A

How to manage the ENG/EMG

The Covid-19 Changes

A dialogue between Belgium, Brasil, Italy and You

A

How and where

Covid -19 targets and mechanisms

A

Targets for Covid-19

Not long after the SARS-CoV-2 outbreak began, scientists discovered that the viral "spike" protein binds to a receptor on human cells known as angiotensin-converting enzyme 2 (ACE2). Another human protein, an enzyme called TMPRSS2, helps to activate the coronavirus spike protein, to allow for cell entry. The combined binding and activation allows the virus to get into host cell.

In the nasal passages, the researchers found that **goblet secretory cells**, which produce mucus, express RNAs for both of the proteins used by SARS-CoV-2 to infect cells.

In the lungs, the RNAs for these proteins have been mainly found in cells called **type II pneumocytes**. These cells line the alveoli (air sacs) of the lungs and are responsible for keeping them open.

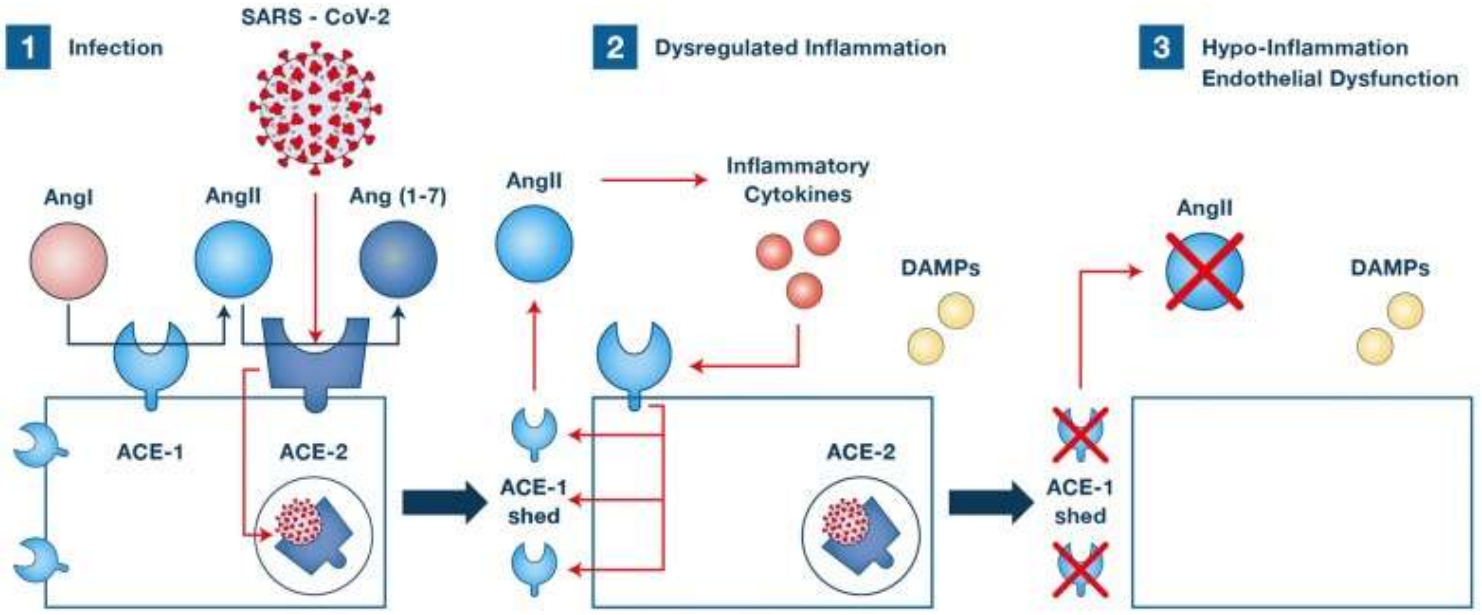
In the intestine, the researchers found that cells called **absorptive enterocytes**, which are responsible for the absorption of some nutrients, express the RNAs for these two proteins more than any other intestinal cell type.

