versus open surgery. The cost-benefit ratio of laparoscopic procedures needs to be evaluated.

There is not yet sufficient evidence that filters and improvised measures, such as closed suction circuits, are reliable. In appendicitis, the cost-benefit of laparoscopy or open appendectomy can be considered, if there is no certainty in the control of the pneumoperitoneum with a laparoscopy procedure. The same can apply for other procedures such as acute cholecystitis, also considering that it can be managed conservatively during the contingency period.

There is still no clear evidence on the relative risks of minimally invasive (laparoscopic) surgery versus the conventional open approach, specific to COVID-19. Therefore, across all surgical societies we continue to monitor emerging evidence to address this issue.

Previous research has shown that laparoscopy and pneumoperitoneum air can lead to the production of bloodborne virus aerosols. Recommendations for highly transmissible virus-associated diseases are based on studies of hepatitis B and papillomavirus, and coronavirus is respiratory transmitted and surgical aerosols have not been shown to contain the virus.

SARS-CoV-2 consists of a single-stranded RNA of about 30,000 nucleotides, ranging in size from 0.06 to 0.14 microns. The virus has been found in nasal passages, saliva, sputum, throat, blood, bile, and feces. Urine and cerebrospinal fluid (CSF) evaluations have been negative. The virus has also been found within cells lining the respiratory tract and gastrointestinal tract; it is suspected to have multiple modes of transmission.

For minimally invasive procedures, the use of devices to filter released $CO_2$ from aerosolized particles should be

strongly considered. The proven benefits of minimally invasive surgery, reduced length of stay and complications, should be seriously considered in these patients, in addition to ultrafiltration of most or all aerosolized particles. Aerosolized particulate filtration may be more difficult to control during open surgery.

It is strongly recommended that the possibility of viral contamination be considered for personnel during open, laparoscopic, or robotic surgery, and that protective measures be strictly employed for personnel safety and to maintain a functioning workforce.

Aerosols can leave the virus virtually everywhere: plastic, metal, or cardboard, and can persist for up to several days. It should be considered that there is a risk of contagion by aerosolization during laparoscopic procedures, so the recommendation is to perform this type of surgery with face masks with high percentage of particle filtration (i.e., N95) and filters to evacuate the pneumoperitoneum.

Filtration can be an effective means of protection against virus release during minimally invasive surgery (MIS) and endoscopy. N95 masks are designed to filter 95% of particles 0.3 microns or larger. Air-purifying respirators (APRs), which are not widely available at this time, can be beneficial for intubation, extubation, bronchoscopy, endoscopy, and possibly tracheostomy. Filters are used to remove smoke and particulates, including viruses. High efficiency (HEPA) air filters have a minimum efficiency rating of 99.97% to remove particles greater than or equal to 0.3 microns in diameter. Ultra-low particulate air (ULPA) filters can remove a minimum of 99.999% of airborne particles, with a minimum particle penetration size of 0.05 microns. ULPA filters can remove 0.1-micron particles. Filtration in positive pressure operating rooms can be accomplished with HEPA filters that are placed in the ceiling and ductwork and provide adequate filtration.

### *Preventive measures in the production of aerosols*

Consider the increased aerosol production in the operating room during intubation and extubation, upper gastrointestinal endoscopy, upper airway surgery such as oropharyngeal, intestinal, and pulmonary surgery.

- Lower the pneumoperitoneum to the minimum.
- Seal the port valves to avoid air leaks.
- Use electrocautery and ultrasonic scalpel as little as possible or not at all.

### *Measures to avoid transmission or contamination with aerosols*

- Ultrafiltration of air with filters designed for surgical smoke, especially in pneumoperitoneum.
- $CO_2$ inlet filter to avoid contamination of the insufflator when the intra-abdominal pressure is higher than that of the insufflator. There should be filters at the exit of the pneumoperitoneum to avoid contamination of the room.

The pneumoperitoneum should be removed through the filter, in a closed system and completely before removing the trocars.

- Improvised filters and measures may not be reliable.
- Masks N95 or larger.
- Eye protection.

If this type of protective equipment is available, the recommendation is to perform laparoscopic procedures using low pressure (recommended 8-10 mmHg). Restrict the use of electrocautery or ultrasonic scalpel since these instruments also generate aerosols.

It is recommended not to use drains, especially if the patient is COVID positive.

**The surgical approach should be the most beneficial for the patient, regardless of the COVID-19 infection status.** In any case, measures to protect the airway and mucous membranes (masks and appropriate goggles) should always be taken. Likewise, although

there is no evidence in this regard, if available, it would be advisable to use smoke filters in the cannulas of the laparoscopy ports.

### *Practical measures for laparoscopy*

The incisions for the ports should be as small as possible to allow passage of the ports, and without allowing leakage around them. $CO_2$ insufflation pressure should be kept to a minimum and ultrafiltration (smoke evacuation or filtration system) should be used, if available.

The pneumoperitoneum should be safely evacuated through an air filtration system prior to closure, trocar removal, specimen removal, or for conversion to open surgery.

## RECOMMENDATIONS FOR MINIMALLY INVASIVE SURGERY: BEST PRACTICE

- Incisions shall be as small as possible.
- Low pneumoperitoneum pressure.
- Seal port valves.
- Filter the air coming out of the insufflator.
- Filter pneumoperitoneum air prior to closure, trocar removal, or conversion.
- Air suction/evacuation device: ultrafiltration.
- Electrocautery and ultrasonic scalpel as little as possible.
- Drains are not recommended in patients with COVID-19.

## PRACTICAL TIPS FOR LAPAROSCOPY SURGERY

- Use filter in insufflator (CO2 inlet).
- Use of filter between aspirator bottle and wall aspirator.
- Five- or 10-mm port to be used as window for mist extraction, connected to tubing with filter.
- Close trocar valve before introduction into the abdominal cavity.
- Close trocar valve before connecting or disconnecting CO2 tubing.
- Close trocar valve when turning on or off CO2 insufflation.
- Turn on insufflator, then open trocar valves.
- Remove $CO_2$ and abdominal gas before removing ports, removing parts, and making incisions. The aspirator shall be activated on any of the 5 mm trocars ($CO_2$ output).

In COVID positive patients: all the above plus the following:

- Use protective measures covering all exposed skin: neck, ears.
- Dress and, above all,
- Remover PPE under supervision, who dictates each action to be performed.

8. **Consent:** the discussion of consent with the patients should be made precisely informing them of the risk of exposure to COVID-19 and the possible consequences. All procedures must have informed consent, specifying the risk of in-hospital SARS-CoV-2 infection and its consequences, which have a high mortality rate during the postoperative period, all in accordance with NOM 004/SSA3/2012.
9. **Regarding transplants,** CENATRA recommends suspending all donation and transplantation procedures. A suspected or confirmed COVID-19 case cannot be a donor or recipient.
10. **Differentiate between COVID-19 infection and sepsis of abdominal origin:** up to 10% of patients may be preceded by digestive symptoms such as diarrhea, nausea and, in a few cases, abdominal pain. Abdominal pain may be clinically confused with pancreatitis or abdominal sepsis. Unlike bacterial sepsis, COVID-19 infection does not cause an increased white blood cell count, nor a classic neutrophilia, and is associated with lymphopenia in approximately 80% of patients and mild thrombocytopenia in the worst prognostic cases. A nonspecific elevation of D-dimer is also frequent. Procalcitonin is elevated in only 5% of cases of COVID-19 infection. However, C-reactive protein (CRP), as in the case of sepsis, can be elevated with a direct relationship with the prognosis and severity of the disease *(Table 1)*.
Anorexia was the most frequent digestive symptom in adults, while diarrhea and vomiting were the most common in adults

**Table 1: Gastrointestinal manifestations in COVID-19.**

| Symptoms | Percent |
|---|---|
| Gastrointestinal | 18 |
| Diarrhea | 12 |
| Nausea and vomiting | 10 |
| Abdominal pain | 9 |

and especially in children. **Abdominal pain** is more frequent in severe patients. Gastrointestinal symptoms appear to be frequent and may occur even without respiratory data. **Diarrhea and vomiting** may be the cause of consultation and not be quickly suspected as part of COVID-19. Abdominal pain seems to be related to decreased systemic oxygenation, and can produce intestinal ischemia, gastrointestinal tract bleeding and pain, ileus, and pancreatitis, among other abdominal alterations.

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## ANNEX 1: ELEMENTS OF PERSONAL PROTECTIVE EQUIPMENT (PPE).

PPE will be required in any procedure considered as "close contact", which includes surgical intervention, as well as other operating room procedures (intubation, regional anesthesia, IV cannulation, etc.).

### REQUIRED EQUIPMENT:

1. Impermeable gown.
2. Mask: conventional surgical masks do not offer protection if aerosols are present. N95 or FFP2/FFP3 type masks are necessary (filtering 96 and 99%, respectively).
3. Glasses: if aerosols are produced in the procedure (we assume that this may be the case, depending on the type of surgery), full-screen eye coverage is essential.
4. Face shield: does not protect from aerosols but is necessary when there is a risk of splashes (blood, vomit, or other biological liquids).
5. Long nitrile gloves.
6. It is advisable for all personnel with long hair to tie it up completely in a low bun and secure it properly. It is also recommended to shave the beard to favor the proper fixation and functioning of the masks.
7. Once the PPE equipment has been put on, the sterile equipment necessary for the surgical intervention will be placed on it: the surgical wash with alcoholic gel will be performed on the basic gloves and the usual sterile gown and gloves will be put on.

### STEP-BY-STEP INSTRUCTIONS FOR EPP (DONNING) PLACEMENT

It is essential that the entire surgical team has undergone prior training in PPE donning and doffing before performing an actual procedure. The collaboration of all members of the surgical team with each other is very important.

### STEPS:

1. Remove ALL personal items from pajama pockets, as well as any accessories (watch, earrings, jewelry, etc.) before donning PPE.
2. Wash hands with hydroalcoholic solution.
3. Unfold the waterproof gown and put on the sleeves.
4. Then, the mask is put on. For proper fixation, the ideal is to hold it by the convexity, apply it to the chin and pass the straps behind the head, it is recommended to cross them for a better grip. Subsequently, the metal piece is adapted on the bridge of the nose.
5. Putting on goggles or protective screen. The straps of the goggles should be adjusted approximately to the size of the head before putting them on to avoid later manipulation. First, goggles are placed on the face, then the straps are pulled over the back of the head.
6. Put on a pair of nitrile gloves (appropriate size) on the outside of the suit, covering the sleeves of the suit at the cuffs.
7. Put on a surgical cap (if it has not previously done put on another one).
8. Mask: it is enough with the one that has already been placed if the level of protection is adequate.
9. Washing (surgical) with alcohol gel on the gloves.
10. Put on the usual surgical gown.
11. Put on usual sterile gloves.



### STEP-BY-STEP INSTRUCTIONS FOR EPP REMOVAL (DOFFING)

It is essential to remove the equipment calmly, slowly, avoiding abrupt movements and under the supervision of a trained colleague. Ideally, the personnel who have been in the operating

room should remove the PPE one at a time. This should be done as far away as possible from the patient and close to the door.

1. Remove surgical gown and gloves as usual, avoid touching it, fold it with the outside (where blood contamination, splashes, etc.) facing inward, and the gloves turned back on themselves. Discard in the container.
2. Wash the base gloves with disinfectant.
3. Remove the protective screen, holding it from behind, bending the head down.
4. Wash with hydroalcoholic solution.
5. Removal of the base gloves. Remove the first one by the external part with one finger, and the second one by the internal part (putting the "clean" finger between the glove and the suit). Discard in the bucket being careful not to touch them, that they do not touch anything or fall out.
6. Wash hands with hydroalcoholic solution.
7. Removal of the protective gown. First, loosen the side knot, then, without touching the skin on the neck, pull the gown from the top to undo the Velcro. When removing the gown, it is essential not to touch more than the inner side of it and fold it over itself so that the outer part is wrapped and covered. It should be lifted carefully to prevent the ribbons from touching anything and placed in the container.
8. Wash hands with hydroalcoholic solution.
9. Removal of the goggles: bend the head forward, closing the eyes and mouth. Grasp the straps at the back and remove them carefully.
10. Wash hands with hydroalcoholic solution.
11. Removal of the mask: again, bending the head down and closing the eyes and mouth, grasp the head straps from behind, and remove it forward and downward. DO NOT touch the front of the mask, as it may be contaminated.
12. Wash hands with hydroalcoholic solution.
13. Exit from the operating room.
14. Disinfection of footwear, either by introduction in a disinfectant (stepping on filters) solution or carefully removal and disinfection by immersion.
15. Complete hand washing up to the elbows.
16. Showering is recommended after completion of the process.

SPECIAL ARTICLE

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# Mexico's legal view of the COVID-19 contingency

## *La visión legal en México de la contingencia por COVID-19*

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**Keywords:**
Legal emergency in SARS-CoV-2 pandemic, COVID-19.

***Palabras clave:***
*Emergencia legal ante la pandemia SARS-CoV-2, COVID-19.*

**ABSTRACT**

The COVID-19 pandemic began in China at the end of 2019. The first case reached Mexico City on February 27, 2020, forcing the Mexican State to adopt extraordinary measures to contain the pandemic and avoid contagion by establishing emergency policies to provide medical care to those infected. The legislation in Mexico is at the height of the circumstances, it grants the Executive and the General Health Council powers to issue sanitary provisions, which are mandatory nationwide, without any precedent, restricting the principles of freedom, equality, legal certainty, and free exercise of the profession contemplated in the Political Constitution of the United Mexican States. In response to these extraordinary actions, the population in isolation confuses civil and political rights by being dominated by fear. To protect the nation, sanitary measures were implemented and access to justice and human rights was restricted. On the other hand, medical care and health services are saturated, presenting non-compliance with the obligation to provide timely information to patients and respect their autonomy by not obtaining informed consent, in addition to the inadequate documentation of the medical care provided in the clinical record. Decision-making during the pandemic is affected by political decisions aimed at achieving control of information. If these conditions continue, the control of public health information and the violation of fundamental principles will continue, even when the pandemic has been brought under control.

***RESUMEN***

*La pandemia de COVID-19 inició en China a finales de 2019, el primer caso llegó a la Ciudad de México el 27 de febrero de 2020 obligando al Estado mexicano a adoptar medidas extraordinarias ante la crisis sanitaria para la contención de la pandemia y evitar el contagio estableciendo políticas de emergencia, con el fin de otorgar la atención médica a los contagiados. La legislación en México se encuentra a la altura de las circunstancias, otorga al Ejecutivo y al Consejo de Salubridad General facultades para emitir las disposiciones sanitarias, las cuales son obligatorias a nivel nacional, sin existir precedente alguno, viéndose restringidos los principios de libertad, igualdad, seguridad jurídica y libre ejercicio de la profesión contemplados en la Constitución Política de los Estados Unidos Mexicanos. En respuesta a estas acciones extraordinarias la población en aislamiento confunde los derechos civiles y políticos al ser dominados por el miedo. Con el objetivo de proteger a la nación se instauran medidas sanitarias y se restringe el acceso a la justicia y a los derechos humanos. Por otra parte, la atención médica y los servicios de salud se encuentran saturados, presentando incumplimiento de la obligación de proporcionar información oportuna al paciente y respetar su autonomía al no recabar el consentimiento informado, aunado a la inadecuada documentación de la atención médica otorgada en el expediente clínico. La toma de decisiones durante la pandemia se ve afectada por las decisiones políticas con el fin de lograr el control de la información. De seguir bajo estas condiciones, el control de la información del sistema de salud pública y la violación de los principios fundamentales continuarán, aun cuando la pandemia haya sido controlada.*

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## INTRODUCTION

The Political Constitution of the United Mexican States in the face of the SARS-CoV-2 pandemic, COVID-19. The rapid and exponential spread of this disease, reaching the limit of becoming a pandemic, has generated an extreme crisis. This situation has forced countries to adopt extraordinary measures to prevent the spread or contagion and to be able to provide medical care to those infected.



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These measures have a direct impact on public, administrative and economic order; this constitutes limitations or restrictions on the exercise of certain fundamental rights. Normally, extraordinary or emergency measures are adopted based on the Constitution, but for unusual situations such as those the world is going through, these measures do not always exist. This forces to make creative and practical interpretations of the Constitution, which may generate some tensions due to government excesses.[1]

The hierarchy of laws in Mexico encompasses the constitutional principles of freedom, equality, safety, and free exercise of the profession, for which it is necessary to observe the legal precepts and the correct application of the current regulations on health and professions.[2]

The concept of hierarchy applied to medical law is closely linked to the concrete application of legal concepts. Not only in its regulatory principles, but also in all those situations that directly affect the practice of the profession.[2]

In any state governed by the rule of law, the existence of legal rules makes possible the harmony of its citizens and the exercise of the fundamental rights of freedom, equality, social protection, and legal certainty.[3]

The Political Constitution of the United Mexican States,[4] in Article 4, establishes the right to health protection and establishes that this right must be in accordance with the principles of equity, quality, free access, and universality, which gives rise to the current General Health Law.

The Executive has the power to establish norms and decrees, which are established in the Constitution. This is stated in Article 89, Section I:[4]

> *It grants powers and obligations to the President to enact and execute the laws issued by the Congress of the Union, providing in the administrative sphere for their exact observance.*
>
> *The President of the Republic is empowered to issue laws in matters of general health. Article 73, Section XVI 1st. and 2nd.*
>
> *1a. The General Health Council will depend directly on the President of the Republic, without the intervention of any Secretary of State, and its general provisions will be obligatory in the country.*
>
> *2a. In case of serious epidemics or danger of invasion of exotic diseases in the country, the Ministry of Health shall have the obligation to immediately dictate the indispensable preventive measures, subject to be later sanctioned by the President of the Republic. Article 89 section XVI.*

Making use of these constitutional powers and privileges, the Executive published on March 27, 2020, in the Official Gazette of the Federation the 1st and 2nd decrees, which we will comment below.

According to Article 73 section, it is the General Health Council who must act in urgent cases, as in this case, whose functions are duly detailed.

As medical professionals, we are obliged to know the provisions and guidelines that the General Health Law establishes in relation to the sanitary emergency, and it is precisely the General Health Council who must implement all the safety measures, in accordance with the international standards recommended by the World Health Organization itself.[5]

The General Health Council is a body that reports directly to the President of the Republic, in the terms of article 73, section XVI, first base of the Political Constitution of the United Mexican States.[5] It is composed of a president, who will be the Ministry of Health, a secretary and thirteen members, two of whom will be the presidents of the National Academy of Medicine and the Mexican Academy of Surgery, and the members determined by its own regulations. The members of the council will be appointed and removed by the President of the Republic, who must appoint to such positions professionals specialized in any of the health branches.[5]

The organization and operation of the General Health Council will be governed by its own internal regulations, which will be formulated by the Council itself and submitted to the approval of the President of the Republic for its issuance.

Since it is an infectious-contagious disease, the Ministry of Health is responsible for the prevention and control of diseases and accidents,

without prejudice to the provisions of the labor and social security laws on occupational hazards, Section II. To establish and operate the National Epidemiological Surveillance System in accordance with this law and the provisions issued for such purpose.[5]

The Ministry of Health and the governments of the federative entities, in their respective areas of competence, will carry out epidemiological surveillance, prevention and control activities for the following communicable diseases: epidemic influenza and other acute respiratory tract infections.[5]

It is worth mentioning that the General Health Law establishes that at the discretion of the Ministry of Health in places where serious epidemics are identified, as well as in adjacent places exposed to the spread, the civil and military authorities and private individuals will be obliged to collaborate with the health authorities in the fight against such disease.[5]

In accordance with sanitary provisions, the competent authorities are empowered to use all medical and social assistance resources of the public, social and private sectors existing in the regions affected by epidemic diseases.[5]

The Ministry of Health shall immediately dictate extraordinary measures in matters of general health to prevent and combat damage to health in epidemic diseases, subject to such measures being later sanctioned by the President of the Republic.[5] In accordance with the foregoing, the Federal Executive may declare by decree the threatened region or regions that are subject, for the necessary time, to extraordinary action in matters of general health.

When the causes that have originated the declaration of a region to extraordinary action in matters of general health have disappeared, the Federal Executive shall issue a decree declaring the termination of such action.[5]

Extraordinary action in matters of general health will be exercised by the Ministry of Health, which may integrate special brigades that will act under its direction and responsibility and will have the following attributions:

I. To entrust federal, state, and municipal authorities, as well as professionals, technicians, and auxiliaries in the health disciplines, with the performance of the activities it deems necessary and to obtain the participation of private individuals for this purpose.
II. To dictate sanitary measures related to meetings of persons, entry and exit in the populations and with the special hygienic regimes to be implemented, as the case may be.
III. To regulate land, sea, and air traffic, as well as to freely dispose of all means of transportation owned by the State and of public service, whatever the legal regime to which the latter are subject.
IV. To use freely and on a priority basis the telephone, telegraph, and postal services, as well as radio and television transmissions.
V. Others determined by the Ministry of Health.[5]

The General Health Law and its regulations provide that we are obligated to attend to emergencies. In case of non-compliance, the following sanctions are contemplated:

*Any health professional, technician, or assistant who, without legitimate cause, refuses to perform the functions or services requested by the health authority in the exercise of extraordinary action in matters of general health, shall be sentenced to six months to three years in prison and fined the equivalent of five to fifty days of the general minimum wage in force in the economic zone in question.*[5]

*Any health professional, technician, or assistant who, without just cause, refuses to aid a person in a case of obvious urgency, endangering his life, shall be sentenced to six months to five years in prison and a fine of five to one hundred and twenty-five days of the general minimum wage in force in the economic zone in question, and suspension from practicing the profession for up to two years. If damage is caused by the lack of intervention, a definitive suspension from professional practice may also be imposed, at the discretion of the judicial authority.*[5]

The persons or public or private institutions that have knowledge of accidents or that any person requires the urgent provision of health

services, shall ensure by the means at their disposal that they are transferred to the nearest health facilities to receive immediate attention, without prejudice to their subsequent referral to other institutions.[6]

The Law of Professions of Mexico City and the respective laws of the states establish that the physician is obliged to put all his scientific knowledge and technical resources at the service of his patient as well as the performance of the work, obligations of means and safety, which defines the *Lex Artis ad hoc*.[7]

The Federal Labor Law in force establishes in Article 132, Section III, that the employer is obligated to timely provide the workers with the tools, instruments, and materials necessary for the execution of the work. They must be of good quality, in good condition and must be returned as soon as they cease to be efficient.[8]

Likewise, the regulations of the General Health Law regarding the provision of health care services oblige both public and private facilities to provide immediate attention to users in the event of an emergency when it occurs in the vicinity of such facilities. Emergency is understood as any acute medical-surgical problem that endangers life, an organ or a function and requires immediate attention.[6]

The lack of protective equipment has been a constant in the amparo lawsuits before the courts. Given that the authorities have ignored the acquisition of supplies, and if they are provided, the quality is not in accordance with international recommendations for the management of patients with suspected COVID-19. The person in charge of the health system is the one who must decide with the competent authorities so that his hospital has sufficient and suitable personnel, equipment, material, and facilities adequate for the services provided; failure to do so will result in an administrative sanction and a fine.[6]

Personnel rendering services in any medical care facility, whose activities could spread any of the communicable diseases according to the General Health Law, must have a sanitary control card issued by the competent authority.[6]

Facilities that refuse to provide medical services in cases of obvious urgency, endangering the life or physical integrity of a person, shall be sanctioned in accordance with the law.[6]

The emergency services shall operate 24 hours a day throughout the year, with a doctor on duty permanently in charge of the same. The person in charge of the emergency service shall take the necessary measures to guarantee the medical evaluation of the patient and the complete treatment of the emergency or stabilize his/her general conditions so that he can be transferred for definitive attention in another hospital unit that has the infrastructure and the physical, technological, and human resources to ensure his/her treatment.[6]

Normally, the admission of a patient to a hospital is voluntary, but sometimes, to avoid risks and damage to the health of the community, the health authority orders the admission; then it is considered mandatory.[6]

In case a patient requests voluntary discharge, it will be explained to him/her that it is not appropriate because it is a contagious infectious disease in a health emergency.

It will be mandatory for the person in charge of health care to notify the Public Prosecutor's Office when the patient shows signs of violent death or when the specific cause of death is unknown, and this will be recorded in the clinical record, and the corresponding legal provisions will be observed.[6]

Likewise, the authorities must be responsible for the custody of the detainees.[6] It is necessary to give informed consent, whenever the patient's condition allows it at the time of admission to the hospital, respecting his/her autonomy and prior explanation of the risks and benefits of the procedure to be performed, being the record signed in writing in the clinical record.

In case of emergency or when the patient is in a state of transitory or permanent incapacity, it will be the closest relative, guardian or legal representative who will sign the informed consent.

When it is not possible to obtain the authorization due to the patient's incapacity and absence of family members, the authorized physicians of the hospital, after evaluating the case and with the agreement of at least two of them, will carry out the therapeutic procedure, leaving a written record in the clinical record.

The document must be printed, written clearly and without abbreviations, amendments or erasures.[6]

## CONCLUSIONS

The collective maturity produced by situations such as isolation and fear can also translate into demands for more truthful and systematic information. The preservation of civil and political rights must be present in the demand for new changes.[11]

It is important to emphasize that in times of emergency and extraordinary

| "Decree published in the Official Gazette of the Federation on March 24, 2020, establishing measures for the COVID-19 epidemic"[9] |
|---|
| **ARTICLE ONE -** National Healthy Distance Day: its objective is the social distancing to reduce person-to-person contagion with special emphasis on vulnerable groups, allowing the disease burden not to be concentrated in reduced time units, to guarantee the care of serious patients |
| Avoid attendance to workplaces, public spaces and other crowded places, to seniors 65 years of age or older and groups of people at risk of developing serious illness and/or die from it, who will enjoy their salary and other benefits established in the current regulations |
| Temporarily suspend school activities at all levels, until April 17, 2020, as established by the Ministry of Public Education |
| Temporarily suspend the activities of the public, social, and private sectors that involve the physical concentration, transit or movement of people as of the entry into force of this Agreement and until April 19, 2020 |
| Suspend temporarily and until further notice from the health authority, mass events and meetings and congregations of more than 100 people |
| Comply with basic hygiene measures |
| The others that at the time are determined necessary by the Ministry of Health |
| **Article three**: The agencies and entities of the Federal Public Administration shall maintain coordination with the Ministry of Health for the implementation of the measures subject to this Agreement |
| **Article four**: The Ministry of Health shall be the only agency responsible for the issuance and management of the official information derived from this Agreement |
| **Article five**: The Ministry of Health shall be responsible for the interpretation for administrative purposes of this Agreement, as well as for the resolution of cases not provided for herein |

| "Extraordinary actions to be implemented in the affected regions of the Mexican territory"**[10] |
|---|
| Use as auxiliary elements all medical and social assistance resources of the public, social and private sectors |
| To acquire all types of goods, services, merchandise, and objects without the need to carry out the public bidding procedure |
| Importing or acquiring in the national territory for necessary quantities or concepts |
| Carry out necessary measures to avoid price speculation |
| Others deemed necessary by the Ministry of Health |
| Use as auxiliary elements all medical and social assistance resources of the public, social and private sectors |
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| Importing or acquiring in the national territory for necessary quantities or concepts |
| Carry out necessary measures to avoid price speculation |
| Others deemed necessary by the Ministry of Health |

** Taken from the agreement published on March 27, 2020, in the Official Gazette of the Federation

measures is when the functioning of the courts, independent and impartial, is most needed to protect the rights of the people and control the excesses of power. Justice cannot be quarantined because then the Constitution, democracy, the rule of law and human rights are also quarantined.

The challenge then is to adapt the functioning of the courts in extraordinary times of pandemic to be able to continue fulfilling their function of resolving disputes.[1]

In most of the controversies that have arisen in this health contingency, the lack of supplies for the protection of health professionals has been a constant. It is worth mentioning that all the legislation in force establishes the obligation to provide the necessary material and that it must be of high quality. The lack of these supplies affects both the patient's safety and that of all the personnel working in the institutions where care services are provided.

Note in the clinical record everything related to the patient's evolution and as stated in NOM 004, record the missing items so that they can later support any medico-legal controversy.

We must comply with the obligations of means (filling out the documents properly and with all the requirements and formalities of the clinical record).

Always have the informed consent. Mexican Official Standard NOM 004-SSA3-2012:10.1.1.7

- We are obliged to promptly attend to emergencies. Even without supplies in qualified emergencies, medical attention cannot be denied.
- In labor matters, it is considered an occupational hazard if the employer did not provide what was necessary to perform the work; if it was provided, it is the responsibility of the employee.
- It is considered a crime to infect people according to the Penal Legislation.
- Respect the service contracts that we have contracted with the institutions. (Civil Legislation).
- To fill out the certificates and the informed consent form correctly.

"The forced confinement has affected all the associative nuclei, so it is inevitable that their members exchange experiences, reflections and projects. From this set of common perceptions and experiences will emerge the satisfaction or dissatisfaction with what the authorities have done or not done."
*Diego Valadés-Ríos*

"The law for the preservation of health" *Salus publica populis Romani*, a precept that places health above other norms, which is why it becomes a supreme norm.[12]

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SPECIAL ARTICLE

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# Personal protective equipment and COVID-19

## *Equipo de protección personal y COVID-19*

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Personal protective equipment, COVID-19, surgical masks, filtering respirators, elastomeric respirators, ocular protection, gowns, gloves.

***Palabras clave:***
*Equipo de protección personal, COVID-19, mascarillas quirúrgicas, respiradores filtrantes, respiradores elastoméricos, protección ocular, overoles, guantes.*

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**ABSTRACT**

Humans produce droplets and aerosols in various situations; transmission of the new SARS-CoV-2 virus is by inhalation and mucosal contact. A proper understanding of the equipment for the protection of healthcare personnel is indispensable. To provide adequate care to patients, it is essential to understand how the devices that make up the personal protective equipment prevent the entry of the virus into the body. It seems that airway protection is much better with respirators, either filtering or elastomeric with a minimum filtration rate of 95%, than with surgical masks, although the evidence is insufficient, and studies are underway to prove or disprove this. The care of the ocular mucosa plays a very important role in the transmission of the virus, so it is recommended the use of glasses or masks preferably airtight in case of being exposed to high aerosolization. Training in the use and removal of gloves and coveralls is essential to avoid contagion. It is concluded that the availability of adequate personal protective equipment is essential in the quality of care of patients with COVID-19.

***RESUMEN***

*Los humanos producimos en diversas situaciones gotas y aerosoles, la transmisión del nuevo virus SARS-COV-2 está dada por inhalación y contacto con mucosas. La comprensión adecuada de cuál es el equipo para la protección del personal de salud es indispensable. Para brindar una atención adecuada a nuestros pacientes es fundamental el entendimiento de la manera en que los dispositivos que conforman el equipo de protección personal impiden la entrada del virus a nuestro organismo. Al parecer la protección de la vía aérea es mucho mejor con respiradores, ya sea filtrantes o elastoméricos con un mínimo de filtración de 95%, que con las mascarillas quirúrgicas, aunque la evidencia es insuficiente, hay estudios en marcha para demostrarlo o refutarlo. El cuidado de la mucosa ocular desempeña un papel muy importante en la transmisión del virus, por lo que es recomendable el uso de lentes o caretas de preferencia herméticos en caso de estar expuesto a alta aerosolización. La capacitación en la colocación y retiro de guantes y overoles es fundamental para evitar contagios. Se concluye que la disponibilidad de un adecuado equipo de protección personal es esencial en la calidad de atención de los pacientes con COVID-19.*

## INTRODUCTION

The concept of personal protective equipment (PPE) for the physician has a very ancient history; the objectives of protecting both the physician and the patient in the current context in which the WHO (World Health Organization) declared COVID-19 as of March 11 as a pandemic disease, healthcare workers are at high risk of infection, with an estimated 4.4 to 20% of those ill.[1]

The new SARS-CoV-2 coronavirus was identified in December in Wuhan province, China. It is a corona-like RNA virus. Transmission is thought to be predominantly by inhalation of droplets and aerosols; there is also transmission by contact with fomites contaminated with respiratory secretions and other body fluids such as feces, flatus, and saliva, whose role in transmission is not yet clear.

Transmission by virus-containing droplets (5-10 µm) and aerosols (smaller than 5 µm) occurs when the infected individual exhales, coughs, or sneezes. Traditional measures recommended to reduce such transmission are: 1. etiquette sneezing, 2. handkerchief sneezing, 3. keeping a



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certain distance, and 4. frequent hand washing. Unfortunately, a significant proportion of the spread of SARS-CoV-2 appears to be largely due to aerosols produced by the breathing and speech of asymptomatic individuals.

Humans produce droplets and aerosols in a variety of situations, and the relationship between various factors such as droplet size, gravity, inertia, evaporation and surface contamination and host susceptibility will determine contagion. It is suspected that the severity of the disease is directly related to the number of aerosols to which the person is exposed; and inversely, the smaller the size of the dispersing particle, the greater the probability of penetration into the lower airway.

The WHO recommendations for social distancing of 1 to 2 meters are based on studies carried out in 1930, in which it was shown that droplets fall to the ground by gravity, but these studies did not consider the effect of aerosols, mainly in closed places.[2]

It is difficult for health personnel to maintain a distance of more than one meter to carry out the examination and management of patients, especially if the patient is seriously ill, so this recommended distance cannot be the primary factor for their protection. So, for this high-risk group, there are special PPE recommendations.

A study conducted in China showed that infection of health care workers is directly related to the availability of adequate PPE. This study showed zero infections in a population of health care workers who used complete and adequate PPE.[3]

Despite the above, health care workers have had to face shortages of adequate protective equipment, lack of support from public health institutions, and overcrowded health services, which make them especially vulnerable to infection through both inadequate and excessive exposure.[4]

To prevent the spread of the SARS-CoV-2 virus among healthcare personnel, the following review of the evidence described to date on best practices in the use of PPE was carried out.



## SURGICAL AND HYGIENIC MASKS

Home-made or hygienic masks are those recommended for the general population, their function is not to disseminate aerosols. They are the simplest and cheapest protective measures, and their use is not recommended in the clinical context of health personnel because there is no standard measuring their efficacy.[5]

Surgical masks are those that are proven to prevent the wearer from spreading bacteria. They are generally classified into three types depending on their quality which is measured in relation to bacterial filtration and splash resistance.[6]

They are used to reduce the possibility of surgical wound infections; they are designed to prevent the spread of bacteria that are present in the airway of the surgeon and the surgical team.

They are considered medical devices and the purpose of their design is not to protect the healthcare worker, but the surgical field so they are not considered personal protective equipment for healthcare personnel.

They are classified into three types depending on their bacterial filtration efficiency, for example, according to the European classification: type I with bacterial filtration of 95%, and type II with bacterial filtration of 98%, there is also a type II classification, some being splash resistant (IIR). In the United States they are classified with the same characteristics in levels I, II and III, the latter refers to the IIR of the European classification, according to the Centers for Disease Control and Prevention (CDC). There are few studies on their effectiveness in viral filtration.

In hospitals they are also used as a barrier measure, they are included in the standard precautions to protect the oral and nasal mucosa from splashes of blood or body fluids; another use is in droplet isolation (large droplets of more than 5 µm).

Surgical masks should not be confused with airway protection devices called filtering face masks, which are classified according to their ability to filter particles from the outside in. The classic example of these respirators is the N95 or KN95, which we will discuss later.

There is a study in which surgical masks vs. N95 respirators are compared in a medical context. This study describes the effectiveness to filter the entry of particles smaller than 5 µm, showing that the best surgical mask offers 75% protection compared to more than 95%

of an N95 respirator. Therefore, surgical masks cannot be considered as PPE for dealing with this SARS-CoV-2 pandemic.[7-9]

In cases of scarce resources, which could mean not having respirators or N95 filters, the CDC recommends the use of three-layer surgical masks that would fall into classification II or IIR in Spain and III in the USA, always remembering that their effectiveness is lost in less than 4 hours.

## FILTERING RESPIRATORS

We will refer to them as filtering respirators to differentiate them from masks, although they are commonly known by that same name in our country. They differ from the medical or surgical masks described in the previous section in that the filtering is from the outside to the inside.

They are classified depending on the percentage of air filtered through them free of particles; there are studies that demonstrate the effectiveness depending on the size of such particles. The tests are performed with particles from 0.02 to 0.5 µm. These studies evaluate the adaptability to the face and mainly the airtight seal they produce; they also evaluate how the filtration efficiency remains during the usual movements of the face.[10]

National health institutions and some initial WHO announcements mention that there is no inferiority of medical-surgical masks with respect to N95 or equivalent respirators in situations where there is no airway manipulation, highlighting that some studies have not shown absolute advantage for respirators Although it is important to emphasize that these studies were conducted in the context of the influenza epidemic and in studies on adenovirus.[8]

Based on the results of a study conducted in Wuhan by Wang et al,[11] the CDC recommended that health professionals in contact with COVID-19 patients should have at least an N95 respirator during patient care, regardless of whether there was airway manipulation. It should be specified that training in the placement and even more so in the removal is very important, since inadequate technique is associated with a greater probability of contagion, and the recommendation for the use of these respirators is that it should not exceed eight hours.[12]

There is another trend that defends the superiority of respirators over surgical masks. The most recent meta-analysis states that according to the context compiled with similar diseases, such as SARS, and MERS, regarding the use of N95 respirators vs. surgical masks, there is a clear benefit in favor of the use of N95 respirators; however, there are two ongoing clinical trials that will surely provide much more information in this regard.[13]

The National Institute for Occupational Safety and Health (NIOSH) is responsible for certifying respirators in the United States (USA). N95 respirators provide respiratory protection against aerosols and splashes, and to avoid falsifications, an authorization number is given based on the test of the equipment, which appears on the mask with the initials TC. Other countries such as China, South Korea, Japan, and others in Europe have their own classifications and certifications *(Table 1)*.

Mexico according to its NOM-116-STPS-2009 uses the same classification of respirators as the United States giving class N for those that are not oil resistant, class R for those that are oil resistant, and P for those that are made for any particle.[14]

**Table 1: List of countries with their respective registration and equivalents.[15,16]**

| USA (NIOSH) | Europe (EN) | China (GB) | South Korea (KMOEL) | Japan (JMHLW-2000) |
|---|---|---|---|---|
| Mexico (NOM-116-STPS-2009) | | | | |
| N95 | FFP2 | KN95 | KF94 | DS/DL2 |
| N99 and 100 | FFP3 | KN99 and 100 | | |

## ELASTOMERIC RESPIRATORS

Elastomeric half-mask or full facepiece respirators are made of synthetic or natural rubber, can be cleaned, disinfected, stored, and reused. They are alternatives to disposable filtering facepiece respirators. While elastomeric respirators are not FDA-cleared for fluid resistance, their NIOSH approval states that they can provide at least equivalent protection to an N95 filtering facepiece respirator.[17-19]

Some types of elastomeric respirators may offer greater protection than N95 respirators. They are equipped with replaceable filter cartridges or flexible filter cartridges, disc- or pancake-shaped (rectangular), which may or may not be housed in a cartridge body.

Because they are reusable, elastomeric particulate respirators provide an alternative respiratory protection option to N95 respirators. The disadvantage is that they require maintenance and a supply of replaceable components including straps, inhalation and exhalation valves, valve caps and filters, and cartridges.[20-22]

They have maintenance requirements that include cleaning and disinfection of facepiece components such as straps, valves, and valve cover. While it is often possible to decontaminate the outer casing of filters, the filter material cannot be cleaned and disinfected for reuse. Filter components should be discarded when they become damaged, soiled, or clogged.[23-25]

There are two types of elastomeric respirators: half mask and full mask. Precautions, limitations, and restrictions on use should be understood prior to use in health care. Full-mask respirators have the same filtering considerations but provide greater protection due to better face sealing characteristics and provide protection to the entire face.

In general, it is recommended that respirators be cleaned and disinfected immediately after removal to avoid contact transmission; precautions should be taken during removal and use. The materials from which the elastomeric components of NIOSH-approved respirators are made vary among manufacturers; consequently, recommended cleaning and disinfection solutions and procedures may also vary according to the manufacturer.

Companies provide limited time of use and other limitations or restrictions depending on the intended use of the respirator. The N-series (N-95) half-mask or 95% efficiency level filtering facepiece respirator has been determined to provide adequate protection in combination with other health care practice interventions such as hand washing, isolation, and physical distancing.

Filter cartridges should be removed from the facepiece prior to cleaning and disinfecting the elastomeric facepiece components. The facepiece components have basic steps for cleaning and disinfection: 1. Remove, 2. Clean, 3. Disinfect, 4. The order and details of each step are essential, and it is very important that respirators are thoroughly air-dried before storage.[26,27]

There is a study showing their systematic use in hospitals in the United States reporting 94% operational efficiency and a 10-fold decrease in costs compared to the use of filtering facepiece respirators, as well as ecological sustainability.[28]

*Table 2* describes the scenarios in which respiratory protection devices are useful. They are classified into 1. surgical and home-made masks, 2. filtering facepieces (self-filtering) and 3. elastomeric respirators: industrial (elastomeric masks).

## FACE AND EYE PROTECTION

According to the recommendations issued by the WHO, the PPE to be used by the surgeon is the one suggested for aerosol-generating activities, which includes eye protection with the use of glasses or face shield; however, the face shield can provide extra protection to the respirator, so its use is suggested without substituting the glasses.[30]

The recommended eye protection is the use of lenses that fit around the eyes, designed with plastic material such as polycarbonate so that they can be reused and are resistant to degradation that could be caused by disinfection; they should have a soft rim that adapts to the physiognomy of the user, fulfilling an airtight seal without indirect ventilation that could filter outside air into the interior; they should also have an anti-fogging coating and an elastic band that allows adjustment to the

user, compatible with the rest of the personal protective equipment.[30-32]

Frame lenses and contact lenses are not considered PPE. Care should be taken when putting on lenses, goggles, or protective glasses over them, as they can cause internal leaks and lead to fogging, and to ensure that even with the frame the protective lenses are correct before entering surgery with a COVID-19 positive patient.[33]

Personal protective eyewear should be placed on top of the coverall cap to prevent external splashes from falling under the hood as well as to fit the cap to the face and not cause leakage into the coverall; only if a full-face mask is used should it be placed under the coverall hood.[33]

Face protection such as face shields are intended to protect eyes, nose, and mouth from contamination by respiratory droplets, aerosols and splashes of secretions and body fluids. It is recommended that they offer coverage from the forehead to the chin including the lateral sides of the face. They are made of a reusable material such as plastic that is easy to disinfect, adapt to the physiognomy of the user and are comfortable to handle to avoid contamination of the surgical field when used; they offer extra protection to the disposable N95 or KN95 respirator to avoid splashes that could contaminate them.[30,34,35]

For disinfection, products that should be used are those identified as effective against the SARS-CoV-2 virus or authorized by the U.S. Environmental Protection Agency (EPA), which publishes a list of authorized disinfectants against this virus. The use of products containing alcohol or chlorine for disinfection is not recommended, as they degrade the anti-fogging product in most lenses.[36-38]

Strategies to optimize eye protection supplies should prioritize the fact that it is essential to have this resource in activities that generate aerosols or risk of splashes, as well as in those that take place in operating room areas. The use of their useful life should be extended according to the manufacturer's direct recommendations and reusable products should be considered.[30,32,34]

## GLOVE WEARING

Regarding the use of gloves, the WHO recommends the use of two pairs of gloves in surgical procedures or activities that have a high risk of breakage.[32]

The composition of the gloves can be latex or nitrile; the advantage of nitrile is its resistance to degradation by the alcohol used for disinfection in the removal of protective equipment, but it has the disadvantage of being less flexible and of not being available in all health centers. The advantages of latex are that it is more flexible and adapts more easily to the user's physiognomy.[30,31]

It is suggested that the first pair be made of nitrile or latex and the second of sterile latex, and the appropriate size be available for the

**Table 2: Types of masks and level of protection.[29]**

| Mask type | Division | | Wearer protection | Patient protection |
|---|---|---|---|---|
| Surgical and home-made | Home-made | | No | Yes |
| | Surgical | I, II y IIR | No | Yes |
| | | | Splashes | Yes |
| Filtering respirators | FFP1 | | No | Yes |
| | FFP2/N95 | Without valve | Yes | Yes |
| | | With valve | Yes | No |
| | FFP3/N100 | With valve | Yes | No |
| Elastomeric (industrial) | Half face | | Yes | No |
| | Full face | | Yes | No |

surgeon. Using different colors of gloves is a strategy that helps to identify more easily if there is any defect, at least one pair should cover more than the wrist, ideally up to the middle of the forearm, and if there is any doubt or evidence of breakage, the gloves should be changed immediately.[30,31] The use of different colors of gloves is a strategy that helps to identify more easily if there is any defect.[30,33,36]

## PERSONAL PROTECTIVE CLOTHING

The international recommendations of both the WHO and the United States Centers for Disease Control and Prevention (CDC) dictate the use of protective clothing in aerosol-generating procedures, indicating the use of an impermeable surgical gown, which can be disposable or reusable, and in case it is not resistant to liquids, the use of a plastic apron underneath the gown.[30,33,39,40]

The CDC reports that there are no clinical studies to compare the efficacy of the use of waterproof surgical gown and the use of waterproof coveralls.[37,42]

The waterproof surgical gown should be resistant to liquid penetration with protection level 4 (resistant to liquids, liquid penetration with hydrostatic pressure, and resistant to virus penetration), have elastic or adjustment at the wrists, a length below the knees, completely cover the back of the user, be the correct size for the user and offer freedom of movement without compromising the integrity of the gown material. Its disadvantage is that it does not offer neck protection, but it can be used in conjunction with a disposable, waterproof scuba suit; it is not recommended to use extra protective equipment without proper training for donning and doffing.[33,41,42]

The coverall is a protective equipment that offers 360-degree coverage to the user. Some models can have a hood and boots included. It should be resistant to liquids and waterproof. Always the appropriate size that gives the user freedom of movement and does not compromise the integrity of the coverall in handling should be use; the closure should be covered by a flap and have elastic or adjustment at the wrists. Training is required in the placement and removal of this protective equipment to avoid contamination. Surgical areas that are not adequately ventilated may be hot, or the user may perceive a greater thermal sensation compared to other protective equipment. It is a good reusable option and should always be used with a sterile gown over it in surgical procedures.[33,41,42]

The WHO and the CDC establish strategies to optimize the supply of protective clothing during health crises, prioritizing the use of this resource in aerosol-generating activities, preferably reusable materials, trying to extend their useful life according to the manufacturer's direct recommendations, and in case of severe shortages, considering the use of a mixture of protective clothing such as reusable or cloth gowns, plastic aprons, sleeve covers, etc.[32,41]

There are clinical studies focused on proposing a third section of personal protective equipment for activities with production of super aerosols or high risk of aerosolization such as those involving manipulation of the patient's eyes, nose, mouth, and neck as well as endoscopic procedures; it is suggested the use personal protective clothing that offers full body coverage such as coveralls or a combination of gowns and skins.[40,42]

More clinical studies are still needed to identify the advantages of one type of personal protective equipment over another, specifically in the treatment of patients infected by the SARS-CoV-2 virus. Learning to use protective equipment correctly and choosing the appropriate components according to the physiognomy of the user is an essential activity for health care personnel, and training in the application and removal of protective equipment continues to be a fundamental part of preventing contagion among health care personnel.