ScienceDaily®

Date:April 22, 2020
Source:Massachusetts Institute of Technology

Mechanisms of Covid-19

A



- Virus infects cell via ACE-2
- Initial local inflammation & endothelial activation
- ↓ AngII metabolism
- Disordered cytokine release
  - Pro-inflammatory cytokine and pro-apoptotic mediators

- ACE-1 shedding occurs
- Increased ACE-1 activity
- Rapid ↑↑ AngII, positive feedback loop inflammation and coagulation.
- Leukocyte infiltration augmented by AngII.

- ACE-1 activity falls
- ↓ AngII to sub-physiologic levels
  - Loss of AngII vasoconstrictive and auto-regulatory effects
  - Microvascular dysfunction
  - ↑ ACE-2 expression
  - If severe, vasodilatory shock

Covid-19 neurological syndromes [A]

- Up to 35-40 % of patients reported neurological symptoms.
- From mild and transitory to severe central stroke damage.
- Nerves, roots, spinal cord may be affected by an inflammatory disease related to Covid-19 infection.
- In some patients the neurological symptoms were the first signs of viral disease.

The new fear

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Normal actvity was subjected to safety procedures for diseases transmitted by blood (HIV, Hepatitis B and C).

Now even **simple interhuman contact may be harmful** for ALL the people present in a medical structure: health workers, patients, staff.

Is the test useful or harmful? Necessary or not? Is better to do it or to postpone it?

A

How do we feel ?

The different types of patient have been classified, based on the results of the swab test, into:

- **Covid + (positive)**
- **Covid-uncertain (suspected positivity, awaiting swab outcome)**
- **Covid - (negative)**

But……. The reality is few swab tests, even less Ab blood tests

<u>How we should consider an asymptomatic patient?????</u>

<u>As for HIV, HCV, HBV we must consider all patients and also ourselves potentially contagious</u>

<u>We are all afraid to bring the virus at home</u>

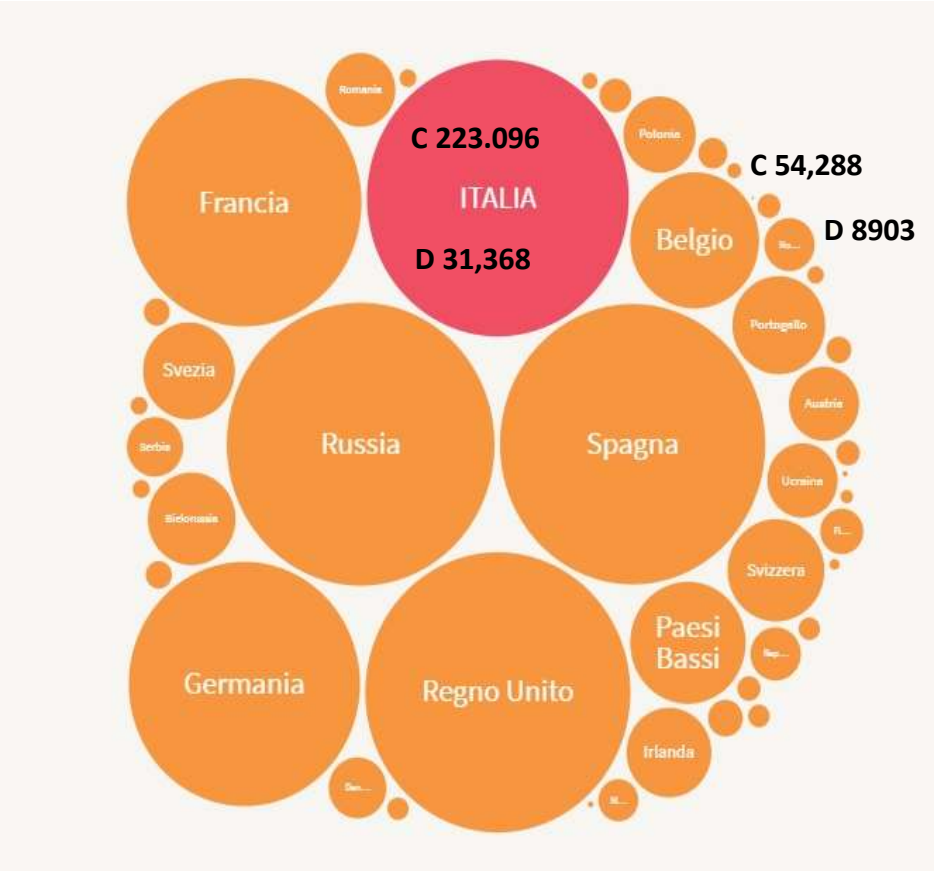
<u>Crosscontamination – potential medicolegal problem?</u>