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SPECIAL ARTICLE

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# Recommendations of the Mexican Association of General Surgery A.C. Back to another normality in surgery

## *Recomendaciones de la Asociación Mexicana de Cirugía General A.C. De regreso a otra normalidad en cirugía*

Juan Roberto Torres Cisneros,* Salvador Francisco Campos Campos‡

The Mexican Association of General Surgery (AMCG), a leading organization integrated by physicians specialized in general surgery, in compliance with its purpose, which is to strive for a better scientific preparation of its members and to ensure the practice of the profession and specialty in a framework of safety for patients and health professionals, with the scientific information available so far, is allowed to make the following recommendations for the resumption of elective surgery programs:

### A. General considerations: COVID-19 and surgery

- Some pathologies can be treated medically and not surgically, without implying a risk for the patient.
- Delays in the treatment of some surgeries may favor complications in patients and carry a poor outcome.
- There are reports in the international literature on the development of respiratory complications in a higher percentage than usual and an increase in perioperative morbimortality in surgical patients with SARS-CoV-2 infection (COVID-19), either known preoperatively or not known and developed postoperatively.
- Surgery and general anesthesia of patients with SARS-CoV-2 (COVID-19) infection are high-risk procedures for contamination of the surgical team involved, especially during airway management.
- Consider the availability of resources for the creation and maintenance of patient transfer circuits and non-COVID-19 areas for the performance of surgical procedures.
- It is important to continuously evaluate the epidemiological conditions of the population, where the geographical area and the hospital center are located, so to know the risk of infection of patients and health professionals.
- Avoid or control as much as possible the procedures that generate aerosols and splashes and use the corresponding personal protective equipment.
- Ensure hospital admission on the same day of surgery. Limit as much as possible the number of days of hospital stay.
- Restriction of the number of visitors and companions as much as possible during the hospital stay.
- Strict adherence to the recommendations on physical distancing, hygiene and use of masks by patients, visitors, accompanying persons and professionals during the hospital stay.
- Active surveillance and separation of elective surgery circulation for the isolation

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of those patients who develop symptoms or signs compatible with COVID-19.

**B. Regarding the exclusion of patients with active infection (COVID-19) prior to scheduled surgical procedures, we recommend:**

- Generate and adapt preoperative protocols and processes with the institution to exclude patients with active SARS-CoV-2 infection.
- Carry out an initial clinical and epidemiological history evaluation approximately 14 days prior to surgery to detect symptoms or risk of COVID-19.
- Strictly recommend and control physical distancing and protective measures for patients two weeks prior to surgery to reduce the chances of infection.
- Rule out active SARS-CoV-2 infection by performing a PCR for SARS-CoV-2 by nasopharyngeal swab as close to surgery as possible, ideally within 72 hours prior to surgery.
- Perform a second evaluation of the clinical and epidemiological history in the anesthesiologist's preoperative assessment prior to surgery to detect symptoms or risk of COVID-19.

**C. In case of emergency surgery we suggest:**

- Consider every patient as a possible carrier of COVID-19 until proven otherwise.
- Given the impossibility of having a PCR test result for SARS-CoV-2 quickly and expeditiously, it is recommended to perform a preoperative chest CT scan to identify possible COVID-19 infection.
- Reserve the indication for routine use of SARS-CoV-2 serology (IgG and IgM) to diagnosis of suspected cases based on the clinical context.

**D. To minimize the risk in health professionals it is recommended:**

- Consider every patient as a possible carrier of COVID-19 until proven otherwise.
- Continuous information and updating of health professionals regarding the disease and the use of personal protective equipment (PPE) in particular.
- Strict frequent hand washing following the recommendations of the World Health Organization.
- The use of surgical mask N95 or similar by professionals.
- The use of additional protection (FFP2 mask or higher, splash gown and screen or closed goggles) in procedures that may generate aerosols.

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SPECIAL ARTICLE

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# Respiratory protection for health care professionals. A perspective to COVID-19

## *Protección respiratoria para profesionales de cuidados de la salud. Una perspectiva ante el COVID-19*

David Sotero Rodríguez-Marín*

**Keywords:**
Surgical masks, N95 respirators, respiratory protection, respirators fit testing.

***Palabras clave:***
*Mascarillas quirúrgicas, respiradores N95, protección respiratoria, pruebas de ajuste de respiradores.*

**ABSTRACT**

The pandemic generated by the new SARS-CoV-2 virus has required the immediate response of health care professionals in a dizzying manner, responding to the exponential increase in the number of patients requiring hospitalization. This situation has required health care professionals to respond immediately to the pandemic situation, including shortages of patient care supplies, including personal protective equipment. This article is intended to explain the differences between surgical masks and respirators, the principles of operation of N95 respirators, their worldwide equivalents (including the Mexican Official Standard NOM-116-STPS-2009), the correct ways to use these devices, and the strategies that exist to optimize the use of these devices during the SARS-CoV-2 health emergency.

***RESUMEN***

*La pandemia generada por el nuevo virus SARS-CoV-2 ha requerido la respuesta inmediata de los profesionales de cuidados para la salud de manera vertiginosa, respondiendo al aumento de pacientes que requieren hospitalización de forma exponencial. Esta situación ha necesitado que los profesionales de la salud atiendan de forma inmediata la situación generada por la pandemia, incluso con el desabasto de insumos necesarios para la atención de pacientes, incluidos los equipos de protección personal. El presente artículo tiene la intención de explicar las diferencias entre mascarillas quirúrgicas y respiradores, los principios de funcionamiento de los respiradores N95, sus equivalentes a nivel mundial (incluyendo la Norma Oficial Mexicana NOM-116-STPS-2009), las formas correctas de utilización de este tipo de dispositivos y las estrategias que existen para optimizar el uso de estos dispositivos durante la emergencia sanitaria por SARS-CoV-2.*

Surgery masks and respiratory protective equipment (also known as respirators) have been widely used by healthcare professionals as methods of infection control.

## SURGICAL MASKS

A surgical mask is defined as a disposable device that provides no fit and is intended to create a physical barrier between the user's mouth and nose and potential contaminants in the immediate environment.[1] These devices are intended to protect the wearer against splashes of body fluids, which are generated during health care procedures, and do not provide any respiratory protection because they do not create a seal on the wearer's face.

Such devices are regulated by the Food and Drug Administration (FDA) in the United States and require performance evaluations of the following parameters:

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- Fluid resistance
- Bacterial filtration efficiency
- Flammability
- Biocompatibility

Bacterial filtration efficiency is performed on the materials used to manufacture surgical masks, looking for the protection they provide against biological aerosols. According to the ASTM-2100 standard of the United States of America, there are three levels of bacterial filtration efficiency *(Table 1)*.[2]

Bacterial filtration efficiency is performed with a test aerosol of approximately 3.0 ± 0.3 μm and is commonly confused with the particulate filtration efficiency at which respiratory protective equipment is approved.

As mentioned above, surgical masks provide protection for users against splashes of body fluids, including saliva droplets to which healthcare professionals may be exposed during medical procedures. However, it is important to note that this type of device does not provide respiratory protection.

## RESPIRATORY PROTECTION EQUIPMENT (RESPIRATORS)

According to NOM-116-STPS-2009 "Personal protective equipment – Negative pressure air purifying respirators against harmful particles – Specifications and test methods", a respirator can be defined as: a positive or negative pressure personal protective equipment that purifies or supplies air to protect the user's respiratory tract against contaminants found in the work environment *(Table 2)*.[3]

**Table 1: Bacterial filtration efficiency levels.[2]**

| | Type 1 | Type 2 | Type 3 |
|---|---|---|---|
| BFE% ASTM F2101 | ≥ 95 | ≥ 98 | ≥ 98 |
| PFE% ASTM F2299 | ≥ 95 | ≥ 98 | ≥ 98 |

These devices are designed to provide protection against any contaminant dispersed in the environment, provided that they have been selected according to the hazard present in the environment, and that the user uses it correctly and consistently throughout the time spent in the workplace.

Health authorities worldwide suggest the use of N95 respirators or their equivalents for healthcare professionals who are in contact with persons confirmed with SARS-CoV-2 virus (COVID-19), especially in those procedures where aerosol generation is likely. In general, they also recommend the use of filtering face pieces or disposable respirators (FFR), because of their ease of implementation and the possibility of disposing of the respirators at the end of their lifetime (generally, one working day).

In the United States of America, the National Institute for Occupational Safety and Health (NIOSH), through the 42 CFR 84 standard, established guidelines for the approval of respirators. Within this standard, NIOSH classifies particulate respirators into nine different classes, according to the type of filter media, and the filtration efficiency of respirators *(Table 3)*.[4]

The filter media used in the construction of particulate respirators are electrostatic filters, which act to easily attract very small particles to the filter surface. Atmospheres containing oils in their composition can damage this electrostatic charge and thus decrease the filtration efficiency of the respirator.

Likewise, particulate filters are tested with aerosols with an aerodynamic mass diameter of 0.3 μm. Because of its size, this aerosol is extremely difficult for a respirator to trap, so it was selected as the test aerosol.

Worldwide, there are other standards for certification and/or approval of respirators, among which those that have similarities with the characteristics expressed by NIOSH standard 42 CFR 84 stand out. *Table 4* shows some equivalent standards for N95 respirators.[5]

The various approvals shown in *Table 4* are equivalent to those established by NIOSH; consideration should be given to performing a

respirator fit test to ensure that the facepiece fits properly on the user's face.

It is also important to consider the respirator selection process according to the application within the healthcare facility. The selection processes are sometimes complicated and are likely to require the assistance of an occupational hygiene or occupational health specialist. There are some tools available that can provide clear guidance for proper respirator selection. To provide protection against SARS-CoV-2 (COVID-19), health authorities suggest the use of particulate respirators, especially an N95 respirator or its equivalent. This recommendation is since the main risk of exposure of health care personnel occurs in procedures where aerosols are generated, such as patient intubation processes or respiratory therapies, and these aerosols, in essence, are liquid particles that are easily trapped by the electrostatic filtering media of respirators.[6]

It is of utmost importance that health care professionals identify respiratory protective equipment suitable for use in areas where SARS-CoV-2 confirmed patients are treated. Disposable or maintenance-free respirators are a good option for protection, provided they are available; in cases where these are limited, professionals could opt for the use of reusable half-face or full-face respirators. Another interesting option is the use of forced air purifying respirators (PAPR's), especially when health professionals need to spend very long periods of time working inside facilities where people with SARS-CoV-2 are treated.

While it is true that most respirators provide protection based on test methods, it is important to consider some other factors that may influence the performance of respiratory protective equipment, such as:

- Ease of placement/removal of the face piece.
- Time of respirator use.
- Compatibility with other personal protective equipment.
- Ease of cleaning/decontamination.

At the industrial level, respirators are used under a written respiratory protection program. This program establishes the guidelines for managing the use of respirators to provide maximum protection to users. Within the Respiratory Protection program, fit testing is established. The purpose of these tests is to ensure that the respirator model used by a person generates an adequate fit (seal) on the face. These fit tests must be performed by all personnel whose activities require the use of respirators. This test can help identify those individuals who, due to their physical or anatomical characteristics, cannot achieve a good respirator seal, compromising safety when using these devices.

Fit testing is a routine practice in industry in general, but little seen in healthcare settings. It is recommended that all employees who use respirators as a measure of protection against

**Table 2: Classification of respirators.[3]**

| | Negative pressure | Positive pressure |
|---|---|---|
| Air purifiers | Disposable respirators<br>Reusable half-face respirators<br>Reusable full-face respirators | Forced air purifiers (PAPR's) |
| Air supply | Pressure-demand air line systems | Air line systems<br>Self-contained air systems |

**Table 3: National Institute for Occupational Safety and Health (NIOSH) classification of respirators.[4]**

| % | N<br>Does not resist oil sprays | R<br>Partially resists oil aerosols | P<br>Aerosol and oil-proof |
|---|---|---|---|
| 95.00 | N95 | R95 | P95 |
| 99.00 | N99 | R99 | P99 |
| 99.97 | N100 | R100 | P100 |

**Table 4: Equivalent respirator standards N95.[5]**

| Certification class (standard) | N95 NIOSH 42CFR84 USA: | N95 STPS NOM-116-STPS Mex. | FFP2 EN-149 2001 EU | KN95 GB2626 2006 China | P2 AS/NZ 1716:2012 Aus. N.Z. | 1st Class Korea KMOEL-2017-64 | DS Japan JMHLW, Notification 214, 2018 |
|---|---|---|---|---|---|---|---|
| Performance of filter (%) | ≥ 95 | ≥ 95 | ≥ 94 | ≥ 95 | ≥ 94 | ≥ 94 | ≥ 95 |
| Testing agent | NaCl | NaCl | NaCl Kerosene oil | NaCl | NaCl | NaCl Kerosene oil | NaCl |
| Test flow (l/min) | 85 | 85 | 95 | 85 | 95 | 95 | 85 |

SARS-CoV-2 virus be fit tested to ensure that the respirator model being used provides adequate protection.

The SARS-CoV-2 health emergency has caused healthcare facilities around the world to experience shortages of supplies, including ventilators and surgical masks. This has prompted health authorities to establish recommendations to extend the life span of ventilators. The US Centers for Disease Control and Prevention (CDC) published strategies for optimizing the supply of personal protective equipment (PPE) on its website on March 18, 2020.[7] These strategies include assessing PPE overdemand capacity, which refers to the ability to handle a sudden and unexpected increase in patient volume that would otherwise severely challenge or exceed a facility's current capacity. The use of three general strata is suggested to describe overdemand capacity, which can be used to prioritize measures to conserve PPE supplies across the continuum of care:

- **Conventional capability:** measures consisting of engineering, administrative and PPE controls that should already be implemented in overall infection prevention and control plans in healthcare settings.
- **Contingency capacity:** measures that can be used temporarily during periods of expected PPE shortages.
- **Crisis capability:** strategies that are not commensurate with US standards of care but should be considered during periods of known PPE shortages.

This health emergency places these strategies in a state of crisis capacity, where PPE shortages are a constant in healthcare settings. Given this situation, CDC guidelines in the United States of America suggest healthcare sites consider crisis capacity scenarios, which should be carefully planned for prior to implementation. CDC suggests that some crisis capacity strategies are uncertain and may present a risk of transmission among healthcare personnel and patients. Among these crisis capacity strategies, CDC suggests:

- Consider using intact PPE that is beyond the manufacturer's designated service life for patient care activities.
- Carefully prioritize the use of PPE for selected care activities.
- If commercial PPE is not available, carefully consider whether alternative approaches will reduce the risk of exposure to health care professionals, and whether these methods are safe for patient care.

On February 4, 2020, the U.S. Federal Government stated that circumstances exist to warrant the authorization of additional

respiratory protective devices in healthcare settings during the SARS-CoV-2 outbreak.

On February 29, the U.S. Food and Drug Administration (FDA) issued a series of updates to manufacturers, facilities, and state and local jurisdictions on emergency use authorizations for respirators and other personal protective equipment.

These emergency use authorizations strengthen the protection of public health institutions in the United States of America against CBRN risks (i.e.: chemical, biological, radiological, and nuclear) by facilitating the availability and use of the necessary supplies to deal with emergencies; in this case, the emergency generated by the SARS-CoV-2 virus. In the case of respiratory protection equipment, the emergency use authorizations establish protocols for respirator decontamination processes, by means of certain methods established and approved by the FDA. It is important to note that these decontamination protocols are only valid during the declaration of a sanitary emergency by the Federal Government of the United States of America.

Respirator decontamination processes are not recommended by any disposable respirator manufacturer since the original conception of these devices is to discard them after use. However, global supply problems of disposable respirators have forced health authorities to seek methods of decontamination of these supplies to keep health care professionals protected.

For a decontamination method to be considered by the FDA, it is required to meet the following conditions:

- Effectively inactivate the SARS-CoV-2 virus.
- Do not damage the filtering media or any element of the respirator (nose clip, adjustment straps).
- Do not damage the fit provided by a disposable respirator.
- That the selected method does not represent a risk for the respirator user.

For respirator decontamination protocols and methods, please refer to the following link:[8] https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization#covidppe.

Currently, manufacturers of respirators and decontamination methods are collaborating with the FDA, universities, and research institutes to evaluate methods of decontaminating disposable respirators in a safe manner.

Finally, a controversial issue for healthcare professionals is whether the respirators being used are approved or certified under the above guidelines. It is important for health care professionals to verify that the respirators comply with the regulations under which they are designed. It is suggested that respirator test reports or certificates be reviewed prior to use to ensure their reliability.

While it is important to verify that respirators are approved under some international standard and remember that these devices provide protection if they fit properly on the user's face, so a pre-use test at the health care facility is recommended.

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# A paradigm shift in education

## *Cambio de paradigma en la educación*

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**Keywords:**
Distance education, simulation, information and communication technology, learning, information society, e-learning in medical education.

***Palabras clave:***
*Educación a distancia, simulación, tecnologías de la información y comunicación, aprendizaje, sociedad de la información, e-learning en educación médica.*

**ABSTRACT**

Learning during the pandemic has taken a turn from one day to the next. Accelerated technological changes have generated a "new normality", have made necessary the efficient use of information and communication technologies as well as simulation in medical and surgical education. The evolution of virtual spaces is not simple; it implies the adoption of new teaching-learning processes. Distance education is an opportunity, thus making it possible not to suspend academic activities and to optimize the availability of time. Clinical and surgical simulation, which can help to replace internships, is carried out on planned and structured scenarios like reality. It allows to evaluate the student through an intervention with him/her to know his/her mistakes and successes, all this through the analysis of the use of captions. Social networks can be used for teaching. Now it is possible to easily watch and listen to virtual conferences, congresses, and so forth. To continue the teaching of residents, the classroom has been moved to virtual sessions, and to complement it, you can have a repository of videos, closed Facebook© groups where you can interact with residents through questions, questionnaires, or through topics for discussion. The global trend is to increase the academic load outside the traditional classroom, that is, in virtual spaces that link simulation, and take advantage of information and communication technologies.

***RESUMEN***

*El aprendizaje durante la pandemia ha dado un giro de un día para otro, los cambios tecnológicos acelerados han generado una "nueva normalidad" y han hecho que se tenga que utilizar de manera eficiente las tecnologías de la información y comunicación, lo mismo que la simulación en educación médica y quirúrgica. La evolución de los espacios virtuales no es sencilla, acarrea adopción de nuevos procesos de enseñanza-aprendizaje. La educación a distancia es una oportunidad, logrando así no suspender actividades académicas y optimizar la disponibilidad del tiempo. La simulación clínica y quirúrgica, la cual puede ayudar a sustituir las prácticas, se lleva a cabo sobre escenarios planeados y estructurados de forma similar a la realidad. Permite evaluar al alumno a través de una intervención con él para hacerle saber sus errores y aciertos, todo esto mediante el análisis del uso de rúbricas. Las redes sociales se pueden utilizar para la educación, se pueden ver y escuchar conferencias virtuales y congresos. Para continuar la enseñanza con los residentes, se pasó del aula a las sesiones virtuales, para complemento se puede tener un repositorio de videos, grupos cerrados de Facebook© donde se puede interactuar con los residentes a través de preguntas, cuestionarios o poner temas a debate. La tendencia mundial es incrementar la carga académica fuera del aula tradicional, es decir, en espacios virtuales que vinculen la simulación y exploten al máximo las tecnologías de la información y comunicación.*

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## INTRODUCTION

The objective of this paper is to discuss the urgent positioning of learning in virtual spaces in a knowledge-based society overwhelmed by accelerated technological changes and epidemiological events that have generated a "new normality" associated with abrupt economic, techno-scientific, social and political movements, among others, which require the efficient use of information and communication technologies as well as simulation in medical and surgical education.

### Change as a primer in education

Never as today, in this globalized world, has the need for change been so necessary to give continuity to processes. The economic, political, and social phenomena of our time



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have radically transformed the environment, impose new challenges, a greater demand for human capital and the necessity of quality collaborative work. Facing this overview, education does not escape this reality and acts accordingly with the implementation of new educational paradigms, with which we are not only fostering a better future, but more importantly, they are transforming the present.

Globalization and the vertiginous development of information and communication technologies (ICT's) have generated a dependence on immediacy and thus on technological tools. Nowadays, none of us can imagine ourselves without the use of cell phones that allow us to contact individuals in distant locations and at the same time this same cell phone informs us of the relevant news of the day, the state of the weather, changes in the stock market or makes us participants, in just minutes, in virtual communities through social networks such as Facebook, Twitter, WhatsApp, etc. We wander amid knowledge, culture, and the commercialization of leisure, where technology intermingles and exploits them in a multiplicity of modalities, through which social networks, videos, television, or video games contribute to teaching, stimulate the resolution of educational problems and, in turn, to entertainment.

Social and economic needs demand radical changes in the way of facing challenges, making decisions, and solving problems. Therefore, education has shifted to a position where the student is the main protagonist of the teaching-learning process, manager of the construction of their knowledge, autonomous and responsible for meeting their training needs, motivated to land their life project as a happy individual in constant improvement to transform their environment into a harmonious one allowing them to achieve their goals as well as personal and collective welfare.

Under this perspective, online education arises as a response to the demands of globalization, technocracy and a knowledge society that requires human capital with systemic thinking associated with cognitive skills, abilities and positive attitudes that respond to the requirements of the labor sector.

Notwithstanding the above, in Mexico the educational paradigm in virtual spaces and its actors (teachers, students, educational institutions, community, etc.) is negotiating the learning curve with different degrees of maturity, with staggered and non-uniform advances among the different socioeconomic strata within the country.

## Evolution and relevance in distance education (DE)

War and pandemics share the need to strengthen the labor force and innovation through the construction of new knowledge and forms of employability to avoid economic recession. By this precept, innovations in technologies for education in virtual spaces point towards an educational revolution that demands relevance in the structuring of contents based on contextualized scenarios, emerging needs of change and above all, that foster visualizing and foreseeing future events.

The evolutionary process of virtual spaces is not simple, since it entails the adoption of diverse behavioral patterns as well as of the teaching-learning process itself, since the crossing of such space gives rise to submerging in areas of possible misunderstandings between the contributions and perceptions of the instructor and the student, since the psychological and communication spaces between student and instructor are never exactly the same, due to that even in face-to-face education there is a certain transactional distance that needs to be narrowed.[1] Therefore specific strategies and techniques for learning in DE show distinctive psycho-pedagogical and instructional concepts that transform the role of the teacher into a facilitator and even more into a catalyst for the individual requirements of the learner, as well as for stimulating interactions among the members of the learning team.

Although the massification of DE in the surgical field is focused on solving the growing demand for continuous training or updating programs as well as taking advantage of the vertiginous technological advances of the 21st century, it implies a great challenge, since it requires having the appropriate infrastructure, qualified personnel in education, information, and communication technologies, as well as

continuous maintenance of the platform and incorporation of new learning objects.

The elements with the greatest impact on DE are the design of the program, the exploitation of diverse media and resources, as well as communication styles, emotional characteristics, personality type and learning styles of the students to promote creativity, self-regulation, commitment, and responsibility of the teacher-student binomial.

## The "new normal" as an opportunity to embrace change in education

Commotion originated by COVID-19 in the world, and undoubtedly in the educational sector, opens a great opportunity to globally adopt the biggest change in DE in history and thus address in our favor the circumstances of confinement as well as to reduce the suspension of academic activities and optimize the availability of time.[2]

This unexpected and abrupt reality embedded in a multiplicity of perceptions of the environment immerses us in a dance of emotions, which move between fear and uncertainty due to the perpetuation of the traditional methods of information transmission and reproduction of obsolete constructs that prevail in our educational system, ranging from the basic to the postgraduate level. The "new normality" invites us to give meaning to the priority, emergent, novel, and effective concepts to become different observers of reality, open to change and challenging to bring out latent competencies making synergy of talents to promote collaborative work for the conversion of threats into opportunities.

This "new normality" converging with DE breaks down the barriers of time and space, brings the population individually and collectively closer to a gamification of audiovisual contact that undoubtedly overcomes isolation;[3] positions the subject as a protagonist, responsible for his/her learning and promoter of conversations that germinate harmonious and friendly mental scenarios for interaction and exchange of experiences that encourage atmospheres of belonging and achievement for assertive decision-making opening up new ways of facing the complexity of the current situation.

In the present century, medical education is undergoing interesting and decisive changes associated with advances in knowledge and technology; epidemiological evolution and patients' demands have led institutions to reformulate the way they teach medicine.[1]

## Simulation as an educational strategy in times of COVID-19

In these times of educational crisis caused by the COVID-19 virus pandemic, virtual resources have been sought to cover the lack of presence of students at the universities; in addition to this, the concern arises as to how to address the clinical practice.[4]

Although DE represents a relevant tool in the learning and evaluation of theoretical concepts and skills such as communication, leadership, and decision making, among others, the training of new surgeons faces important challenges in the acquisition of competencies in clinical practice and surgical skills, where clinical simulation is an important element for teaching.[5]

Clinical simulation is a discipline that is defined as a set of methods that facilitate the acquisition of skills and abilities by doctors in training in scenarios like real life in a safe learning environment with the aim of not putting patients at risk. Currently, this discipline represents one of the teaching strategies that allows a medical student or resident of any specialty, facing planned scenarios, designed, and structured in a similar way to reality, to strengthen the development of skills, attitudes, and aptitudes with the objective of maintaining the humanization of medical practice, and above all, the safety of patients by promoting teamwork.

It is important to point out that the implementation of clinical simulation does not turn its back on the face-to-face teaching processes in medical and surgical education, nor does it replace the practice with the real patient. On the contrary, it represents a complement and a link between the basic science phase and the clinical phase, acting as a bridge between the theoretical and the

practical, with the advantage of being able to repeat a procedure as many times as necessary until it is mastered and then perform it safely with less complications in the real patient. It undoubtedly shortens the learning curve and through debriefing (conversation between two or more people to review the simulated event), the student may explore and analyze his/her actions, discovers the error, reflects on his emotional states, and obtains new information to improve his performance in real situations.[6,7]

In these times of confinement, we should not make the mistake of thinking that simulation can fully replace surgical practice with patients in real scenarios; However, simulation centers promote the development of skills and abilities in an efficient manner, given that they have controlled and contextualized spaces that allow the student to be present in person and adopt themes centered on "doing" and showing "how to do it" based on the evidence of superior aptitude established in Miller's pyramid of knowledge, which is why they constitute an efficient solution to the impediment of student presence and for clinical practice in current times of pandemic.

By the afore mentioned, many questions arise about the field of action and contribution of clinical simulation for the development of surgeon competencies in times of pandemic. In this regard, low fidelity simulation requires anatomical parts or simulators of specific tasks for knots and sutures, laparoscopy, or anastomosis exercises, among others, which may require the presence of the student all of which can be implemented remotely nowadays. If the resource is at hand, for example, the student or resident may be recorded doing his training box, and the teacher can see what the student has done and make the appropriate recommendations.

On the other hand, there are dynamics such as video sessions, where simulated clinical cases or surgical events can be used to interact remotely to develop clinical reasoning or skills such as decision making. This is known in some media as telesimulation.[6]

Finally we may conclude that although this unexpected battle that healthcare personnel face against COVID-19 is not yet over, the lessons learned have induced us to critically evaluate the current methods of educational delivery in the face of this uncertain and changing overview,[8] so it is imperative to live the now with an empowered vision, eager for improvement and enterprising to develop DE and simulation strategies that minimize the interruptions of face-to-face training programs in medical personnel in training with permanent updating in all surgical specialties.

The global trend is to increase the academic load outside the traditional classroom, that is, in virtual spaces that link simulation and make the most of information and communication technologies to build learning experiences at the student's particular pace and, moreover, that allow him/her to identify the most relevant and timely points to discover or create opportunities for progress and the foundation of new knowledge.

## Use of social networks in surgical education

During this pandemic the use of social networks such as Facebook, Twitter, YouTube, Instagram, Snapchat, among others, are the most important source to spread the news about COVID, unfortunately not all news is real. On the contrary, much news are false, and there is much misinformation.[9] Almost two billion people in the world make use of social networks during the pandemic, which has caused to spend more time in front of the screen. Traditional sales have been replaced by online sales, and teaching has had to be carried out through this modality.[10] Similarly, businesses, if they use them in an intelligent and creative way, can have positive results. New platforms have emerged, such as Tik-Tok and Edu-Tok, which is the educational part. Also, the use of Podcast and Telegram are changing the scenario in social networks.[10]

Derived from the pandemic it has been observed that the use of social networks has been useful, especially to provide medical information that is considered true, but it has also fallen into what is now known as infodemia in which false notes prevail, especially because the image of a nurse or a doctor is used to give these notes. That is why platforms such as Facebook, for example, direct the user to the World Health Organization sites for reliable

information. Social networks can be used for education. Through them it is possible to watch and listen to virtual conferences specially to learn about COVID-19 and generate discussion, since several congresses or conferences have been cancelled due to the pandemic.[11] What should we do to avoid infodemia? We should follow health authorities and specialists who are recognized and reliable in the information they provide. Information arrives daily to our networks, e-mails, WhatsApp; therefore, we should not recirculate information that has not been verified.[11]

### How can we use technology with residents during this pandemic?

Since the beginning of the pandemic, both the American College of Surgeons and the Mexican Association of General Surgery decided to suspend scheduled surgery, to perform only emergency surgery, not to gather more than 10 people, and to reduce the number of personnel in the operating room. All this has changed the surgical teaching of residents from one day to the next. Some proposals have been made to continue with the same by making use of technology.[12]

When transferring classroom work out of the classroom, you need to properly instruct what you want and encourage student participation with questions and discussion. You can have a repository of videos that the resident can watch later; the videos should be different according to the hierarchy. Another option that was raised was to open a closed Facebook group where daily questions are uploaded to prepare them for their certification exam and to invite them to academic conferences of our association or other surgery-related associations. For classes there are different free platforms that can be used from the cell phone, tablet, or computer. It is recommended to record the sessions so that they remain in the cloud and are available to the residents.[12]

On Twitter there are different surgical education accounts and surgeons who upload their clinical cases, and there is also interaction through opinion; topics and articles that are also uploaded for review and good discussion. This should be generated always trying to make it evidence-based medicine and surgery. The uploading of cases must be, as we have already described, with the patient's consent, times, etc.

From now on we must consider all the tools we have at hand to innovate in surgical education.

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SPECIAL ARTICLE

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# Perioperative management of the patient with suspected or confirmed COVID-19 infection

## *Manejo perioperatorio del paciente con sospecha o confirmación de infección por COVID-19*

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**Keywords:** COVID-19, perioperative management, personal protective equipment, cytokines.

***Palabras clave:*** *COVID-19, manejo perioperatorio, equipo de protección personal, citoquinas.*

**ABSTRACT**

SARS-CoV-2 affects the host using the angiotensin-converting enzyme 2 (ACE2) receptor. The first step in virus entry is the binding of the trimeric protein S (spike) of the virus to the human ACE2 receptor, which is expressed in multiple organs, including the lung, heart, kidney, and intestine, and most importantly in endothelial tissue. Within the main pathophysiology is the cytokine storm, the uncontrolled systemic inflammatory response that results from the release of large amounts of proinflammatory cytokines and chemokines by immuno-effector cells. The cytokine storm is coupled with the metabolic response to the trauma of surgery, resulting in an inflammatory hyper-response that can lead to multiple organ failure. Management of the patient with COVID-19 disease and surgery involves different medical and surgical specialties.

***RESUMEN***

*El SARS-CoV-2 afecta al huésped utilizando el receptor de la enzima convertidora de angiotensina 2 (ACE2). El primer paso en la entrada del virus es la unión de la proteína trimérica S (spike) del virus al receptor ACE2 humano, el cual se expresa en múltiples órganos, como pulmón, corazón, riñón e intestino, y aún más importante, en el tejido endotelial. Dentro de la fisiopatología principal está la tormenta de citocinas, que da lugar a una respuesta inflamatoria sistémica no controlada que resulta de la liberación de grandes cantidades de citocinas proinflamatorias y quimiocinas por células inmunoefectoras. La tormenta de citocinas se une a la respuesta metabólica que implica el trauma de una cirugía, lo cual ocasiona una hiperrespuesta inflamatoria que puede llegar a la falla orgánica múltiple. El manejo del paciente con la enfermedad de COVID-19 y cirugía implica diferentes especialidades médicas y quirúrgicas.*

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## INTRODUCTION

In our academic lives we may have read about the pandemics that had struck mankind centuries before. We may have read about and perhaps managed patients with SARS, MERS, and even influenza; however, we had not faced such a large and difficult to control pandemic. We are facing a new virus, the SARS-CoV-2 virus which produces COVID-19. It is a virus with a positive single-stranded RNA genome.[1]

There are four groups of coronaviruses: alpha, beta, gamma, and delta. The genome of the SARS-CoV-2 betacoronavirus has 80% homology with the earlier SARS-CoV and 96% homology with the bat coronavirus Bat-CoV RaTG13, so it is thought that it may



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be derived from a coronavirus originating from bats.[2]

During the 21st century, coronaviruses have evolved three times to be able to infect people: in 2002 with SARS-CoV and in 2012 with MERS-CoV, both beta coronaviruses. The outbreak of the current coronavirus in 2019 has resulted in a global pandemic with unpredictable consequences.

The main route of transmission is by person-to-person contact and respiratory droplets produced by talking, coughing, or sneezing. "Flügge droplets" are tiny droplets (more than 5 microns) produced naturally when talking, coughing, or sneezing by an infected person. When discharged from the nose or mouth, these droplets can reach the mucous membranes of the mouth, nose or eyes of another person and transmit the virus to them if they are nearby.[3] It is important to know that these droplets do not remain suspended in the air but are deposited rapidly up to just under one meter. Once deposited, the virus can be detected up to three hours after aerosol administration, four hours on a copper surface, 24 hours on cardboard, and up to two to three days on plastic and steel.[3] Therefore, the most effective way to stop transmission is to increase hygiene and social distancing measures and individual protection.

## PATHOPHYSIOLOGY

SARS-CoV-2 affects the host using the angiotensin-converting enzyme 2 (ACE2) receptor. The first step in virus entry is the binding of the trimeric protein S *(spike)* of the virus to the human ACE2 receptor, which is expressed in multiple organs, including the lung, heart, kidney, and intestine, and most importantly in endothelial tissue. The virus is internalized using the endocytic pathway into endosomes using a clathrin-and caveolin-independent mechanism, while requiring cholesterol and sphingolipid-rich microdomains or *lipid rafts*. Endothelial cells are found throughout much of the body, including blood vessels. The cause of the alterations caused at the vascular level by COVID-19 is still not fully understood. However, the damage at the vascular level of different organs affecting human engineering through endothelial tissue has been proven.

Cytokine storm: one of the main mechanisms of acute respiratory failure syndrome (ARDS) is the so-called cytokine storm, or also cytokine release syndrome. It is an uncontrolled systemic inflammatory response resulting from the release of large amounts of proinflammatory cytokines (interleukin [IL]-1b, IL-6, IL-10, IL-12, interferon [IFN]-alpha, IFN-gamma, TNF-alpha, and/or TGF-beta, etc.) and chemokines (CCL2, CCL3, CCL5, CXCL8, and/or CXCL10, etc.) by immunoeffector cells, e.g., macrophages activated by SARS-CoV, MERS, and SARS-CoV-2 infection.[4,5] The cytokine storm will cause ARDS and multiple organ failure, and ultimately lead to death in severe cases of infection.

Another important concept is secondary hemophagocytic lympho-histiocytosis (sHLH), also known as macrophagic activation syndrome,[6] which is a hyperinflammatory syndrome characterized by fulminant and fatal hyper-cytokinemia with multiorgan failure. HLHS is frequently triggered by viral infections.[6,7] The main features of sHLH include fever, cytopenias, and hyper ferritinemia. ARDS may be seen in up to 50% of patients.

A cytokine profile like sHLH is associated with severity of COVID-19 disease.[8] Indeed, in most patients, ferritin and IL-6 are found to be very elevated, being higher in patients who died, suggesting that mortality may be due to viral hyperinflammation.[8]

There is evidence of viral infection in endothelial cells along with diffuse endothelial inflammation. The virus uses the ACE 2 receptor expressed by pneumocytes in the alveolar epithelial lining to infect the host causing lung injury; it can also be expressed in other organs.[9]

Recruitment of immune cells, either by direct viral infection of the endothelium or immunomodulated, can result in generalized endothelial dysfunction associated with apoptosis. The vascular endothelium is an active paracrine, endocrine, and autocrine gland that is indispensable in the regulation

of vascular tone and maintenance of vascular homeostasis.[9,10]

Endothelial dysfunction is the primary determinant of microvascular dysfunction, causing increased vasoconstriction with subsequent organ ischemia, with inflammation associated with tissue edema and causing a procoagulant state.[11]

Viral elements have been found among endothelial cells and inflammatory cell accumulation with evidence of both endothelial and inflammatory cell death. This suggests that SARS-CoV-2 facilitates the induction of endothelitis in various organs as a direct consequence of viral development and host immune response. Likewise, apoptosis and pyroptosis also play an important role in endothelial injury.[11]

This endothelitis caused by SARS-CoV-2 may explain the microcirculatory alterations in the vascular bed and the clinical sequelae that occur in COVID-19 survivors. On the other hand, in the clinical presentation of severe cases of COVID-19, lymphopenia, higher levels of ferritin and D-dimer, as well as IL-2R, IL-6, IL-10 and TNF-alpha, among others, are observed. The absolute number of CD4+ and CD8+ lymphocytes decrease significantly more in severe patients, and the frequency of TCD4+ cells tend to be lower in severe cases. Somehow, it is as if the T cells remaining in the circulation, in addition to being decreased in number, appear to be functionally depleted.[12]

In short, the accumulated evidence so far indicates that patients with severe COVID-19 usually suffer a cytokine storm, and this altered immune response should be considered, as it has very relevant implications for the treatment of patients. Therefore, it is advisable to treat the hyperinflammatory state of these patients.

This hypothesis justifies the use of different treatments to stabilize the endothelium while viral replication is present, particularly with anti-inflammatory drugs, anti-cytokine drugs, ACE inhibitors, and statins.[9,13,14]

This strategy is particularly relevant for vulnerable patients with pre-existing endothelial dysfunction, which is associated with male sex, smoking, arterial hypertension, diabetes mellitus, obesity, and established cardiovascular disease, all associated with adverse outcomes in COVID-19.

## HOW DOES ALL THIS HELP US IN SURGICAL PATIENTS?

Different studies have shown that surgical patients are part of a group vulnerable to SARS-CoV-2 exposure in hospitals and mainly susceptible to pulmonary complications, due to the proinflammatory cytokine response and immunosuppressive response to surgery and mechanical ventilation.

The exact impact of surgical stress and anesthesia (with the expected associated inflammation as well as other common complications such as the occurrence of atelectasis) on the predisposition to new COVID-19 infection or exacerbation of infection in an asymptomatic COVID-positive patient undergoing surgery is unknown.[15] Based on current evidence, although the mortality of COVID-19 is believed to be between 1-3%, most deaths have occurred in elderly patients with underlying cardiopulmonary conditions, most of whom are hypertensive, diabetic, and obese.[15-17]

In a publication in *The Lancet*[16] investigators examined data from 1,128 patients with perioperative COVID-19 at 235 hospitals. Overall, the 30-day mortality rate in the study was 23.8%. Mortality was disproportionately high in all subgroups, including elective surgery (18.9%), emergency surgery (25.6%), minor surgery such as appendix surgery or hernia repair (16.3%), and major surgery such as hip surgery or colon cancer surgery (26.9%). Operated patients may be susceptible to subsequent pulmonary complications caused by inflammatory and immunosuppressive reactions to surgery and mechanical ventilation.[16]

Postoperative patients are another group of patients in whom COVID-19 infection is a diagnostic challenge and has a high mortality rate. A complicated postoperative course can be observed, especially in elderly patients with underlying health conditions.

In this context, the risk and benefit of performing elective surgical procedures should be carefully evaluated. In some

situations, postponing elective surgical procedures may be the right decision, with consideration also given to preserving resources, including personal protective equipment, and maintaining treatment space for critically ill patients.[18-20]

The main complication arises from the cytokine storm in the pulmonary epithelium (the organ where most of the epithelial tissue is located) and the immediate silent hypoxia in these patients, especially if they were intubated. It should be remembered that the complications that a patient infected with COVID-19 may present are ARDS (acute respiratory distress syndrome) 90%, respiratory failure 83%, secondary or nosocomial infection 27.3%, acute cardiac failure 9.1%, encephalopathy with hypoxia 18.2%, acute renal failure 18.2%, shock 9.1%, and hepatic failure 9.1%. If the patient is immunocompromised, complications may be more severe and multiple organ failure and death may occur.

If the patient is known to be infected with COVID-19, immediate treatment for SARS-CoV-2 should be given and treatment for the presenting surgical condition should be concurrent. But if the patient is not known to be infected but is in fact infected, or is an asymptomatic carrier, the problem may occur in the perioperative period.

The cytokine storm is coupled with the metabolic response to trauma, resulting in an inflammatory hyper-response, which can lead to multiple organ failure.

General surgery associations and societies have issued special considerations for the performance of surgical procedures[20-24] since the beginning of the health contingency.[21,22] There are no conclusive studies that indicate greater contamination by aerosols produced in laparoscopy compared to open surgery, but fewer infections have been observed when the surgical teams are wearing personal protective equipment, remembering that the greatest risk of infection occurs during intubation and extubation of the patient.

On the other hand, cases of time-sensitive diseases (oncologic) should be performed by carefully selecting surgeries and patients as well as emergency surgeries, since not performing them means condemning these patients to a poor prognosis regardless of the pandemic.[23,24] According to the ASA *(American Society of Anesthesiologists)* physical status, in time sensitive procedures the ASA I or II patient can be operated on; in the case of the ASA III patient with a history of diabetes, arterial hypertension, congestive heart failure, immunosuppression and in the case of ASA IV or higher patients requiring intensive care or massive transfusion, and where possible complications may outweigh the benefit, the recommendation is that they should be cancelled and other treatment alternatives should be sought.[15]

## PROTECTIVE EQUIPMENT DURING THE PERIOPERATIVE PERIOD

Protection of personnel is a priority; if health personnel become ill, they deplete the workforce to fight the pandemic, becoming just another patient to be cared for, and putting other personnel at risk.

The recommendations are very clear when it is necessary to intubate COVID-19 positive or suspected patients, and complete personal protective equipment (PPE) is indispensable and care such as planning transportation routes from one room to another, and management protocols have already been universally proposed. However, there is another facet: the perioperative context of healthy or apparently healthy patients, since it has been estimated that the proportion of asymptomatic patients is 17.9%. However, this is variable, since experience has shown that there can be up to 80% of asymptomatic patients during an incubation period of the SARS-CoV-2 virus of five days or more and the development of symptoms, so there are COVID-19 positive patients who can be transmitters during this period[25] so precautions should be taken at the time of surgery to avoid infecting or infecting them.

General anesthesia is recommended for patients with suspected or confirmed COVID-19 to reduce the risk of cough. Other types of anesthesia may be selected depending

on the type of surgery and individual patient needs. It should be remembered that intubation and extubation should be performed inside the operating room (with surgeons not required to be present in the room).[15,20]

Several studies have identified that immediate postoperative pulmonary complications occur in half of patients with perioperative SARS-CoV-2 infection and are associated with high mortality. This has direct implications for clinical practice worldwide. These increased risks associated with SARS-CoV-2 infection should be weighed in the balance and consideration given to decreasing these risks by delaying surgery. The patients most vulnerable to adverse outcomes are male, those aged 70 years or older, those with comorbidities (ASA grades 3-5), patients with cancer surgery, and those requiring major or emergency surgery.[18,19]

Greater care should be taken during the pandemic than is the case in normal or routine practice. Male patients aged 70 years or older who have surgery, whether emergency or elective, are at increased risk, particularly of high mortality, although minor elective surgery has also been associated with higher than usual mortality.

During SARS-CoV-2 outbreaks, consideration should be given to postponing non-critical procedures and promoting non-surgical treatments to delay or avoid the need for surgery.

However, if surgery must be performed, it should be remembered that postoperative outcomes in SARS-CoV-2 infected patients have higher morbidity and mortality than the pre-pandemic baseline rates of pulmonary complications and mortality. Thirty-day postoperative mortality of 23.8% has been reported, including all surgical patients. The highest mortality in SARS-CoV-2 patients was primarily in those who had postoperative pulmonary complications, which was approximately 50% of patients.[18] In the subgroups of elective surgery patients, mortality was 18.9%, in emergency surgery patients was 25.6%, in minor surgery patients was 16.3%, and 26.9% in major surgery patients.[18]

## WHAT DOES THE SURGEON HAVE TO DO?

The first thing the surgeon should keep in mind is that any patient may be a carrier of COVID-19, even if he or she presents asymptomatic.

Therefore, the surgeon must keep relevant hygiene measures.[26]

1. Appropriate use of personal protective equipment (PPE): the use of personal protective equipment is recommended for every surgical procedure performed on a patient with a confirmed COVID-19 infection or a patient in whom infection is suspected *(Table 1)*.
2. N95 respirators, respirators or filters offering a higher level of protection should be used when an aerosol-generating procedure (e.g., patient intubation in the operating room, nasogastric tube placement) is to be performed on infected or suspected COVID-19 patients.
3. Disposable respirators and respirator masks should be removed and disposed of properly in the appropriate containers.
4. Perform hand hygiene after disposing of respirator or mask.
5. It is necessary to learn how to put on and remove the PPE (the ideal is to have an instructor). Fit testing is essential to ensure proper fit of the mask *(Table 1)*.
6. In the operating room or in the office or intensive care unit, the number of people should be as few as possible.
7. The transportation of the patient after surgery or from the emergency room to another destination must follow a strict protocol and with the minimum number of personnel and always with PPE.
8. Frequent hand hygiene is indispensable.[26]
9. Operating rooms with negative pressure and/or similar anterooms are recommended when available.
10. Appropriate PPE should be used according to the institution's policy as well as the intraoperative protocol.
11. It is necessary for all health personnel to be aware of the permanence of COVID-19 on different surfaces, being infectious (e.g.,

cardboard one day, plastic three to four days).