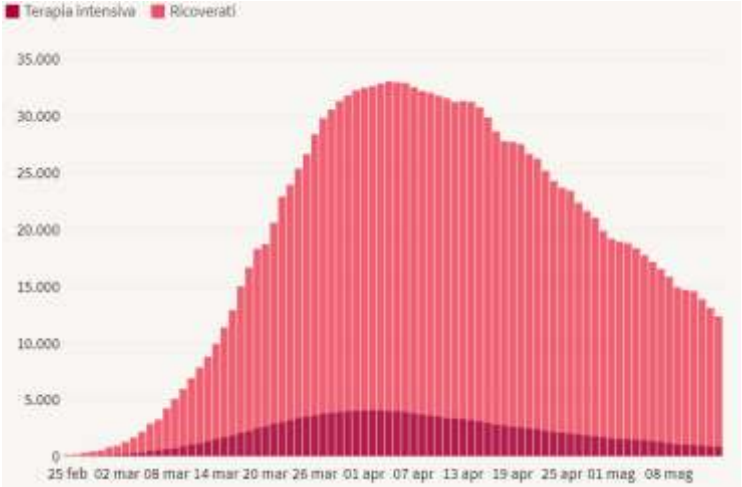
https://www.nytimes.com/2020/03/30/magazine/coronavirus-medical-ethics.html

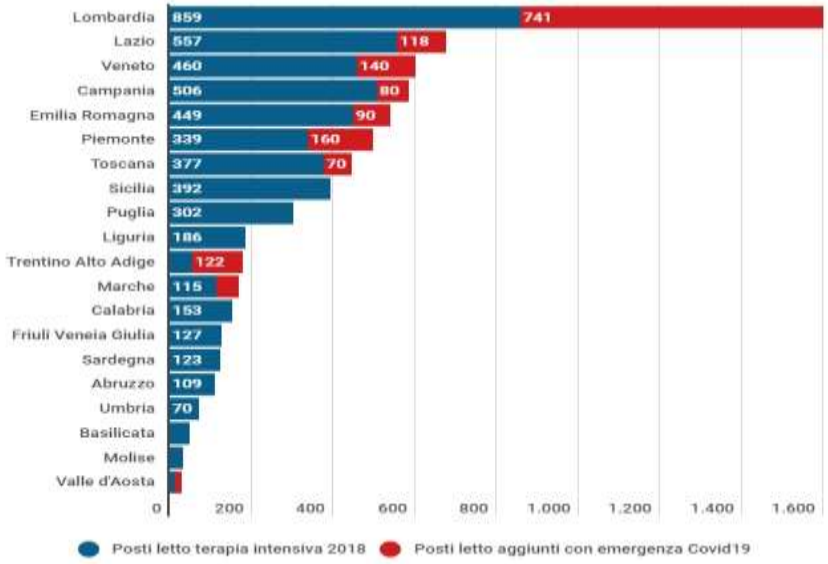
COVID – 19 WORLD

COVID impact
we restart but the problem is still there

A







PATIENTS X DEADS

C

MAY 14YH 2020

Fonte: Universidade Johns Hopkins (Baltimore, EUA), autoridades locais
Números atualizados pela última vez em 14 de maio de 2020 18:42 GMT