12. Have a minimum number of personnel in the operating room, including during intubation, as well as during the entire surgery or procedures. There should be no visitors or observers.
13. Use the smoke evacuator or aspirator when using electrocautery.
14. Post-operative/recovery: Transportation of a patient with COVID-19 or suspected COVID-19 infection to an outside recovery area or intensive care unit should be attended by a minimum number of transport personnel waiting outside the operating room. Personnel should wear personal protective equipment. This equipment should not be the same as that used during the procedure.
15. Recommendations for surgeon protection before and after separation from a patient with suspected COVID-19 infection vary from institution to institution. However, those that are universally called for are:
    a. Remove used clothing from home and store in a garment bag.
    b. Wear laundry after arrival at the hospital.
    c. After separating from the patient, remove clothing for laundering, and consider bathing before wearing clean suit or home clothes.
    d. Wash hands frequently and maintain safe social distancing.
16. Once at home: what should be done to keep the family safe?
    a. In some countries, health care institutions and/or systems have hotel or other accommodations for health

**Table 1: Recommendations for personal protective equipment. *University of Kansas Health System.***

| Non-suspected COVID-19 patient care | Care of the suspected or confirmed COVID-19 patient (if the maximum distance is 90 cm between patient and physician, the patient should also wear a surgical mask) | Aerosolizing procedures in suspected or confirmed COVID-19 patients and in all patients submitted to airway procedures |
|---|---|---|
| When: | | |
| • Asymptomatic patient<br>• Minimum distance of 150 cm from the patient for less than one minute | • COVID-19 asymptomatic patient<br>• Positive or pending COVID-19 test | • All procedures resulting in aerosolization |
| Where: | | |
| • Medical offices<br>• Emergency services<br>• Acute care medical units<br>• Intensive Care Units<br>• Procedure rooms | • Medical offices<br>• Emergency services<br>• Acute care medical units<br>• Intensive Care Units<br>• Procedure rooms | • Medical offices<br>• Emergency services<br>• Acute care medical units<br>• Intensive Care Units<br>• Procedure rooms |
| PPE required: | | |
| • Surgical mask | • Eye protection/face shield<br>• Surgical mask<br>• Coverall/gowns<br>• Gloves | • Respirator N95 or PAPR + face shield + eye protection<br>• Coverall/gowns<br>• Gloves |

All categories: hand washing before and after patient care regardless of isolation.
PPE = personal protective equipment, PAPR = powered air-purifying respirator.

care workers who cannot or prefer not to go home after their activities.
b. Make the family aware that viral contamination of surfaces is a known means of infection transmission.
c. Maintain hand sanitizer and/or disposable gloves for use of ATMs, vending machines, gas pumps, and transfer of items at the time of purchase.
d. Clean cell phones frequently before, during, and after patient care activities. Cell phones may be stored in a sealable bag during work activities. The phone can be used inside the bag.
e. You must remove your clothes and wash them when you get home.
f. Reduce physical contact with family members and wash hands frequently.
g. Clean hard surfaces at home with an effective disinfectant solution (e.g., 70% alcohol).[26]

## TREATMENT OF PATIENTS CONFIRMED OR SUSPECTED OF COVID-19[27,28]

Fist consideration is that of the surgical pathology that the patient needs; however, as already explained, it should be given at the same time as the treatment for atypical viral pneumonia.

1. Hypoxemia management. If a patient is admitted to the intensive care unit (ICU) it is because his/her life is at risk, or he/she has failure of one or more organs, or the hemodynamics are altered. Respiratory failure is the primary and most common in COVID-19 cases and oxygen should be administered immediately. In adult patients with COVID-19 and acute respiratory distress syndrome (ARDS) and respiratory distress, hypoxemia, or shock (without intubation or mechanical ventilation), immediate supplemental oxygen is recommended until $SpO_2 \geq 94\%$ is achieved.
   The use of high-flow nasal cannula oxygen therapy and noninvasive mechanical ventilation (NIMV) should be restricted to units where only patients with suspected or confirmed COVID-19 are hospitalized in an adequate ventilation or negative pressure environment and if all personnel in the area correctly use aerosol protection measures. If this is not possible, mechanical ventilation with orotracheal intubation should be preferred. In adult patients under mechanical ventilation and ARDS it is recommended to use low tidal volumes (4 to 8 ml/kg predicted body weight) maintaining plateau pressures below 30 cm $H_2O$. Use positive end-expiratory pressure (PEEP) for alveolar recruitment (optimal PEEP) and if necessary, use the prone position for 12 to 16 hours (some articles mention up to 36 hours) to improve hypoxemia.[29]
2. Hemodynamic management. The hemodynamic pattern *per se* of patients with COVID-19 is not yet known; however, it is important to measure blood volume on admission and to initiate conventional hydric resuscitation according to the patient's clinical picture to avoid hydric over-resuscitation. The dynamic parameters normally used are internationally valid: central venous pressure, pulmonary pressure and occlusion (invasive), systolic volume variation, pulse pressure variation, skin temperature, capillary filling time, or lactate measurement. Hydric resuscitation is recommended to be done with balanced crystalloid solutions such as 0.9% saline or lactated Ringer's solution. It is not recommended to use hydroxyethyl starches, gelatins, or dextran, or to use albumin for hydric resuscitation and/or intravascular volume expansion.[29,30]
3. If shock persists despite hydric resuscitation, norepinephrine should be administered as a first-line vasoactive agent instead of other agents. In the absence of norepinephrine, epinephrine or vasopressin may be used as first line over other inotropic agents. The dose of the vasoactive drug should be increased until a mean arterial pressure (MAP) of 60-65 mmHg is reached. It is suggested that vasopressin be added (not

changed) as a second-line agent when vasopressor association is required if the expected MAP is not achieved by norepinephrine.[29]

4. Steroids. There is discussion on the administration of systemic steroids: the first line is, if the administration of two vasoactive agents is necessary, corticosteroids are administered. The second: in patients with mechanical ventilation and respiratory failure without ARDS, administration of systemic corticosteroids is not suggested. However, in patients with ARDS, after the fifth day, it is suggested to start corticosteroids to avoid pulmonary fibrosis as much as possible.[29,30] Third: lately European studies, basically from the United Kingdom, suggest the administration of dexamethasone to reduce the hyperinflammatory state 6 mg IV for five days.[31]
5. Antibiotics. It is suggested to use antimicrobial agents empirically for five to seven days according to institutional protocols considering the clinical diagnosis (e.g., community-acquired/atypical pneumonia, sepsis) and local data of bacterial resistance. Third generation cephalosporins plus a macrolide may be used. Antibiotic administration should be initiated within one hour of patient evaluation. In surgical patients, if the underlying pathology is sepsis or associated with sepsis, the ideal is to start with first line carbapenems (such as ertapenem) and if anaerobic germs are suspected start metronidazole, always PLUS a macrolide (clarithromycin/azithromycin).
6. Antivirals. Lopinavir is a human immunodeficiency virus (HIV) type 1 aspartate protease inhibitor. Ritonavir inhibits CYP3A-mediated metabolism of lopinavir, thereby increasing serum concentration of lopinavir, hence the combination: lopinavir-ritonavir. Previously, during SARS and MERS outbreaks, they were used with some good results. Currently, in severe patients, the response is good.
7. Thromboprophylaxis/anticoagulation. Hospitalized patients, critical or not, can be complicated by sepsis-induced coagulopathy, disseminated intravascular coagulation, or venous thromboembolism due to prolonged bed rest, amongst other causes. However, critically ill patients with COVID-19 appear to be particularly predisposed to thrombotic complications. As in all surgical patients, antithrombotic prophylaxis should be managed; however, in the case of patients with SARS-COV-2 pneumonia, thrombosis is a continuous state, according to the physiology already explained. Ideally, D-dimer and fibrinogen should be measured, and prophylaxis or anticoagulation should be decided according to their test results. Conventional heparin or low molecular weight heparin is recommended. These drugs mainly prevent venous thromboembolism as well as micro embolism occurring at pulmonary, cardiac and cerebral levels (including ischemic attack, systemic arterial embolism and/or myocardial infarction).[29-31]
8. Interleukin-6 inhibitors (tocilizumab). Tocilizumab is a humanized immunoglobulin that blocks the IL-6 receptor. It is used to block severe T-cell response or life-threatening cytokine release syndrome (cytokine storm).[30,31]
9. Convalescent patient plasma. This is the blood plasma of a person who has recovered from an infection and contains neutralizing antibodies against the offending agent. It is considered as a form of passive immunotherapy. Convalescent patient plasma has been explored as a treatment option in SARS and severe influenza. It is still under study, and while initial results appear to be promising, the evidence is limited by the observational nature of the current studies and the size of the samples (very small). Recently, the FDA and here in Mexico studies are currently in place in selected specialized research centers and only in severe patients.

Severe SARS-CoV-2 pneumonia disease was defined as patient with dyspnea,

respiratory rate ≥ 30/min, $SpO_2$ ≤ 93%, Kirby index (PAFI) < 300, and/or pulmonary infiltrates > 50% in 24 to 48 hours. Life-threatening illness is defined as respiratory failure, septic shock, and/or multiple organ dysfunction or failure. Eligible plasma donors need to have a history of COVID-19 disease proven by positive PCR testing and be IgG positive; complete resolution of symptoms at least 28 days prior to donation or complete resolution of symptoms at least 14 days prior to donation and negative PCR testing for COVID-19; negative testing for human leukocyte antigen (HLA) antibodies, with defined SARS-CoV-2 neutralizing antibody titers (e.g., greater than 1:80).

Potential risks of this plasma transfusion include pathogen transmission, anaphylaxis, transfusion-associated circulatory reactions; and transfusion-related acute lung injury and overload (TRALI).[30-32]

10. Remdesivir (GS-5734). A viral RNA-dependent RNA polymerase inhibitor with inhibitory activity against SARS-CoV and Middle East respiratory syndrome (MERS-CoV),[4-7] was identified early on as a promising therapeutic candidate for COVID-19 because of its ability to inhibit SARS-CoV-2 *in vitro*.[8] It has been observed that initiation of remdesivir 12 hours after inoculation with MERS-CoV9,[10] reduced pulmonary virus levels and lung damage. In the latest study reported in the *New England Journal of Medicine*, where remdesivir was administered for patients hospitalized with COVID-19 and requiring supplemental oxygen therapy, among its conclusions it highlights that despite a faster recovery and withdrawal of mechanical ventilation in fewer days, given the high mortality despite the use of remdesivir it is clear that treatment with an antiviral drug alone is not sufficient. Future strategies should evaluate antiviral agents in combination with other therapeutic approaches or combinations of antiviral agents to continue to improve patient outcomes in COVID-19.[31,33]

## CONCLUSIONS

In conclusion, treatment should first address the underlying pathology and, depending on the severity of the pneumonia and the altered target organs, continue with comprehensive management. Always, the ideal is always team-making decisions (surgery + critical care + infectious diseases) for the patient's recovery.

Once hospitals resume routine surgery, it is likely to be in settings that remain exposed to SARS-CoV-2. In the future, routine preoperative screening for SARS-CoV-2 may be possible with rapid tests that have low false-positive rates, but hospital-acquired infection remains a challenge [27,28]. Strategies are urgently needed to minimize hospital transmission of SARS-CoV-2 and mitigate the risk of postoperative pulmonary complications in SARS-CoV-2-infected patients whose surgery cannot be delayed. In Mexico, some hospitals have been declared as COVID-19 sites in order to be prepared for the contingency; however, given the natural history of the disease, its dissemination and epidemiological prognosis, the initial organization does not exempt the rest of the hospitals from being involved in the care of patients infected with COVID-19, which implies the participation of the entire health system of the country. As specialists, we have a strong commitment, and knowing the disease and protecting ourselves will be our best weapons during this pandemic.

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at the authors' work center, the authors declare that they have followed the protocols on patient data privacy while preserving their anonymity. The informed consent of the patient referred to in the article is in the possession of the author.

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# Impact of the COVID-19 pandemic on the practice of General Surgery in Mexico. National survey

## *Impacto de la pandemia COVID-19 en la práctica de Cirugía General en México. Encuesta Nacional*

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**Keywords:** Coronavirus, SARS-CoV-2, COVID-19, general surgery, personal protection equipment

***Palabras clave:*** *Coronavirus, SARS-CoV-2, COVID-19, cirugía general, equipo de protección personal.*

**ABSTRACT**

**Introduction:** In December 2019, an outbreak of pneumonias of unknown cause was first reported in the city of Wuhan, Hubei province, China; its contagiousness quickly crossed borders, and became a pandemic that to date is present in 188 countries, with a total of 16,950,407 cases and 664,961 deaths. This event has generated substantial changes in all areas of human activity, and medical and surgical practice have not been an exception. **Objective:** To collect and analyze data related to some conditions of the general surgeon's practice and the effect caused by the COVID-19 pandemic, in addition to highlight useful information with the possibility of building a reference of support for personal actions and for decision makers. **Material and methods:** In this descriptive observational study, the authors developed an anonymous survey using the Survey Monkey® tool which sent to surgeons by e-mail and taking the database of associates of the Mexican Association of General Surgery and reinforced by social networks. To get an overview, the following sections were included: demographic data, professional activity, hospital characteristics, surgical practice, personal protective equipment, and COVID-19. **Results:** 723 responses were obtained from surgeons, from which following data were collected: 90.32% were general surgeons, 79.61% were male and 20.39% female; main group age ranged from 30 to 60 years (75.5%); the main comorbidity was hypertension (23.24%), with a medium level of risk of complications (59.86%) for COVID-19 severity. The 52.52% of surgeons worked in the so-called COVID Hospitals; elective surgery was performed in 44.2%. In minimally invasive surgery no $CO_2$ filtering device was used in 63.99% of the procedures and only 20.76% of operating rooms had negative pressure. The personnel acquired their own personal protective equipment in 48.5%; the personnel with the greatest contagion were the medical staff (42.46%), and those

***RESUMEN***

***Introducción:*** *En diciembre de 2019 se reportó por primera vez un brote de neumonías de causa desconocida en la ciudad de Wuhan, provincia de Hubei, China; su contagiosidad rápidamente traspasó fronteras, y se convirtió en una pandemia que a la fecha está presente en 188 países, con un total de 16,950,407 de casos y 664,961 muertes. Este evento ha generado cambios sustantivos en todos los ámbitos de la actividad humana, la práctica médica y quirúrgica no son la excepción.* ***Objetivo:*** *Recolectar y analizar datos relacionados con algunas condiciones de la práctica del cirujano general y el efecto causado por la pandemia COVID-19, además de resaltar información útil con la posibilidad de construir una referencia de apoyo para acciones personales y para los tomadores de decisiones.* ***Material y métodos:*** *Estudio observacional descriptivo, los autores desarrollaron una encuesta anónima utilizando la herramienta Survey Monkey®, enviada a cirujanos por correo electrónico y tomando la base de datos de asociados de la Asociación Mexicana de Cirugía General, reforzado por redes sociales. Para tener un panorama general, se incluyeron los siguientes apartados: datos demográficos, actividad profesional, características del hospital, práctica quirúrgica, equipo de protección personal y COVID-19.* ***Resultados:*** *Se obtuvieron 723 respuestas de cirujanos, de los que se recolectaron los siguientes puntos sobresalientes: 90.32% fueron cirujanos generales, del género masculino 79.61% y femenino 20.39%; el grupo de edad está centrado entre 30 y 60 años (75.5%); la principal comorbilidad es la hipertensión (23.24%), con un nivel medio de riesgo de complicaciones por COVID-19 en 59.86%. El 52.52% de los cirujanos laboran en Hospitales COVID; la cirugía electiva se realiza en 44.2%, en cirugía de mínima invasión no se utiliza algún dispositivo para filtrar $CO_2$ en el 63.99% y sólo 20.76% de las salas de operaciones cuenta con presión negativa. El personal adquiere su*

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working in the emergency service (43.26%); and as a response to this situation, 49.57% had issues adapting in the professional and family fields. **Conclusions:** The impact of the COVID-19 pandemic has generated substantive changes in the practice of general surgery in Mexico, from an immediate response that requires training and prevention measures to the development of medium- and long-term strategies for the best performance and safety for patients and health professionals.

*equipo de protección personal en el 48.5%; el personal con mayor contagio es el médico (42.46%), y del servicio de urgencias con 43.26%; y como respuesta a esta situación le ha sido complicado adaptarse en el terreno profesional y familiar al 49.57%.* ***Conclusiones:*** *El impacto de la pandemia COVID-19 ha generado cambios sustantivos en la práctica de cirugía general en México, desde una respuesta inmediata que requiere capacitación y medidas de prevención hasta desarrollar estrategias a mediano y largo plazo para el mejor desempeño y seguridad para los pacientes y los profesionales de la salud.*

## INTRODUCTION

Although throughout the history of mankind contagious diseases have gained relevance, it is evident that we are currently living through a historical event, with unprecedented events for current generations, both in daily activities and in the field of health, which have brought about radical changes.

In late December 2019, a cluster of cases of pneumonia of unknown etiology was reported in Wuhan city, Hubei province, China.[1,2]

Subsequently, the causative agent, a new virus of the coronavirus (CoV) family, was identified and the disease it produces was named by the World Health Organization (WHO) as coronavirus-19 disease (COVID-19). Because of its rapid global spread and high contagiousness, it was declared a worldwide health emergency.[3-5]

COVID-19 is primarily a respiratory disease; the spectrum of infection with this virus can range from asymptomatic individuals with very mild non-respiratory symptoms to severe acute respiratory disease, sepsis with organ dysfunction and death;[6] the virus caused a greater involvement amongst the vulnerable population, including the elderly and patients with comorbidities such as hypertension, diabetes, and obesity, among others.[3]



According to current evidence, the SARS-CoV-2 virus is transmitted mainly between people through respiratory droplets and by contact; when an infected person is within one meter when coughing or sneezing, and inoculation is by mouth, nose or conjunctiva;[6] this contamination is direct, although it can be indirect by contamination of inert surfaces with the virus.[7,8]

We know more and more about the nature of this SARS-CoV-2 virus. It belongs to the beta coronavirus genus, as do SARS-CoV and MERS-CoV, both of which caused the epidemics reported in China (2002) and Saudi Arabia (2012), respectively. On January 12, 2020, its genetic sequence was discovered through electron microscopy. The SARS-CoV-2 virus has been identified to have projections or spicules on its surface that give it its corona-like appearance. Like SARS-CoV, it requires the angiotensin-converting enzyme-2 (ACE-2) receptor for entry into the host cell; both originate from the bat. However, in the case of SARS-CoV-2, the intermediate host between the bat and the human has not been determined.[8,9]

In addition to the previously mentioned epidemics, in the last 20 years the H1N1 pandemic (2009) and the current coronavirus pandemic have been added, which has represented a global health crisis. Up to this time, 16,950,407 cases have been documented with 664,961 deaths. In Mexico, since the first case reported on February 28 of this year, there have been 408,449 cases and 45,361 deaths.[10,11]

Under this scenario, in similar works using a survey, changes in working conditions have been identified, as well as the steps necessary to reinforce the safety of the professional staff and reduce risk in surgical care. What stands out is that despite a critical situation and uncertainty, the professional activity continues to seek the best response to this challenge.[12,13]

## MATERIAL AND METHODS

To obtain an overview of the general surgeon's practice in the face of the COVID-19 pandemic, a descriptive observational study was carried out, supported by a digital survey tool (Survey Monkey®). This work is the result of a collaborative work of the Mexican Association of General Surgery and the Academia Aesculap Mexico Foundation. The survey consisted of 60 questions with the points considered most relevant, reviewed, and validated by five general surgeons, with the following sections: demographic data, characteristics of the hospital where they work, surgical practice, personal protective equipment, and COVID-19 incidence. It was sent to general surgeons chosen from the database of the Mexican Association of General Surgery and reinforced in social networks from May 11 to 30, 2020.

A probabilistic sampling with analysis of the variables included in the survey was carried out.

## RESULTS

The survey was answered by 723 surgeons from the 32 Mexican states, with the greatest representation of Mexico City (20.50%), which was the entity with the greatest impact in terms of the number of infections, people confirmed with COVID-19 and deaths. The complete results are shown in the following tables: I. Demographic data and professional activity, II. Characteristics of the hospital where he/she works, III. Surgical practice, IV. Personal protection equipment, and V. COVID-19 features.

## DISCUSSION

**Demographic data and professional activity** *(Table 1)*. With the results obtained it was possible to perform an analysis of the working conditions of general surgeons in Mexico in the face of this COVID-19 pandemic.

In relation to age group and gender, it corresponds to a pattern previously identified in the surgical community.* Regarding health conditions or comorbidities, the prevalence of diabetes mellitus is lower compared to the general population (5.91 vs 7.5%); as for arterial hypertension, it is like the national reference (23.42-23.6%). Relating to overweight and obesity differences were identified when compared to general population (35.64 vs 39.7%), being more notorious in obesity (8.96 vs 29.9%).[14-16]

Another risk factor was reported in 128 respondents, including 12 that smoked, 10 with bronchial asthma, six with cancer and three with heart disease.

The survey used a digital tool designed by the Mexican Institute of Social Security known as "Calculator to evaluate the level of severity to health in case of suffering from COVID-19". The results show that 31.80% of surgeons had a "high" level and 8.35% a "very high" level in a mostly male population (79.61%), with 37.34% over 50 years of age and hypertension, which has already been mentioned as the main risk factors studied for severe COVID-19.[17]

It is evident that professional activity has been affected restricting the surgical practice, both in the public (28.51%) and private (31.13%) settings, with relevant consequences; this situation that will be analyzed in greater detail in another section. It is also very important to highlight the drastic changes and the impact on professionals in training (medical and nursing students) by reducing their attendance at hospitals by 83.86%. No less important is the impact seen on residents, who have focused their activities on on-call duty by 60% and these are now more spaced out by 18.82%, thus limiting their surgical training. Although a few months have passed since the beginning of this critical situation, the repercussion has been important with the need to restructure the surgical programs to optimize the workforce and, at the same time, apply preventive measures such as physical distancing and reduce risks for those physicians in training. Every training activity had to be modified, which has forced to make rapid and drastic changes with greater flexibility and determination to continue with a program, a condition that requires the study and analysis in greater depth that will surely modify the education models so far in force.[18,19]



* Cote-Estrada Lilia. Survey of the Alliance for Surgical Patient Safety (AMCG- FAAM), April 2019.

**Table 1: Demographic data and professional activity.**

| No. | Query | Results | % |
|---|---|---|---|
| 1 | What is your age? | | |
| | 20-30 | 71 | 9.82 |
| | 31-40 | 205 | 28.35 |
| | 41-50 | 177 | 24.48 |
| | 51-60 | 164 | 22.68 |
| | 61-70 | 99 | 13.69 |
| | Over 70 | 7 | 0.97 |
| 2 | What is your gender? | | |
| | Male | 566 | 79.61 |
| | Female | 145 | 20.39 |
| 3 | What is your specialty? | | |
| | Anesthesiology | 3 | 0.41 |
| | Intensive Care | 1 | 0.14 |
| | Emergency Medicine | 3 | 0.41 |
| | General Surgery | 653 | 90.32 |
| | Other | 63 | 8.71 |
| 4 | Do you have any co-morbidities? | | |
| | Diabetes mellitus | 29 | 5.91 |
| | Arterial hypertension | 115 | 23.42 |
| | Overweight | 175 | 35.64 |
| | Obesity | 44 | 8.96 |
| | Other | 128 | 26.07 |
| 5 | Identify your risk level *http://www.imss.gob.mx/covid-19/calculadoracomplicaciones* | | |
| | Medium | 416 | 59.86 |
| | High | 221 | 31.80 |
| | Very high | 58 | 8.35 |
| 6 | What is your current main activity? | | |
| | Surgical practice | 693 | 95.85 |
| | Administrative function | 71 | 9.82 |
| | Research | 21 | 2.90 |
| | Teaching | 94 | 13.00 |
| | Retired | 31 | 4.29 |
| 7 | What is your hospital activity? | | |
| | Directive board | 43 | 6.12 |
| | Head of service | 68 | 9.67 |
| | Attending physician | 526 | 74.82 |
| | Resident | 66 | 9.39 |

**Continued from Table 1: Demographic data and professional activity.**

| No. | Query | Results | % |
|---|---|---|---|
| 8 | In what type of institution do you perform your surgical practice? | | |
| | Public | 228 | 31.40 |
| | Private | 191 | 26.31 |
| | Both | 307 | 42.29 |
| 9 | During this pandemic, what is your professional activity like? | | |
| | Works on a regular basis | 116 | 15.98 |
| | Only public practice | 102 | 14.05 |
| | Only private practice | 23 | 3.17 |
| | Restricted activities in public practice | 207 | 28.51 |
| | Restricted activities in private practice | 226 | 31.13 |
| | I am in quarantine | 52 | 7.16 |
| 10 | If you are a resident, what are the main changes in your activity? | | |
| | Regular activities | 6 | 7.06 |
| | On-call activities only | 51 | 60.00 |
| | More spaced out guards | 16 | 18.82 |
| | The activity is restricted to non-COVID areas. | 12 | 14.12 |
| 11 | Do medical or nursing students still attend your hospital? | | |
| | Yes | 16.14% | 112.00 |
| | No | 83.86% | 582.00 |

**Hospital features** *(Table 2)*. The surgeons surveyed work in Social Security hospitals in 78.80% and private hospitals in 11.64% in the 32 Mexican states; the majority are in contact with suspected or COVID-positive patients, since they practice in the so named COVID hospitals (52.52%), classified in this way by a government disposition as part of the COVID-19 Hospital Reconversion Program, with the purpose of influencing the prevention and control of the SARS-CoV-2 virus disease pandemic in Mexico.[20] However, in hospitals that do not have this category, 81.31% have a special section for the care of these patients; with respiratory triage in 94.23% of them.

Regarding hospital infrastructure, the following data stand out: one third (33.15%) has between 20 and 100 beds, with less than 20 intensive unit care beds (50.21%); serious intubated patients (66.50%) are in intensive care units but are also distributed in other services such as internal medicine, emergency services, and in other adapted hospital areas (46.02%). It is important to emphasize that in addition to sufficient equipment in the aforementioned areas, it is essential to have trained personnel. Regarding the surgical area, most of the hospitals have less than five operating rooms (51.05%) and from five to 10 the percentage is 34.87%. In 41.01% of these hospitals, exclusive rooms for patients with suspected COVID have been arranged. Among the measures recommended to reduce the risk of contamination in operating rooms is the use of negative pressure and in this case only 20.76% have this resource. Another preventive measure is disinfection. Of the staff,

**Table 2: Hospital features.**

| No. | Query | Results | % |
|---|---|---|---|
| 12 | What is the institution where you work? | | |
| | SSA | 185 | 29.51 |
| | IMSS | 244 | 38.92 |
| | ISSSTE | 46 | 7.34 |
| | State ISSSTE | 2 | 0.32 |
| | SEDENA | 10 | 1.59 |
| | PEMEX | 7 | 1.12 |
| | Private Hospitals | 73 | 11.64 |
| | Another | 60 | 9.56 |
| 13 | Which Mexican state do you work in? | | |
| | There was participation from the 32 Mexican states. | | |
| | The largest representation was from Mexico City | 147 | 20.50 |
| 14 | Where do you live? | | |
| 15 | What is the total number of beds in the hospital where you work? | | |
| | Less than 20 beds | 92 | 12.87 |
| | 20-50 | 145 | 20.28 |
| | 51-100 | 135 | 18.88 |
| | 100-150 | 108 | 15.10 |
| | 150-200 | 87 | 12.17 |
| | 200-250 | 59 | 8.25 |
| | 230-300 | 56 | 7.83 |
| | Other | 33 | 4.62 |
| 16 | Has your hospital been named as COVID-19? | | |
| | Yes | 375 | 52.52 |
| | No | 339 | 47.48 |
| 17 | Is there a special section for COVID-19 patients in your hospital? | | |
| | Yes | 583 | 81.31 |
| | No | 134 | 18.69 |
| 18 | How many beds are designated for suspected or COVID-19 positive patients? | | |
| | Less than 20 | 266 | 41.37 |
| | 21-30 | 91 | 14.15 |
| | 31-40 | 45 | 7.00 |
| | 41-50 | 45 | 7.00 |
| | Over 50 | 196 | 30.48 |
| 19 | What is the number of beds available in the intensive care unit of your hospital? | | |
| | None | 188 | 26.52 |
| | Less than 10 | 356 | 50.21 |
| | 11 a 20 | 114 | 16.08 |

**Continued from Table 2: Hospital features.**

| No. | Query | Results | % |
|---|---|---|---|
| | 21-30 | 24 | 3.39 |
| | Over 30 | 27 | 3.81 |
| 20 | What is the number of intubated patients in your hospital? | | |
| | None | 214 | 30.40 |
| | Less than 10 | 296 | 42.05 |
| | 11 a 20 | 99 | 14.06 |
| | 21-30 | 47 | 6.68 |
| | 31-50 | 19 | 2.70 |
| | 41-50 | 14 | 1.99 |
| | Over 50 | 15 | 2.13 |
| 21 | In which areas are patients intubated? | | |
| | Intensive care unit | 393 | 66.50 |
| | Internal medicine service | 193 | 32.66 |
| | Emergency department | 139 | 23.52 |
| | Adapted areas | 272 | 46.02 |
| | Other | 39 | 6.60 |
| 22 | Is there a respiratory triage space in your hospital? | | |
| | Yes | 650 | 94.23 |
| | No | 39 | 5.66 |
| 23 | What is the number of operating rooms in your hospital surgical unit? | | |
| | Less than 5 | 366 | 51.05 |
| | 5 to 10 operating rooms | 250 | 34.87 |
| | 11 to 15 operating rooms | 74 | 10.32 |
| | 20 or more operating rooms | 27 | 3.77 |
| 24 | Do you have exclusive operating rooms for COVID-19? | | |
| | Yes | 289 | 41.05 |
| | No | 412 | 58.52 |
| 25 | Do the operating rooms have negative pressure? | | |
| | Yes | 147 | 20.76 |
| | No | 561 | 79.24 |
| 26 | Do you know the substance used to disinfect operating rooms? | | |
| | Yes | 376 | 52.51 |
| | No | 340 | 47.49 |
| 27 | If yes, what substance is used? | | |
| | Sodium hypochlorite | 307 | 77.72 |
| | Hydrogen peroxide | 26 | 6.58 |
| | Quaternary ammonium derivatives | 41 | 10.38 |
| | Other | 21 | 5.32 |

**Table 3: Surgical practice.**

| No. | Query | Results | % |
|---|---|---|---|
| 28 | Is your hospital performing elective surgery during the COVID-19 pandemic? | | |
| | Yes | 316 | 44.20 |
| | No | 399 | 55.80 |
| 29 | If yes, how often do you perform elective surgery? | | |
| | As usual | 27 | 5.57 |
| | Less than 30% reduction | 62 | 12.78 |
| | 31-59% reduction | 45 | 9.28 |
| | 60-80% reduction | 71 | 14.64 |
| | 81-100% reduction | 51 | 10.52 |
| | Only emergency surgery is performed | 229 | 47.22 |
| 30 | Before any surgical procedure is performed, is the PCR test for COVID-19 performed on patients? | | |
| | Yes | 114 | 1.22 |
| | No | 589 | 83.78 |
| 31 | During the pandemic, what is the most frequently performed surgical procedure in conventional surgery? | | |
| | Cholecystectomy | 181 | 26.81 |
| | Appendectomy | 257 | 38.07 |
| | Hernioplasty | 12 | 1.78 |
| | Exploratory laparotomy | 110 | 16.30 |
| | Trauma surgery | 42 | 6.22 |
| | Other | 73 | 10.81 |
| 32 | Does your hospital perform minimally invasive surgery? | | |
| | Yes | 515 | 73.26 |
| | No | 188 | 26.74 |
| 33 | What is the most common procedure? | | |
| | Cholecystectomy | 481 | 81.25 |
| | Appendectomy | 59 | 9.97 |
| | Hernioplasty | 7 | 1.18 |
| | Exploratory laparotomy | 22 | 3.72 |
| | Other | 23 | 3.89 |
| 34 | Is any mechanism or device used to filter $CO_2$? | | |
| | Yes | 238 | 36.01 |
| | No | 423 | 63.99 |
| 35 | In general, what equipment do you use for $CO_2$ filtration? | | |
| | Based on water seal | 120 | 29.34 |
| | Using $CO_2$ inlet filters | 79 | 19.32 |
| | Using filters at the exit of the pneumoperitoneum | 115 | 28.12 |
| | A system where the vacuum cleaner is used | 123 | 30.07 |
| | Other | 32 | 7.82 |
| 36 | Do you perform any additional security measures? | | |
| | No | 474 | 73.15 |
| | Yes | 174 | 26.85 |

52.51% know which substances are used and they consist of sodium hypochlorite (77.72%) and hydrogen peroxide (7%).

An operating room with positive pressure and air changes could eliminate the virus from the environment. However, negative pressure is crucial in a situation like the COVID-19 pandemic. In this case, it is possible to implement this system with relatively simple adjustments, but it is important to note that it is not the only measure needed and other complementary actions should be considered such as the appropriate use of personal protective equipment (PPE).[21,22] Another important measure is the disinfection of the operating room, for which it is essential to use the appropriate substance and procedures; the surface disinfectants recommended to effectively inactivate SARS-CoV-2 consist of 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite.[23,24]

**Surgical practice** *(Table 3)*. In early March 2020, the Center for Disease Control and Prevention (CDC) and the world's major surgical societies, including the Mexican Association of General Surgery, recommended canceling or rescheduling elective surgeries and shifting these to outpatient settings, when possible.[25] The reaction of physicians was to restrict care to emergency cases and postpone elective surgical procedures in all disciplines except oncology. Consequently, non-urgent, non-essential or elective surgeries, where the surgeon and patient may consider it possible to wait for two to three months without consequences, were restricted or cancelled *(Figure 1)*.

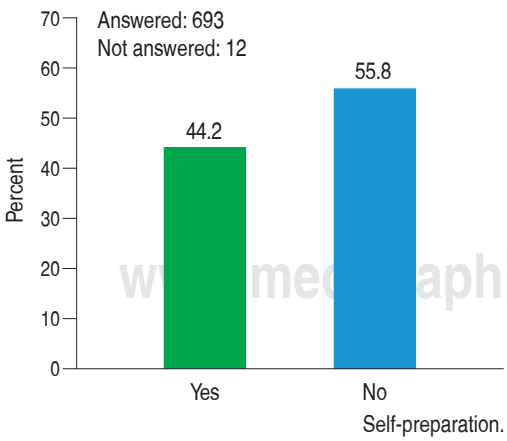


***Figure 1:*** *Q28 Does your hospital perform elective surgery?*

Even though the delay in elective surgery can become a serious problem in the context of possible adverse health implications, this is one of the main recommendations. In this Mexican survey, it was striking that only in a quarter of hospitals (25.16%) it was reduced by 60-100%, and in almost half of the hospitals (47.22%) only emergency surgery was performed, and almost 20% of the hospitals continued with elective surgery ignoring the recommendations, with the risk this implies for the surgical teams in case of not having personal protective equipment, and for the patients themselves. The surgeries mostly performed in the survey were cholecystectomy and appendectomy with almost 90% and trauma surgery in more than 6%, which are basically emergency surgeries; hernioplasties accounted for a minimum amount.

In the first 12 weeks of confinement, according to published estimates, nearly 30 million elective procedures have been cancelled globally and nearly 200,000 in Mexico alone.[4] Many cancellations were for benign conditions; however, more than 80% of cancer operations were also postponed.[26]

The risks associated with surgery and COVID-19 must be carefully balanced against those of delaying surgery on an individual patient basis.

According to an article published in *Lancet* journal, on possible complications in elective surgery with positive or unknown COVID and later diagnosed, the operated patients presented a 51% morbidity with pneumonia and/or acute respiratory distress syndrome or needed unexpected ventilation in the 30 days after the operation.[27]

Regarding minimally invasive surgery (MIS), the survey showed that 26.74% do not perform it in their hospitals, which reflects the reality of hospital in Mexico, that lack laparoscopic equipment. Of those that do perform laparoscopic surgery, 36% use some mechanism for $CO_2$ filtration, 29.34% use water seals (improvised and not yet proven to be effective) and almost 50% use

**Table 4: Personal protective equipment.**

| No. | Query | Results | % |
|---|---|---|---|
| 37 | Currently, how do you get your personal protective equipment that you use for your daily activities? | | |
| | It is provided by the institution | 278 | 39.27 |
| | I acquired it with personal resources | 343 | 48.45 |
| | I acquired it with personal resources and have contributed financially amount to acquire PPE for residents and other health personnel. | 87 | 12.29 |
| 38 | The personal protective equipment provided to you at your hospital is: | | |
| | Equal for all patients | 184 | 27.38 |
| | Only for suspected and COVID positive patients. | 342 | 50.89 |
| | Only for COVID positive patients | 146 | 21.73 |
| 39 | If your hospital provides you with PPE, is it sufficient and of adequate quality? | | |
| | Yes | 249 | 37.84 |
| | No | 409 | 62.84 |
| 40 | When performing surgeries, in addition to the surgical uniform: cap, boots, gown and sterile gloves, what other personal protective equipment are you provided? | | |
| | Safety goggles, N95 or similar, and face shield | 311 | 53.44 |
| | Closed goggles, N95 or similar, waterproof gown and face shield | 172 | 29.55 |
| | Safety goggles, N95 or similar, waterproof gown, face shield and coveralls | 99 | 17.01 |
| 41 | Is the personal protective equipment for other members of the surgical team the same as for the surgeon? | | |
| | Yes | 475 | 70.06 |
| | No | 203 | 29.94 |
| 42 | Do you know how to put on and remove personal protective equipment? | | |
| | Yes | 654 | 92.90 |
| | No | 50 | 7.10 |
| 43 | Do you consider it necessary to receive training in donning and doffing of personal protective equipment? | | |
| | Yes | 571 | 81.46 |
| | No | 130 | 18.54 |
| 44 | What is the source of the training you have received in donning and doffing PPE? | | |
| | On behalf of your institution | 375 | 53.80 |
| | On behalf of the medical association | 57 | 8.18 |
| | Through social networks or other means of communication | 265 | 38.02 |

**Continued from Table 4: Personal protective equipment.**

| No. | Query | Results | % |
|---|---|---|---|
| 45 | Do you use an N95 or similar respirator for your daily activity? | | |
| | Yes | 523 | 74.29 |
| | No | 181 | 25.71 |
| 46 | What type of mask/respirator do you use? | | |
| | Surgical mask | 155 | 21.89 |
| | N95 | 346 | 48.87 |
| | KN95 | 141 | 19.92 |
| | FFP2 | 16 | 2.26 |
| | FFP3 | 15 | 2.12 |
| | Other | 35 | 4.94 |
| 47 | What is the handling and destination of your N95 or similar respirator? | | |
| | Discard after use | 303 | 4.17 |
| | They are decontaminated for reuse in the sterilization plant. | 50 | 7.29 |
| | I decontaminate it | 333 | 48.54 |
| 48 | Do you have sufficient supplies for hand hygiene? | | |
| | Yes | 603 | 85.29 |
| | No | 104 | 14.71 |
| 49 | According to your perception, what is the most frequently performed action? | | |
| | Hand washing with soap and water | 426 | 60.08 |
| | Hand disinfection with alcohol-based solution | 283 | 39.92 |
| 50 | According to your perception, has hand hygiene compliance increased? | | |
| | Yes | 685 | 96.61 |
| | No | 24 | 3.39 |

pneumoperitoneum inlet and outlet filters, although they do not specify which ones, but so far, they are the most used in our country and globally.[28]

It is worth remembering main recommendations: use a closed suction system, avoid redundant incisions, use leak-free trocars such as balloon trocars, avoid creating a leak for smoke evacuation, and aspirate the entire pneumoperitoneum before retrieving a specimen, at the end of the procedure before removing the trocars or before conversion to open surgery. In case of lack of adapted skills and equipment allowing safe laparoscopic surgery, laparotomy should be preferred instead.[29]



On the other hand, respondents state that the polymerase chain reaction (PCR) diagnostic test as a preoperative measurement was only performed in 1.22%, despite the fact that it has been recommended to perform PCR diagnostic tests and/or chest axial tomography (in case of emergency surgery) on all patients to be operated on in order to select the

**Table 5: COVID-19.**

| No. | Query | Results | % |
|---|---|---|---|
| 51 | Do you know the number of staff at your hospital who have tested COVID positive? | | |
| | Yes | 475 | 67.19 |
| | No | 232 | 32.81 |
| 52 | Which is the service with the most affected personnel? | | |
| | Emergency department | 244 | 43.26 |
| | Intensive care unit | 33 | 5.85 |
| | Clinical services | 162 | 28.72 |
| | Surgical services | 54 | 9.57 |
| | Other | 71 | 12.59 |
| 53 | Which personnel are most affected? | | |
| | Physicians | 242 | 42.46 |
| | Nursing staff | 226 | 39.65 |
| | Laboratory personnel | 1 | 0.18 |
| | Residents | 45 | 7.89 |
| | Other | 56 | 9.82 |
| 54 | In relation to specialist physicians, who are the most affected? | | |
| | Intensivist physicians | 48 | 8.73 |
| | Internists | 147 | 26.73 |
| | Emergency physicians | 216 | 39.27 |
| | General Surgeons | 21 | 3.82 |
| | Other surgical specialists | 36 | 6.55 |
| | Other | 82 | 14.91 |
| 55 | Have there been any fatalities? | | |
| | No | 487 | 73.12 |
| | Yes | 179 | 26.88 |
| 56 | Have you heard of any deaths of general surgeons? | | |
| | No | 594 | 93.10 |
| | Yes | 44 | 6.90 |
| 57 | Have you suffered any type of aggression or discrimination for being a physician? | | |
| | Yes | 84 | 11.98 |
| | No | 617 | 88.02 |
| 58 | When you get up in the morning and face another workday, do you feel fatigued? | | |
| | Yes | 322 | 46.20 |
| | No | 375 | 53.80 |
| 59 | Do you feel emotionally drained performing your medical practice during the COVID-19 pandemic? | | |
| | Yes | 400 | 57.22 |
| | No | 299 | 42.78 |
| 60 | How do you consider the adaptation of your medical practice during the COVID-19 pandemic? | | |
| | It has been easy to adapt to the new work environment | 146 | 20.80 |
| | It has been difficult to adapt professionally | 171 | 24.36 |
| | It has been difficult to adapt to the professional and family environment. | 348 | 49.57 |
| | Extremely difficult to adapt | 28 | 3.99 |
| | I cannot adapt | 9 | 1.28 |

best available treatment for the patient, and when the patient is already infected to avoid aggravation of the respiratory situation, due to intubation and surgical aggression. In addition, it favors the choice of the approach route (laparoscopy or laparotomy) and for the health personnel to take the necessary protective measures to avoid possible infections, since there are reports of positivity in surgeons of 23.5% and residents of 26.6%.[30-32]

**Personal Protective Equipment (PPE)** *(Table 4)*. PPE is indispensable in the prevention of infection during the COVID-19 pandemic, especially in health professionals who are in the first line of contact with sick people and in some serious cases, in whom the viral load is high. The results of the survey showed that 39.27% of the PPE is provided by the institution where they work which, in their opinion, is not of proper quality and is incomplete. On the other hand, most of health professionals (48.45%) had to acquire it with their personal resources. Facing this situation, Surgeons for Mexico "Joining forces" has brought together several medical-surgical organizations led by the Mexican Association of General Surgery, to provide support to surgeons in the states with the greatest needs. To date, 1,878 face masks and 1,958 KN95 respirators have been delivered in the States of Mexico, Colima, Merida, Cancun, Mexico City, Veracruz, and Guerrero.**

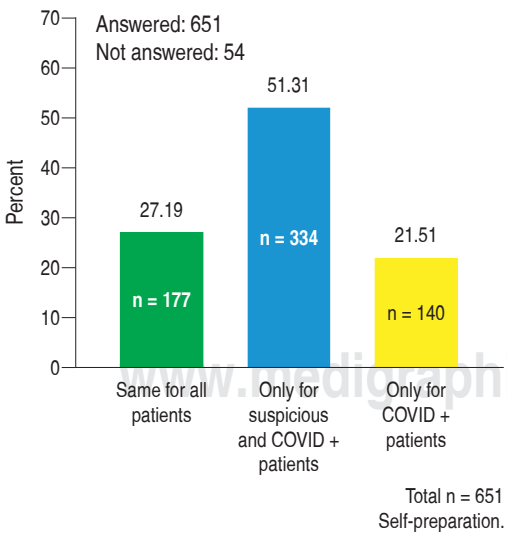


***Figure 2:*** *P38 personal protective equipment provided to you at your hospital.*

The complete PPE used by the surgeons was in 53.44%, in addition to the waterproof gown in 29.55% and coveralls in 17.01%. They considered that training for donning and doffing PPE was needed in 81.46%. However, 38% have obtained training through social networks and the media. Respiratory protection has become the first vital line of defense; the N95 respirator is the most frequently used (48.87%). It is a disposable device but, in the event of a crisis, it is possible to reuse it under established decontamination protocols that are usually carried out in the Sterilization Center. But in this case, this action was carried out by the surgeons themselves (48.54%).

The N95 respirator has been the device with the greatest presence during this pandemic, since it represents protection for the health professional and a significant reduction in the risk of infection, by filtering 95% of airborne particles. The recommended decontamination for this respirator processes are heat, gas plasma and ultraviolet light.[33]

The availability of adequate material and sufficient PPE has been one of the most relevant issues since the beginning of the pandemic, due to the worldwide shortage[34] *(Figure 2)*.

Another important preventive measure is hand hygiene, since it prevents cross-contamination, which, when touching any contaminated surface or device, can facilitate the transport of the virus to the mouth, nose, and eyes; fortunately, 85.29% of the population surveyed had the necessary supplies. Washing with soap and water is the most frequent practice (60.08%) and the perception of an increase in compliance was 96.61%. During the last five years, Mexico has worked intensively through institutional and governmental campaigns to promote and consolidate the increase in hand hygiene and make it a habit to reduce health care-associated infections. In a study related to hand hygiene compliance in surgical services,

** Torres-Cisneros Roberto. Cirujanos por México Personal Protective Equipment donation registration, June 2020.

it only reached 9%;*** we were in search of the best strategies to achieve this purpose, but too far from imagining that a virus could be the engine of this change.

**COVID-19** *(Table 5)*. In relation to the health professionals, those most affected were physicians 43.26% and nurses 39.65%; the most affected service was the emergency departments (43.26%), surgical services (9.57%), and in terms of medical specialties, emergency physicians (39.27%) were the most affected, while deaths of general surgeons were identified in 6.90%.

Health care personnel have been significantly affected during this pandemic, with one report accounting for a total of 39,032 (41%) nurses and physicians 30%, with 584 deaths.[35]

In the present study, some points were reviewed in relation to the psycho-emotional impact generated by SARS-CoV-2 infection (COVID-19) in the work environment of the surveyed surgeons.