PATIENTS X DEADS

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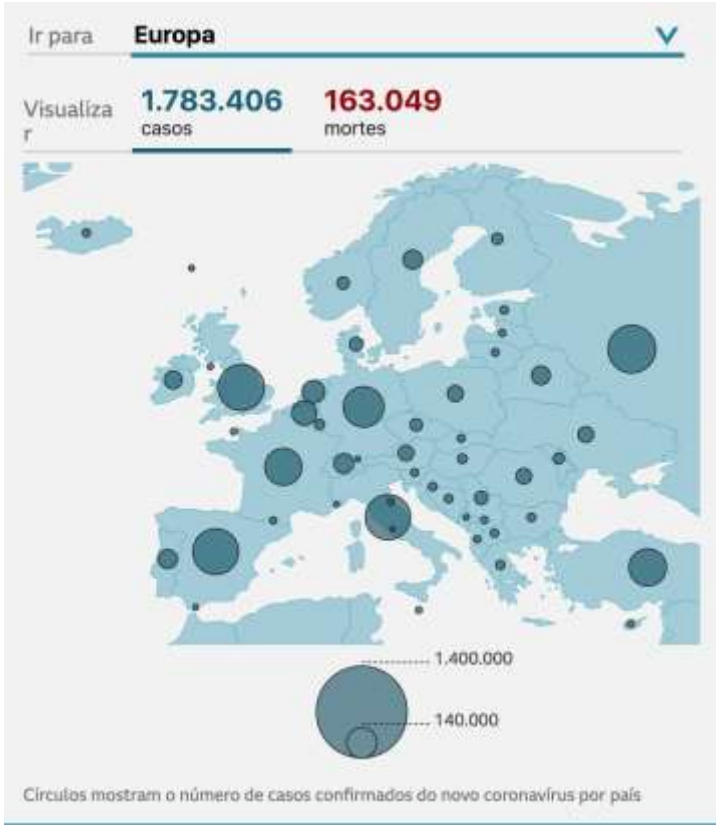
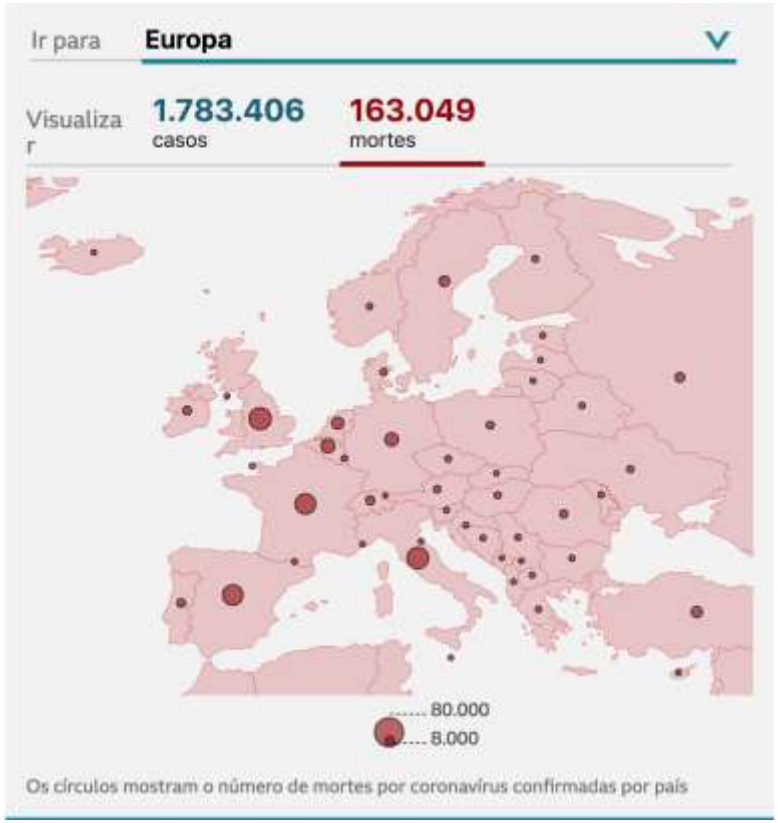
MAY 14YH 2020