There are no previous reports in the literature on the discrimination suffered by health personnel, surgeons, internists, nurses, etc., who in the performance of their professional duties have had to care for patients with COVID-19. Our study found that 11.98% (84/701) of those surveyed accepted having been victims of social discrimination, which can be translated as rejection by the non-medical population, due to fear and ignorance that medical personnel could be a vector of transmission of the disease to the community.

*Burnout* syndrome is an emotional disorder associated with stress caused by the work environment. It is characterized by emotional fatigue, organizational cynicism, low productivity, job dissatisfaction, depersonalization, and increased rate of medical errors.[36] Shanafeld et al, in a study of 7,905 recently graduated surgeons, found a 70% prevalence of emotional fatigue before the COVID-19 pandemic.[37] In the present study, 46.2% (322/697) of the surgeons surveyed agreed to experience fatigue upon waking up to start another workday. 57.22% (400/699) of the surgeons surveyed agreed to feel emotionally exhausted while performing their medical practice during the COVID-19 pandemic.

The daily conditions in the face of eventualities are changing. The surgical scenario changes from patient to patient, even with the same disease, so the surgeon must necessarily develop, among his non-technical skills, an enormous capacity for adaptation and resilience. In a study by the University of Cincinnati, in 2019, the correlation between *burnout* syndrome and resilience was studied in 103 general surgery residents. A direct association was found between the presence of burnout and the adaptive capacity and resilience developed over the years of surgical practice.[38] In our study, 20.8% (146/702) of the surgeons surveyed had adapted easily to the new conditions of life and surgical work in the face of the COVID-19 pandemic. In contrast, 1.28% (9/702) recognized that it has been impossible for them to adapt to the use of permanent protection measures and to the increase in the use of PPE. It is also interesting that almost half of the respondents (49.57%, 348/702) considered that the arrival of COVID-19 has made it difficult to achieve a balance between professional and family work, since many surgeons who treat patients with COVID-19 daily and who are on the first contact line have had to isolate themselves without seeing their families for months.

In Mexico, there are no previous studies that have evaluated the prevalence of burnout in the population of general surgeons in the country, so our study is the first to explore this aspect of life in our specialty. However, in the absence of previous epidemiological studies, it is not possible to distinguish between the previous prevalence of these traits in the pre-COVID and post-COVID eras, which motivates future studies aimed specifically at exploring these conditions.

## CONCLUSIONS

The SARS-CoV-2 coronavirus pandemic has constituted a great challenge in contemporary medicine. No health system could visualize a

*** Cote-Estrada Lilia. Institutional Hand Hygiene Campaign, Mexican Institute of Social Security 2016.

problem of such magnitude and, therefore, none was prepared for it. However, it has been essential to make decisions and implement actions in response to the needs arising from this health crisis. In the same sense, health professionals have been affected in their personal, professional, and family fields. The present study shows an overview in the practice of the general surgeon in Mexico in a particular scenario, which obliges more than ever to radical changes by redefining roles, adapting programs, specifying and designing strategies with the necessary adaptation and resilience, without forgetting to prioritize safety for the patient and for the health professionals.

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# Impact of the SARS-CoV-2 pandemic on the General Surgery residency at the General Hospital of Mexico

## *Impacto de la pandemia por SARS-CoV-2 en la residencia de Cirugía General en el Hospital General de México*

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**Keywords:**
General surgery residency, COVID-19, training, SARS-CoV-2.

***Palabras clave:***
*Residencia cirugía general, COVID-19, entrenamiento, SARS-CoV-2.*

**ABSTRACT**

**Objective:** To demonstrate the impact of the SARS-CoV-2 pandemic on the training of General Surgery residents at the Hospital General de México, in order to implement new teaching strategies. **Material and methods:** An intentional search was performed in the institutional database of surgical procedures, identifying those performed by residents of the General Surgery service from November 2019 to February 2020, prior to the SARS-CoV-2 pandemic, and compared with the procedures performed in March and April 2020, after the beginning of the pandemic. **Results:** Group 1: 1,494 surgical procedures were found with the following distribution of surgeries performed by surgery residents: R1 = 279 (18.67%), R2 = 444 (29.71%), R3 = 531 (35.54%) and R4 = 240 (16.06%). With the following monthly average (n = 373.5): R1 = 69.75, R2 = 111, R3 = 133 and R4 = 60. Group 2: 42 surgical procedures with the following distribution: R1 = 3 (7.14%), R2 = 19 (45.23%), R3 = 14 (33.33%) and R4 = 6 (14.28). **Conclusions:** The SARS-CoV-2 pandemic decreased the number of procedures to which surgical specialty residents were exposed, potentially triggering a slowdown in practical skills or even a setback.

***RESUMEN***

***Objetivo:*** *Demostrar el impacto de la pandemia por SARS-CoV-2 en la formación de residentes de Cirugía General del Hospital General de México, para implementar nuevas estrategias de enseñanza.* ***Material y métodos:*** *Se realizó una búsqueda intencionada en la base de datos institucional de procedimientos quirúrgicos, identificando los realizados por los médicos residentes del servicio de Cirugía General de noviembre del 2019 a febrero del 2020, previo a la pandemia por SARS-CoV-2 y se comparó con los procedimientos realizados en marzo y abril del 2020, posterior al inicio de la pandemia.* ***Resultados:*** *Grupo 1: se encontraron 1,494 procedimientos quirúrgicos con la siguiente distribución: R1 = 279 (18.67%), R2 = 444 (29.71%), R3 = 531 (35.54%) y R4 = 240 (16.06%). Con el siguiente promedio mensual (n = 373.5): R1 = 69.75, R2 = 111, R3 = 133 y R4 = 60. Grupo 2: 42 procedimientos quirúrgicos con la siguiente distribución: R1 = 3 (7.14%), R2 = 19 (45.23%), R3 = 14 (33.33%) y R4 = 6 (14.28).* ***Conclusiones:*** *La pandemia por SARS-CoV-2 disminuyó el número de procedimientos a los que se exponen los residentes de las especialidades quirúrgicas, pudiendo desencadenar en una desaceleración en las competencias prácticas o, incluso, un retroceso.*

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## INTRODUCTION

The COVID-19 pandemic presents challenges in the training of surgical specialty residents worldwide. The exposure to surgical procedures to which they are subjected decreased substantially, due to the reconversion of centers with high surgical demand, such as the General Hospital of Mexico "Dr. Eduardo Liceaga", to care of patients with SARS-CoV-2 virus infection, sometimes in a exclusive way,



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partly as a result of the fact that scheduled surgical procedures were suspended to reduce the risk of hospital infection of healthy patients and mortality in carriers of the virus.[1] In addition, all rotations through other hospitals were suspended.

The technologies currently implemented, applied to the simulation of surgical procedures, have been replacing the surgical training that was previously performed directly on patients, largely to reduce the surgical risk of patients undergoing surgery performed by trainees. Simulation in surgery has been used worldwide as a strategy to try to mitigate the impact that the pandemic has had on the practical learning curve of residents in surgical specialties. The objective of this work is to expose the estimated impact that the COVID-19 pandemic has had on the direct exposure of general surgery residents to surgical procedures.

## MATERIAL AND METHODS

We conducted a retrospective, observational, cross-sectional, and descriptive study. An intentional search was made in the institutional surgical procedures database, which is collected ambispectively (both in retrospective and prospective ways), to identify the procedures in which the resident physicians of the General Surgery Service intervened between November 2019 and February 2020, prior to the pandemic caused by the SARS-CoV-2 virus (Group 1). A monthly average of procedures was obtained and compared with those performed in March and April 2020, the period corresponding to the hospital reconversion for pandemic care (Group 2).

It was divided into four groups taking as a parameter the year the resident was attending and the surgical procedures that were assigned to the academic year, which is usually performed in our hospital unit. Subsequently, the procedures were grouped by specialty clinic in which they were performed, which resulted in wall and soft tissue surgery (WST), hepato-pancreato-biliary surgery (HPB), emergency surgery (URG), scheduled night surgery (SNS), upper digestive tract surgery (UDT) and neck surgery (NS). The total number of residents per year is, in the first year 22, second year 21, third year 16 and in the fourth year 16.

For the comparison of the difference in number of procedures between groups, Student's t-test was used, assigning a value $< 0.05$ as a statistically significant difference.

## RESULTS

For group 1, a total of 1,494 surgical procedures were found with the following distribution by academic grade: R1 = 279 (18.67%), R2 = 444 (29.71%), R3 = 531 (35.54%) and R4 = 240 (16.06%), with the following monthly average (n = 373.5): R1 = 69.75, R2 = 111, R3 = 133 and R4 = 60.

In group 2 there were 42 surgical procedures with the following distribution by academic grade: R1 = 3 (7.14%), R2 = 19 (45.23%), R3 = 14 (33.33%) and R4 = 6 (14.28%).

**When analyzing the number of procedures by specialty clinic, the following distributions were found.**

WST for R1 there was a 100% reduction in the number of surgeries (group 1 = 12.75 vs group 2 = 0; $p < 0.05$). For R2 there was a significant reduction (group 1 = 64 vs group 2 = 5; $p < 0.05$), as well as for the R3 (group 1 = 13 vs group 2 = 0; $p < 0.05$), and for the R4 group (group 1 = 0.3 vs group 2 = 0; $p < 0.05$).

WST surgery: no procedures were performed by R1 or R2. For R3 there was a significant reduction in surgeries between groups (group 1 = 53 vs group 2 = 2; $p < 0.05$). In the group analysis for R4, similarly, there was reduction in the number of surgeries (group 1 = 29 vs group 2 = 4; $p < 0.05$).

URG surgery: there was a significant decrease in surgeries performed by R1 (group 1 = 54 vs group 2 = 3; $p < 0.05$), likewise for R2 (group 1 = 42 vs group 2 = 14; $p < 0.05$), for R3 (group 1 = 65 vs group 2 = 11; $p < 0.05$) and for R4 (group 1 = 7.8 vs group 2 = 1; $p < 0.05$).

SNS: in scheduled night surgery no procedures were performed by R4, there was a 100% reduction of procedures for R1 (group 1 = 3 vs group 2 = 0; $p < 0.05$), for R2 (group 1 = 2.3

vs group 2 = 0; $p < 0.05$) and for R3 (group 1 = 0.3 vs group 2 = 0; $p < 0.05$).

UDT surgery: no procedures were found to be performed by R1, with a reduction in the number of procedures for R2 (group 1 = 0.8 vs group 2 = 0; $p < 0.05$), for R3 (group 1 = 1.3 vs group 2 = 1; $p < 0.05$) and for R4 (group 1 = 6.5 vs group 2 = 1; $p < 0.05$).

Neck surgery: no procedures were found for R1, with a reduction in surgeries for R2 (group 1 = 1.8 vs group 2 = 0; $p < 0.05$), for R3 (group 1 = 0.3 vs group 2 = 0; $p < 0.05$) and for R4 (group 1 = 17 vs group 2 = 0; $p < 0.05$).

## DISCUSSION

Education during the COVID-19 pandemic has changed the teaching methods at virtually all levels. Face-to-face classes have been discontinued and instead have been implemented virtually, as well as reducing the number of residents present on the service in the same shift to reduce personnel exposure.[2]

In recent decades, numerous factors, including social, professional, and legal factors have forced all surgical training programs to seek alternative methods of resident training. Within such hands-on learning methods in the surgical setting, simulation-based training has taken on great relevance to replace or amplify real-patient procedural experiences with artificially conceived, guided exercises that evoke or reproduce substantial aspects of the real world in an interactive and safe manner.[3]

Simulation, when properly integrated into learning and competency testing, plays an important role in the acquisition of the critical and reflective thinking skills necessary to provide competent and safe patient care.[4] Bloom first described a classification system of different learning objectives for students in 1956, consisting of three "domains": cognitive, affective, and psychomotor.[5] It is therefore considered that these three characteristics must be present to achieve learning and skill development using simulators.

A wide variety of simulation-based activities exist, ranging from inanimate video trainers, human anatomical model simulators until more recent virtual reality computer-based trainers. Currently, inanimate trainers are widely implemented in all surgical training programs and serve as the main platform for laparoscopic skills training.[4]

Regarding the transfer of skills acquired during simulation training into an operative environment, a systematic review conducted in 2008 evaluated 10 randomized controlled trials, concluding that the skills acquired appeared to be transferable, assessing some parameters such as performance time and ability to complete the procedure. However, methodological weakness was noted since, in most studies, trainees received simulation training concurrently with real patient training and the strength of the conclusion was limited by variability in the methodology of the included studies.[6]

More recently, in 2014, a systematic review including 16 randomized controlled trials, with a total of 309 participants, it was found that the sham literature consistently showed benefits in terms of operative time and performance scores.[7] However, it was again acknowledged that more studies, with homogeneous methodology, are required before it can be concluded that simulation skills are directly transferable toward real-patient procedures.

With respect to the adjustments that have been made worldwide in hospital centers because of the COVID-19 pandemic, multiple studies have been published describing the role of the surgical service in different hospital centers. In New York, one of the cities most affected by the pandemic, the work plans of the surgical specialties were adapted to reduce the exposure of the residents, as well as to support the areas that required more personnel to face the pandemic, reserving teams of residents who could replace the previous ones in the event of contracting the disease.[8] On the other hand, a study described, within the action plan for continuing resident training, strategies to reduce exposure, as well as to reduce the impact of the cessation of normal activities performed by surgical residents, even using inexpensive and homemade materials.[9] In the same way, the teaching method was changed from a classroom model to a distance model through online platforms, which allowed academic sessions to be conducted in a non-face-to-face manner to comply with the recommendations of social distancing.[10]

To our knowledge, there are only studies that subjectively measure the impact of the COVID-19 pandemic; in the first of these, and one of the most important, the authors conducted surveys of residents who were doing the urology subspecialty in Italy, to assess the impact of the pandemic in terms of both academic training and the decrease in routine procedures performed prior to the pandemic, compared to the stage of reconversion for pandemic care, in which the perception of the residents was analyzed.[11]

In our work, this same was done but in an objective manner, having taken as a basis the procedures found in the hospital database, which are those to which a resident was routinely exposed prior to the COVID-19 pandemic.

Thus, we found that for the first academic year of the general surgery residency, the services in which the greatest number of surgical procedures were performed were WST surgery, where there was a reduction in the total number of procedures after the hospital reconversion, and URG surgery, where there was also a significant reduction in the number of surgeries performed. In the second academic year, residents in the WST and URG services were most affected, with a statistically significant reduction in the number of surgeries performed. For third year residents, this difference was greater in the WST and URG services. And finally, for fourth year residents WST, neck, UDT, and URG surgeries showed also significant lower procedure numbers given the characteristics of the surgeries performed by these services.

It is important to emphasize that this article provides an overview of the significant decrease in the number of procedures performed by general surgery residents. This was due to the specific assignation of residents in our unit to exclusive care of COVID patients. Most of these patients were not exposed to any surgical procedures during the hospital's conversion to pandemic care.

## CONCLUSION

The COVID-19 pandemic has decreased the number of procedures to which surgical residents are exposed and may lead to a slowdown or even a decline in practical skills.

It will be a challenge to apply the necessary instruments to evaluate the competencies of the residents according to their academic year, to adapt the teaching to generate specialists with all the competencies stipulated in the objectives of the academic plans.

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established at the authors' work center, the authors declare that they have followed the protocols on the privacy of patient data while preserving their anonymity. The informed consent of the patient referred to in the article is in the possession of the author.

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# Surgical treatment of acute appendicitis in a COVID-19 positive patient at a tertiary level hospital

## *Tratamiento quirúrgico de la apendicitis aguda en paciente COVID-19 positivo en hospital de tercer nivel*

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**Keywords:**
Appendix, appendicitis, COVID-19, SARS-CoV-2.

***Palabras clave:***
*Apéndice, apendicitis, COVID-19, SARS-CoV-2.*

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**ABSTRACT**

**Introduction and objective:** Acute appendicitis is considered the most common cause of acute surgical abdomen. It has a prevalence of 7% in the world population; laparoscopic surgical treatment is the treatment of choice. However, at the beginning of the COVID-19 pandemic, a probable increase in the risk of contagion for the work team due to the use of the laparoscopic approach was described, for which reason our hospital opted for open treatment for patients with acute abdominal pathology. We consider it relevant to share our experience in a national reference center. **Case presentation:** 47-year-old female patient, who starts with a clinical picture of abdominal pain, nausea, and vomiting; she took analgesic and antibiotic drugs. After migration of pain, increase and exacerbation of abdominal pain, she decided to see a private physician who ordered CT abdominal scan that showed signs of acute appendicitis and images suggestive of infection by SARS-CoV-2, so she was sent to our unit. It was decided to perform an open appendectomy and she was discharged to the Intensive Care Unit with favorable evolution. **Discussion:** Currently, the diagnosis of acute appendicitis in the context of a patient with COVID-19 represents a challenge, since there are symptoms shared by both diseases, so we consider it relevant to share our experience in a tertiary-care level hospital. No relationship was found in the pathological study between coronavirus disease and acute appendicitis.

***RESUMEN***

***Introducción y objetivo:*** *La apendicitis aguda es considerada la causa más común de abdomen agudo quirúrgico. Cuenta con una prevalencia de 7% en la población mundial; el tratamiento quirúrgico laparoscópico es el de elección. Sin embargo, a inicios de la pandemia COVID-19, se describió un probable aumento de riesgo de contagio para el equipo de trabajo por el uso del abordaje laparoscópico, por lo que en nuestro hospital se optó por el tratamiento abierto para los pacientes con patología aguda abdominal. Consideramos relevante compartir nuestra experiencia en un centro nacional de referencia.* ***Presentación del caso:*** *Paciente femenino de 47 años, quien inicia cuadro clínico con dolor abdominal, náusea y vómito; con ingesta de analgésico y antibiótico. Después de migración de dolor, aumento y exacerbación del dolor abdominal, decide acudir al médico particular en donde se le realiza tomografía, la cual reportó apendicitis aguda e imágenes sugestivas de infección por SARS-CoV-2, por lo que es enviada a nuestra unidad. Se decide realizar apendicectomía abierta y es egresada a la Unidad de Cuidados Intensivos con evolución favorable.* ***Discusión:*** *Actualmente, el diagnóstico de apendicitis aguda en el contexto de un paciente con COVID-19 representa un reto, ya que existen síntomas que pertenecen a ambas enfermedades, por lo que consideramos relevante compartir nuestra experiencia en un hospital de tercer nivel. No se encontró relación en el estudio patológico entre la enfermedad por coronavirus y la apendicitis aguda.*

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## INTRODUCTION

Acute appendicitis is a cause of abdominal pain and is considered the most common cause of lower abdominal pain and acute surgical abdomen, which can progress to perforation and peritonitis.[1] It has a worldwide prevalence of 7%. Its diagnosis has traditionally been clinical and has been complemented by laboratory and imaging studies.[2] Due to the current pandemic, thoracic computed tomography (CT) has been implemented as part of the protocol of an emergency surgical patient, regardless of the abdominal diagnosis, to rule out COVID-19 infection.[3]

Appendectomy through laparoscopic approach is the treatment of choice;[1] however, at the beginning of the COVID-19 pandemic, a probable increase in the risk of contagion for the entire surgical team was described with the use of endoscopic surgery, due to the pressurized expulsion of intracavitary gas when removing and introducing instruments through the ports (despite the anti-leakage membranes they have), as well as at the end of the procedure when evacuating the gas.[4] The risk of using laparoscopy is considered higher than that of conventional open surgery[5] and for this reason, the open approach has been chosen in most cases according to recommendations for laparotomy over laparoscopy provided by different surgical societies.[6-8] Technical implementations have been made, such as filters or modifications in suction, which in the future will benefit the use of laparoscopy.[9]

Due to the pandemic, we have encountered greater difficulty in the diagnosis of abdominal surgical pathologies, since fever, nausea, vomiting, and abdominal pain can be confused as symptoms of COVID-19[10] and, after a literature review, we found that there are only three reported cases of acute appendicitis

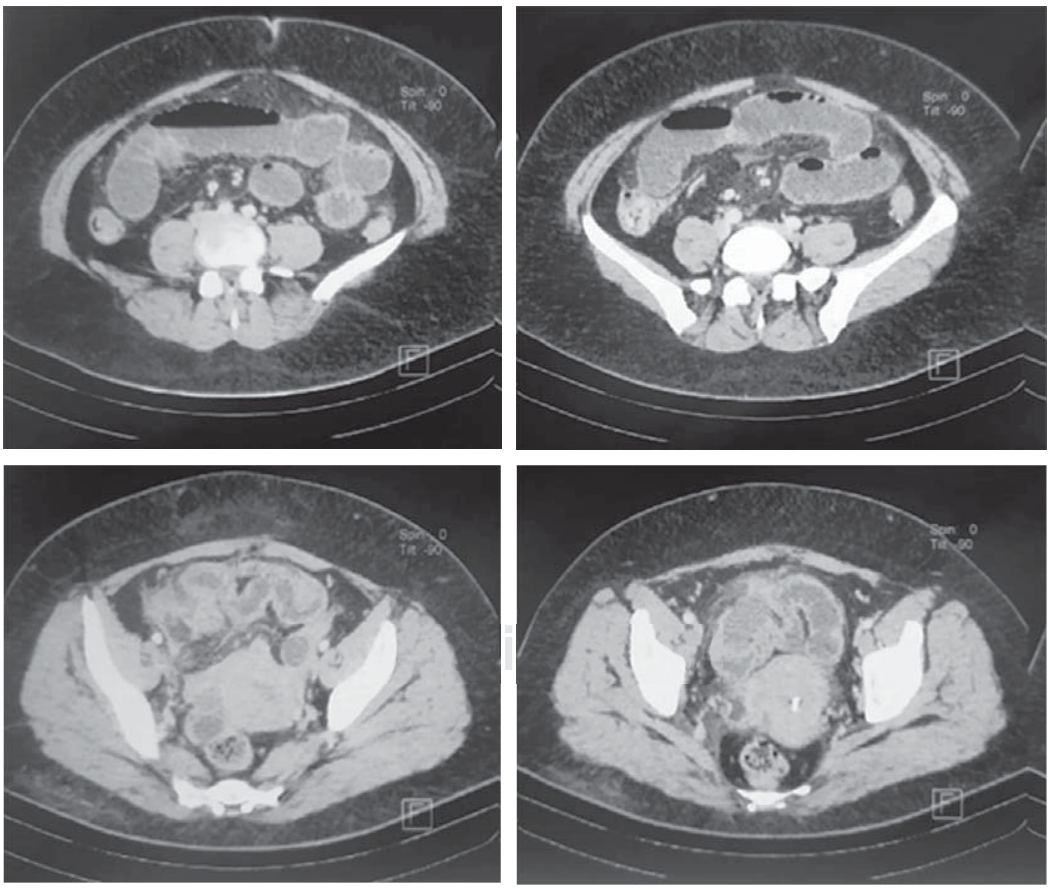

***Figure 1:***

*Computed axial tomography scan of the abdomen. The cecal appendix is not visualized but distal ileum loops with mural thickening and inflammation of the mesenteric fat of the right iliac fossa are observed, suggesting an inflammatory process.*

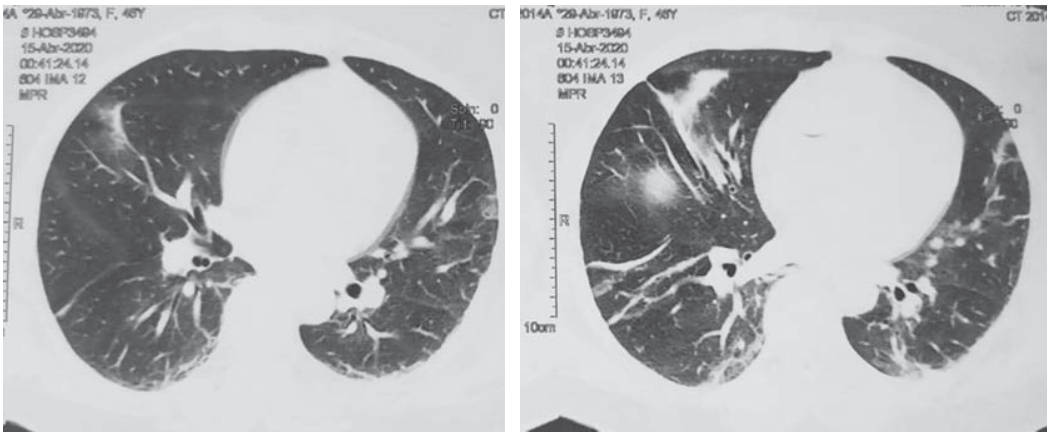

***Figure 2:***

*Computed axial tomography scan of the lung, showing parenchymal changes suggestive of atypical SARS-CoV-2 pneumonia.*

management in this context: one treated with laparoscopic appendectomy[11] and two were managed conservatively.[12,13] So, we consider it was relevant to share the experience at the Hospital General de México "Dr. Eduardo Liceaga", which is a tertiary-care level hospital that was designated as a care center in the country for treating patients with SARS-CoV-2.

*Objective*. To share the experience in a patient with acute appendicitis with the added diagnosis of COVID-19 in a tertiary hospital center.

## CLINICAL CASE

This is the case of a 47-year-old female patient with no relevant medical history. She smoked 20 cigarettes per day with a smoking index of 25, which is considered as a major risk for chronic obstructive pulmonary disease (COPD); she had an elective cesarean section 13 years ago. Her condition began four days prior to her evaluation, when she presented pain in the epigastrium of intensity 7/10 without irradiation, without triggering or exacerbating factors; it was accompanied by nausea and vomiting of food content on five occasions. Twenty-four hours after the onset of the symptoms, she reported having self-medicated with the antispasmodic drug butyl-hyoscine 10 mg every 12 hours, after which she had a slight improvement, so she was left to free evolution. 48 hours later she presented increased vomiting, as well as abdominal pain that had migrated to the right iliac fossa. She did not report having fever. She went to a private hospital 72 hours after the onset of the symptoms, where amikacin as antibiotic was administered along with an analgesic drug and metoclopramide at unspecified doses, without relieving the symptoms. At another private hospital where she was taken because of increasing intensity of abdominal pain, laboratory studies were performed that showed: a white blood cell count of $23.3 \times 10^3/\mu l$ with a neutrophil count of $(19.48 \times 10^3/\mu l)$. The rest of the laboratory parameters were within normal range values. Once acute appendicitis was suspected, a contrasted thoraco-abdominal-pelvic CT scan was requested, which showed signs of a probable acute appendicitis complicated with a localized abscess, as well as findings of air bronchogram and data suggestive of atypical pneumonia due to SARS-CoV-2 *(Figures 1 and 2)*, so it was decided to send her to the emergency department of our hospital unit.

When the patient was in emergency respiratory triage, surgical evaluation was requested. The patient was found with a heart rate of 106/min, respiratory rate of 22/min, capillary oxygen saturation of 88% when beathing room air, a body mass index (BMI) of 30. Bilateral basal rales were heard on lung auscultation. And she has positive appendicular signs as well as signs of peritoneal irritation on abdominal examination. Complementary lab studies were requested such as D-dimer (3,268), ferritin (96), procalcitonin (0.81), and lactate dehydrogenase 164 IU/l. A polymerase chain reaction (PCR) on pharyngeal swab was

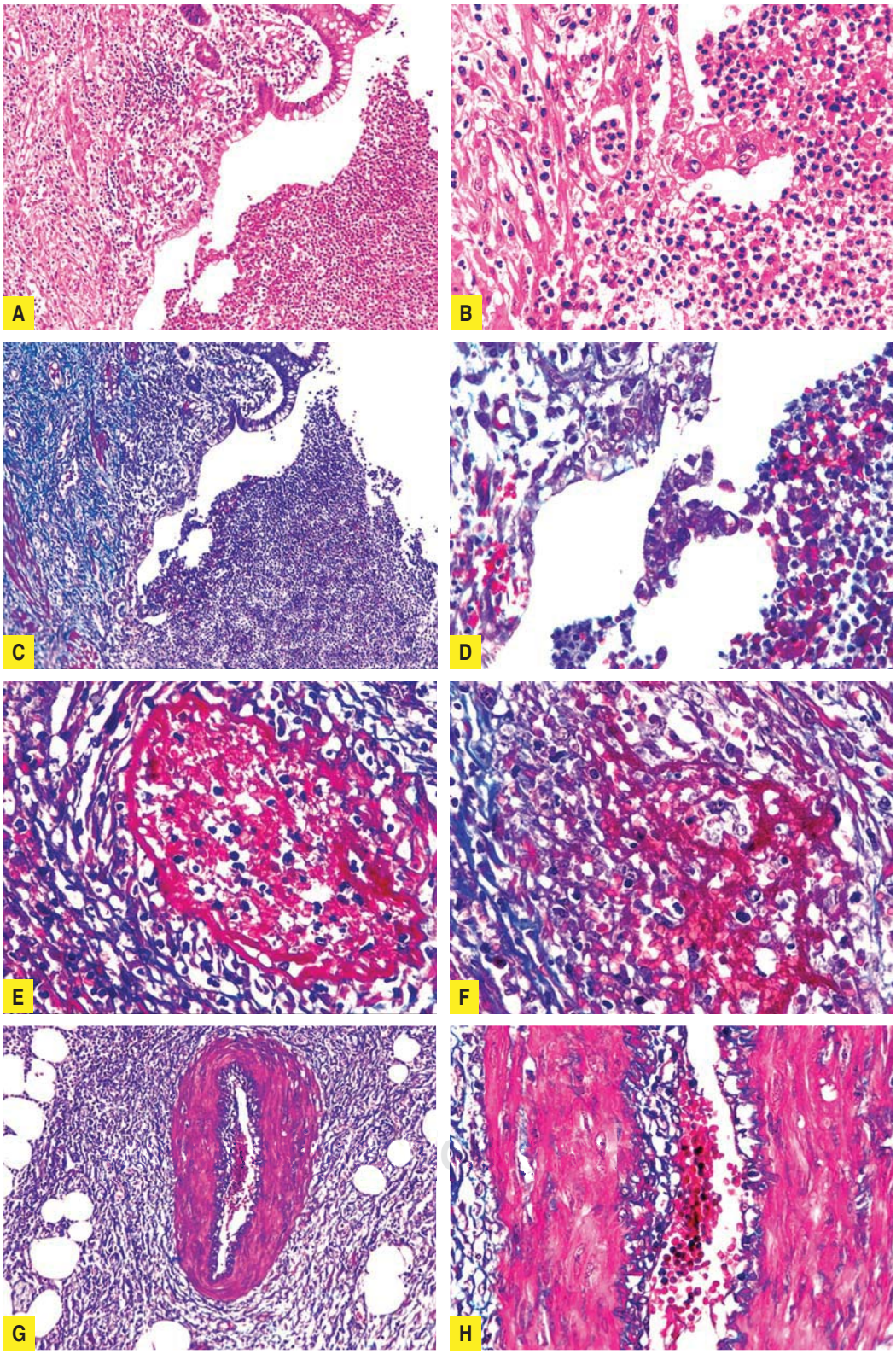


***Figure 3:***

*Histopathological study slides:* ***A-D:*** *Ulcerated appendicular mucosa (conventional hematoxylin-eosin and Masson's trichrome stain).* ***E-F:*** *Secondary vasculitis in medium caliber vessels, located contiguous to the ulcerated area.* ***G-H:*** *Medium caliber vessels, located in the sub serosal tissue; absence of acute thrombosis is evidenced.*

not performed at this time due to hospital budget restrictions. She was taken to the operating room at that time.

An open appendectomy implementing international recommendations and with the necessary protocol and personal protective equipment was decided. An infraumbilical median incision was made, finding an infraumbilical aponeurotic defect of 2 × 2 cm with preperitoneal fat inside. Upon entering the cavity, we found a cecal appendix measuring 6 × 2 × 2 cm in retrocecal position with the presence of perforation at the junction of the middle third with the distal third, as well as a peri-appendicular abscess of approximately 50 ml. An appendectomy with Zuckerman invaginating technique and, subsequently, local surgical lavage with 500 ml of 0.9% saline solution was performed. No external drainage was placed, and wall closure with simple continuous suture with polypropylene 1 and skin closure with polypropylene 3-0 was done.

The patient was admitted to the Intensive Care Unit with mechanical ventilation, where a PCR was performed for SARS-CoV-2, which was positive, and treatment continued with a double antibiotic regimen for seven days with ceftriaxone 1 g intravenous every 12 hours and metronidazole 500 mg intravenous every 8 hours. Subcutaneous enoxaparin 80 mg every 12 hours, chloroquine 450 mg every 24 hours and oseltamivir 75 mg every 12 hours for five days. A nasogastric tube was used for enteral route. She was treated with mechanical ventilation and evolution was favorable, so she was extubated on the sixth day after admission and discharged from the Intensive Care Unit on the eighth day of hospital stay. She was transferred to the area assigned for patients with COVID-19 and was discharged 13 days after surgery. The histopathological study reported acute fibrinopurulent perforated appendicitis *(Figure 3)*.



## DISCUSSION

Currently, the diagnosis of acute appendicitis in the context of a patient with COVID-19 represents a challenge, since there are symptoms that belong to both diseases[14] and to diagnostic scales such as Alvarado, RIPASA *(Raja Isteri Pengiran Anak Saleha)* or AIR *(Appendicitis Inflammatory Response)*;[1] therefore, according to international recommendations, we consider it necessary to perform an imaging study in these patients, with thoracoabdominal CT scan being the imaging study of choice, since it allows to guide a differential diagnosis between both pathologies.[3] There is no evidence in the literature comparing or supporting conservative vs. surgical treatment. So, in our center, we consider performing surgical treatment with the necessary protective equipment and an open surgical approach without the use of electrocautery, since we do not have the necessary equipment for the safe use of laparoscopic surgery. However, with a safety equipment this will not be ruled out in the future.[15,16] No relationship was found in the histopathological study between coronavirus disease and acute appendicitis.

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# Rebuilding some order in the chaos. Problems of the COVID surgeon

## *Reconstruir algún orden en el caos. Problemas del cirujano COVID*

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**ABSTRACT**

This article discusses the chaos of the surgeon and the various issues facing the COVID-19 pandemic. It addresses several problems. One, that medical controversies have become disputes and public policies based on occurrences, omissions, and Estate rhetoric. Two, how the excess of information from heterogeneous and poor quality of thousands of publications of poorly done studies, of conflicts of logic between methodology and conclusions, and of false or fraudulent results, is difficult to process and produces saturation and confusion. And finally, the role of practical experience, recommendations, and criteria that each surgeon will have to assume to find a personal order in the chaos is discussed.

***RESUMEN***

*Este artículo trata el caos del cirujano y los varios problemas que enfrenta ante la pandemia de COVID-19. Aborda varios problemas. Uno, que las controversias médicas se han convertido en disputas y políticas públicas a base de ocurrencias, omisiones y retóricas de Estado. Dos, cómo el exceso de información –de calidad heterogénea e incompleta, de miles de publicaciones de estudios mal hechos, de conflictos de lógica entre metodología y conclusiones y de resultados falsos o fraudulentos– es difícil de procesar y produce saturación y confusión. Finalmente, se discute el papel de la experiencia práctica, de las recomendaciones y de los criterios que cada cirujano deberá asumir para encontrar un orden personal en el caos.*

> Any attempt to organize journal science into a unified whole would soon encounter numerous difficulties. [...] Journal science bears, therefore, the provisional and the personal stamp. [...] If fact is understood to mean only the fixed and proven, then it exists only in handbook science.
> (Ludwik Fleck, 1935)[1]

## SCIENTIFIC CONTROVERSIES

Science advances through controversies arising from the publication of experimental and observational results. However, the proof burden may be subject to technical and instrumental refinement and based on evidence not yet available at some point in the controversy.[2]

Everything is provisional in journal science. At best, it is the product of the consensus of a few experts. In this COVID-19 pandemic, nothing is yet fixed, handbook, or textbook science.[1]

What hypotheses can stand as scientific facts, the quality of evidence, replication of experiments, refereeing mechanisms and peer reviews are all controversial.[3] Above all, long time is required for confirmation or refutation.

## CONTROVERSIES, PUBLIC POLICIES, OCCURRENCES AND SERENDIPITIES

When medical controversies come to public, the argumentative disorder is contaminated with the opinions of those who do not

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understand scientific research, how it operates, nor its limitations. There is a gap between what studies "say" and what the officials who implement public health policies interpret.

Without understanding specialized publications, without background knowledge to face the epistemic challenge, with mixtures of incoherent beliefs and even magical thinking and diverse interests, they turn controversies into disputes of all kinds.

The entanglements, which could have been solved with foresight and prudence, have become rhetoric by officials to *dilute the public perception* of the problem, *so as not to create alarm*, instead of forming coherent general recommendations.

Rulers and officials have designed contradictory policies, between hesitations and unsubstantiated ideas, from obligatory to optional rigor, which can be neither one nor the other without having made provisions for economic and social support for most of the population living in poverty and extreme poverty.

That majority, a workforce without education, social security, or access to health services[4] – previously insufficient and now saturated – cannot understand or comply those provisions.

The paternalism of the enlightened increases the general confusion when several officials still appear in press conferences and massive events without any protection, united in an *ideological herd* immunity that is not immune to contagion either. To dissociate speeches from actions is to send a confusing double message.

Conflicts of interest between financial and public health advisors will have a very serious social impact. The dispute over whether to privilege health or economics is a "false dilemma". The hasty reopening will have produced more cases, deaths, and economic damage,[5] and it has become a very costly mistake that will have a boomerang effect for years to come.[6,7]

In such a conflict of interests and long-standing idleness, health workers, ignored or minimally supplied, in addition to buying supplies with their own resources, have had to manufacture and recycle masks and personal protective equipment (PPE) with various serendipities, from washing to baking them.[8,9] Faced with risk and deficient policies, it is necessary to improvise. The proverb "adapt or die" applies here.

## THE TSUNAMI OF INFORMATION

Information on SARS-CoV-2 transmission, contagion, and the multisystem disease it produces has become in a few months a "tsunami of articles", accounting more than 5,000 per week, 31,000 by the end of May, and 52,000 by mid-June 2020, which are impossible to scrutinize and evaluate despite purpose-built artificial intelligence (AI) tools.[10] They are published online before peer review, with some warning of "publication online" [*ePub ahead of print*] or "draft" [*pre-proof*], in a rapid dissemination effort whose disadvantage is the sheer volume.

There is a COVID-19 *Open Research Dataset (COVID-19 Open Research Dataset*, CORD-19) that includes more than 128,000 peer-reviewed and preprint articles and previous studies on coronaviruses.[11] There is also a *Novel Coronavirus Information Center for* open access to research and news published by Elsevier.[12]

The issues with such a large amount of information are several, such as the lack of time to read them, the difficulty of separating the gold from the dross, the fact that 20% of them are not free and less than 50% provide the full text. Much of the literature is inaccessible to physicians or AI programs.

On the other hand, AI algorithms are not always accurate and the quality of what is published is heterogeneous; most are only commentaries, or poor-quality models and protocols. Physicians have preferred to resort to traditional methods, newsletters from different societies, journals with great tradition and prestige, and word-of-mouth recommendation.[10]

The value of information technologies lies in the fact that they can calm the discordance between old beliefs and new, anxiety-producing information.[13] But much of the online literature lacks quality, and we must add the enormous amount of pseudoscience that proliferates in language that is simple, convincing, and attractive not only to the sick, but also to the unwary physician.

It is not impossible for physicians to be tempted to take shortcuts and cut corners in their analysis. The ability to think critically affects the way we act with "smart" technology. Phones and computers can serve as a "second brain" to lighten thinking, but they can affect, for the worse, our will to believe and our worldview.[14] Being a physician does not mean being immune to intellectual garbage.

In chaos there are rules worth remembering; the 80/20 rule, erroneously called the Pareto Principle, reformulated by Juran as "the little vital and the much trivial".[15] Or the Sturgeon's law, which stipulates that "nothing is always absolutely so, [that] ninety percent of everything is garbage" [my translation].[16]

For years there has been another pandemic, the *"morbus fraudulentus"*.[17] A published article is a published article. Whatever it says, it fattens journals and curricula vitae with bullshit that is difficult to verify. Bullshit, without euphemisms or quotation marks, has increased and spreads with communication technologies.[18,19]

Daniel Dennett warns against the use of *"profundities"* that at first glance are "manifestly false but would be crucial *if they were true* [or on the other hand] are true but trivial".[20] (*Italics* are mine) Discard them requires intelligence, background knowledge, the ability to detect conflicts between the logical validity of a study's methodology and its conclusions and, above all, the willingness to analyze conscientiously what is read.

Mention should also be made of online discussions, which have proliferated to a saturation point. They have several limitations; slow rhythms, they consume more hours compared to literature selection processes, there can be several in only one day, and time is invested in receiving information of unequal and redundant quality, since we all drink from almost the same sources. The same recurring topics and opinions also saturate.



## EVIDENCE, EXPERIENCE, CRITERIA, CONSENSUS, AND RECOMMENDATIONS

When evidence is scarce, is produced slowly, or the information is so extensive that it surpasses human capacity, experience gains value. The American College of Surgeons[21] has issued recommendations on cancellation or prioritization of elective procedures. But the *Society of American Gastrointestinal and Endoscopic Surgeons* (SAGES) specifies on its website that "these are not formal guidelines, and due to time constraints, *they have not been reviewed* and authenticated *using standard rigorous processes"*.[22] (*Italics* are mine.)

Despite the recommendation to perform rapid serological tests on all candidates for surgical intervention and, even more so, *regularly* on *all* health care workers, not only for the protection to which they are entitled, but also to evaluate which hospitals can work "free" [*sic*] of COVID,[23-25] in Mexico they have been rejected on the grounds that they are not sensitive enough and that "there is no technical, scientific, logical, automatic connection between the number of tests and the success of control".[*sic*][26]

Asymptomatic infections have already been documented in healthcare workers in Belgium and the UK, even when wearing masks and PPE. In the first study, the majority who tested positive for IgG (75%) recalled having previous symptoms; most commonly, anosmia, fever, and cough.[27] In the other study, all those who had worked in COVID environments tested positive for viral genome analysis, but so did 66% of those who worked in "Non COVID units".[*sic*][28]

Challenges include increased diagnostic testing capacity, logistic problems in public hospitals, staff turnover times, and decreased workforce if a good number of them were to test positive.[28] But if absence of evidence is not evidence of absence, then *a non-sensitive test is more sensitive than no test at all*. Physicians and patients infect each other, and both hospitalized patients and healthcare workers should be considered at-risk populations.

At the height of the contagion, the surgeon, who is not an epidemiologist accustomed to mechanisms, devices and protection protocols that do not work if they are not used correctly, and for which he was never trained, is facing non-familiar situations. Recent epidemics, limited to distant regions, have been attended by others.

Before thinking about elective surgery, as the source of his/her main income, and even

if emotionally his/her head is on how he/she is going to survive the upcoming recession, he/she must think rationally, how not to get caught in the sea of viruses and lose everything. Everything' can mean not only the income, but also life. To do this, the surgeon must first train and master PPE techniques and movement protocols in the operating room.

There are recommendations, protocols, and checklists *for COVID surgeon safety* arising from international organizations.[29-31] Some national associations have issued relevant algorithms, policies, and procedures,[32] but not all hospitals have the financial capabilities for compliance. Each team will have to adjust to the lack of national foresight, to the trial-and-error process, and to its learning curve.

I am not saying that it is easy, and even less so in a catastrophic situation. I am saying that an adequate adaptation implies *the deliberate exercise of postponing some emotions*. Humans are not Aristotelian, meaning "rational by nature" but, as has been demonstrated, we are poor processors of information. To maintain emotional stability, we are averse to change and justify our beliefs and intuitions.[33-35]

Light judgment and quick conclusions are efficient when they are likely to be correct, save time, and the costs of a possible error are acceptable. But light judgment is risky when the situation is uncertain, the stakes are high, and there is little time to gather and process information. In such circumstances, intuitive errors can be prevented by rational, deliberate analysis, and thinking slowly.[36]

## THE RASHOMON EFFECT

This scenario presents *the Rashomon effect*, which derives from the short story *In the Forest*, in which Ryunosuke Akutagawa[37] recounts a murder from several different testimonies, including that of the dead man (through a medium), and leaves the reader the task of constructing conclusions, without knowing exactly what happened.

From a failed State, with administrative disorder, with policies arising from the immediacy of the deficient count of daily deaths, a collapsed health system with no coordination to provide indispensable inputs with the appropriate quality, even less to establish standards, and with redundant rhetoric, the surgeon can expect nothing more than a Rashomon effect.

## USEFUL FICTIONS

It is a fact that there are surgeons in the guild who are deficient in *lingua franca*, who resort only to information in Spanish. It is natural for some to expect a guide or Mexican Official Norm (*Norma Oficial Mexicana* [NOM]) on any aspect related to COVID-19 –from tracing to protocols, to whatever you want, all of which may take years and is not exempt from being incomprehensible.[38]

What can be done? Assume little known realities and disguise them as *useful fictions*, as provisional hypotheses. Since the Middle Ages they were known as *fictio rationis*, or the instruments necessary for certain forms of reasoning, situations that we assume *"as if"*, as if they were true, as hypothetical realities.

And here comes the interesting thing; in uncertainty it cannot be said that "they are", but neither can it be said that "they are not". They can be used "with awareness of their falsity, but at the same time [while gathering sufficient evidence] with awareness of their *fruitfulness*".[39] (*Italics* are mine.)

As a rule of thumb, the useful fiction is to *assume* that "every patient (and every hospital territory) is *COVID positive* until proven otherwise". Safety itself will depend on it.

Assuming that everything is COVID positive implies to develop skills and adaptive measures against the inefficiency and abandonment of the State. Those skills are three: resilience, which is the ability to recover in the face of an adverse situation; creativity, that implies constant imagination to solve practical problems; and solidarity cooperation, being the only thing that will alleviate the orphanhood of a State that does not fulfill its social contract.

## A PARADOX IN CHAOS

A paradox brings together two apparently irreconcilable and opposing ideas, but with a "deep and surprising coherence in its figurative sense".[40]

Two quotations from Heraclitus of Ephesus, trite and perhaps little thought, are paradoxes. His fragment 12 says "to anyone who enters the same river different waters are always flowing". Fragment 6 says that the sun "is not new every day, but continually new".[41,42]

If we connect these fragments with Fleck's epigraph, it is easy to realize how useless it is to pursue the fixed. Everything alive is changeable, except our stubborn will to seek and want to live certainties.

At the beginning of this pandemic, despite the solidarity of the guilds and not of the public institutions, every surgeon is, paradoxically, *alone in the face of chaos*. This applies not only for the academic and teaching surgeon, but also for the common surgeon, for whom surgery was *simply* a way of making a living. In order to adapt, he or she must make practical decisions, based on heuristics and his or her own criteria, which are not exempt from error.[39-35]

It is easy then to see again the problem, well tangible and not philosophical, which is the gap between evidence and experience. Each surgeon will face the challenge of establishing *his or her best practices*.

To survive the general chaos, each surgeon will have to build *his or her own personal order.*

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