Fonte: Universidade Johns Hopkins (Baltimore, EUA), autoridades locais
Números atualizados pela última vez em 14 de maio de 2020 18:42 GMT

PATIENTS X DEADS

C

MAY 14YH 2020

Fonte: Universidade Johns Hopkins (Baltimore, EUA), autoridades locais
Números atualizados pela última vez em 14 de maio de 2020 18:42 GMT

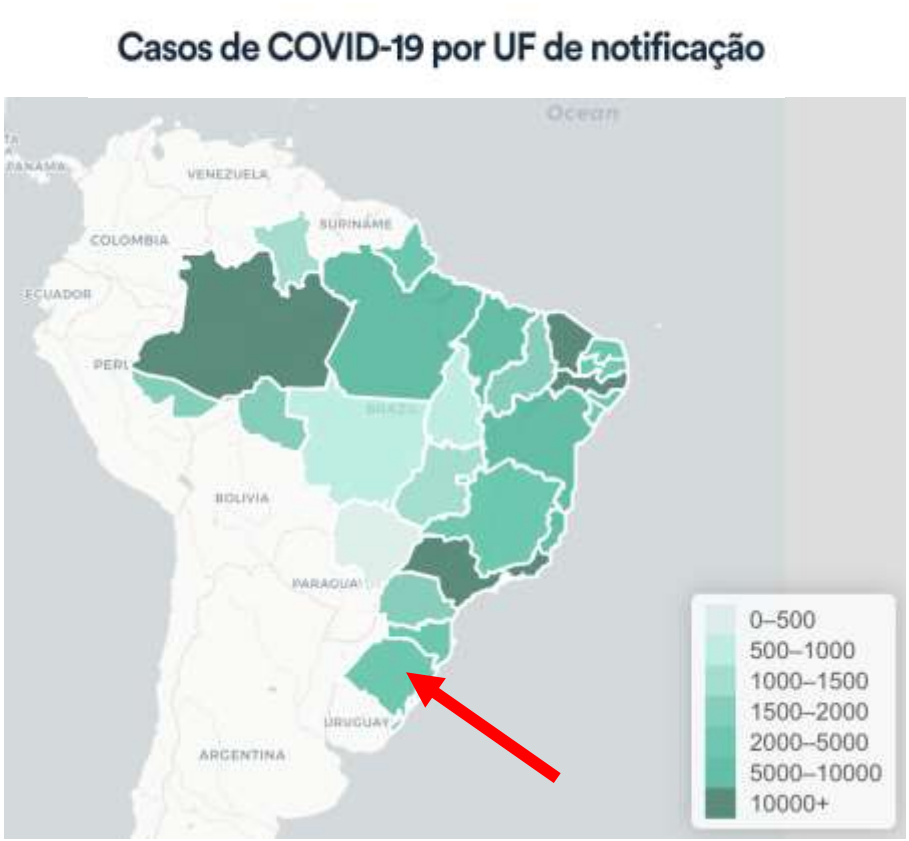
BRAZIL (better BraSil)

C

PATIENTS X DEADS

C

MAY 14YH 2020



*Mortes a cada 100 mil pessoas

Filtro: Mundo

	Mortes	Mortalidade*	Total de casos	Novos casos (0 10 100)
Estados Unidos	84.857	25,9	1.397.852	24 DE JAN
Reino Unido	33.614	50,1	233.151	
Itália	31.368	51,7	223.096	
França	27.425	41,7	141.356	
Espanha	27.321	58,5	229.540	
Brasil	13.555	6,5	196.375	
Bélgica	8.903	77,5	54.288	
Alemanha	7.868	9,5	174.284	

Fonte: Universidade Johns Hopkins (Baltimore, EUA), autoridades locais
Números atualizados pela última vez em 14 de maio de 2020 18:42 GMT

Patient screening

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Inpatients: to examine who is hospitalised in **COVID-19 +** and non COVID-19 use the protections according to the guidelines given by the institutions or hospitals.

Outpatients : phone pre-screening through secretarial staff at least 24 hours before or electronic form to be filled in.

On the day of exam a questionnaire is handed out to the patient and any accompanying person

TELEPHONE or TRIAGE STATE OF HEALTH DIAGRAM A

Have you had COVID 19? YES □ NO □

If the answer is YES, is it cured (negative buffer?) YES □ NO □

Are you in quarantine? YES □ NO □

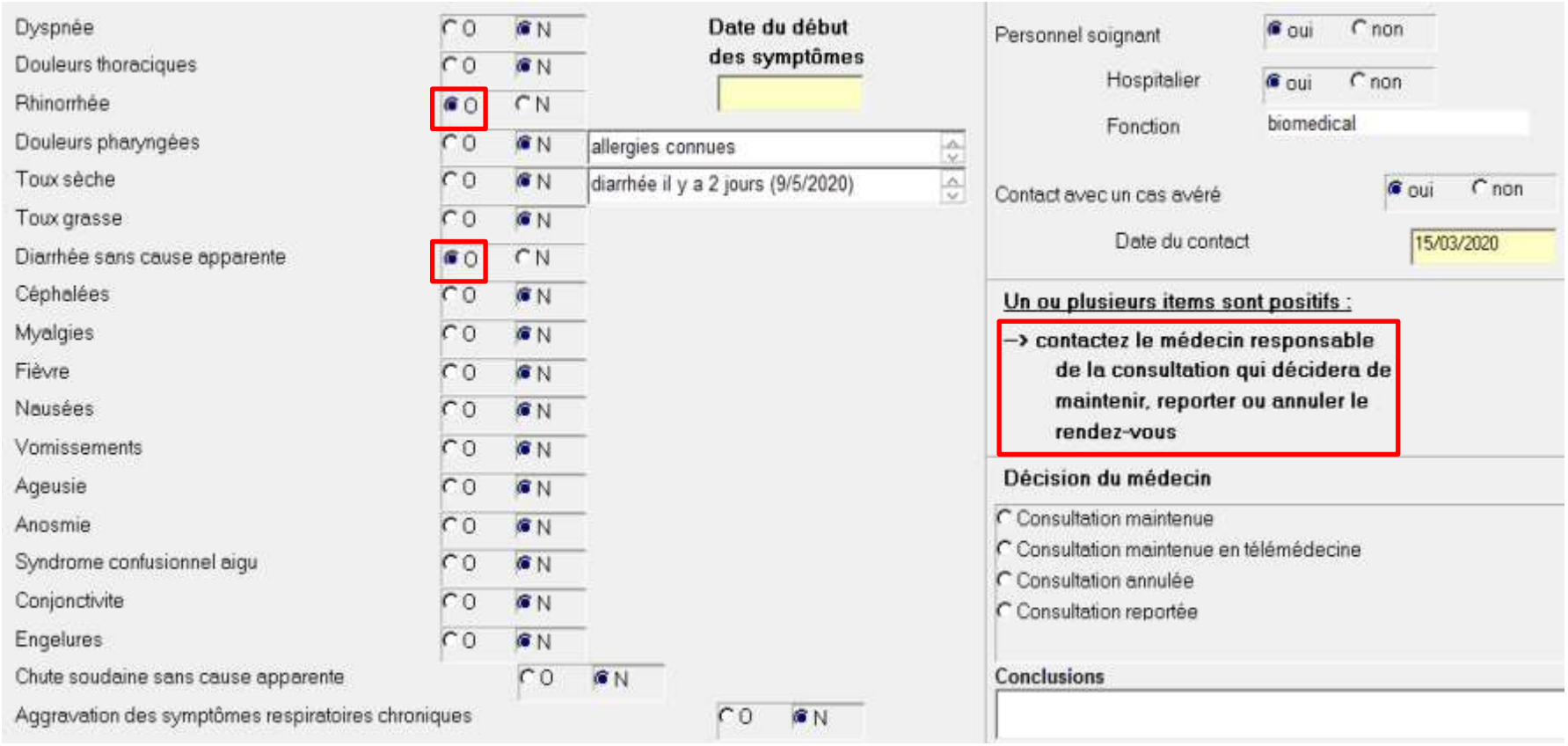
MAJOR SYMPTOMS at present or in the past 14 days
Fever> 37.5 ° YES □ NO □
Cough YES □ NO □
Breathing difficulties YES □ NO □
Ageusia, anosmia YES □ NO □
Conjunctivitis YES □ NO □
Diarrhea? YES □ NO □

Epidemiological screening

A

- **EXPOSURE** TO VERIFIED CASES COVID 19 (**positive swab test**) YES □ NO □
- **EXPOSURE** TO SUSPECTED CASES YES □ NO □
- **CONTACTS** WITH FAMILIES OF SUSPECTED CASES YES □ NO □
- **COHABITANTS** WITH FEVER OR INFLUENTIAL SYMPTOMS (**no swab**) YES □ NO □
- **CONTACTS** WITH FEVER OR INFLUENTIAL SYMPTOMS (**no swab)** YES □ NO □
- **ATTENDANCE** OF HEALTH ENVIRONMENTS WITH ASSESSED / SUSPECTED CASES YES □ NO □
- **WORK YES** □ NO □ □ SMART WORKING □ A IN CONTACT WITH OTHER SUBJECTS
  □ WITH PROTECTION DEVICES
  □ WITHOUT USING PROTECTION DEVICES
- In which place _____ (eg type: office, public exercise, transport other
- **HAVE YOU TRAVELLED** IN THE LAST 14 DAYS? YES □ NO □

Covid-19 screening computerized card



F

Covid-19 screening computerized card

	YES	NO
dyspnea		
chest pain		
pharyngeal pain		
rhinorrhea		
dry cough		
diarrhea without apparent cause		
headache		
myalgia		
fever		
nausea		
vomiting		
ageusia		
anosmia		
acute cufusional syndrome		
conjunctivitis		
frostbite		
sudden fall without apparent cause		
worsening of chronic respiratory symptoms		

	YES	NO
médical staff		
contact with a proven covid case		

symtom onset	4/05/20

one or more items are positive contact the doctor who will decide to maintain, postpone or cancel the appointment

doctor's decision	
consultation maintained	
telemedicine consultation	
consultation canceled	
postponed consultation	

Waiting room and medical rooom A

- Patients are allowed access if wearing a surgical mask and gloves (wear new gloves after hand disinfection only inside the medical office, shoe covers)
- Taking patient and accompanying person body temperature
- Triage questionnaire completed on the arrival
- Plexiglass shield for the secretarial desk
- **<u>Number of people: interpersonal distance must be kept</u>**
- Separated entry and exit whenever possible
- Only patients admitted
- Accompanying person (with mask and gloves) only if minors or seriously handicapped patients
- **2 workers in the lab (MD + TNP)**

A

PERSONAL PROTECTIONS

A

Exposure risk for healthcare personnel

Epidemiologic risk factors	Exposure category	Recommended Monitoring for COVID-19 *(until 14 days after last potential exposure)*	Work Restrictions for Asymptomatic HCP
Prolonged close contact with a patient with COVID-19 (beginning 48 hours before symptom onset) who was wearing a cloth face covering or facemask (i.e., source control)			
HCP PPE: None	Medium	Active	Exclude from work for 14 days after last exposure
HCP PPE: Not wearing a facemask or respirator	Medium	Active	Exclude from work for 14 days after last exposure
HCP PPE: Not wearing eye protection	Low	Self with delegated supervision	None
HCP PPE: Not wearing gown or gloves[a]	Low	Self with delegated supervision	None
HCP PPE: Wearing all recommended PPE (except wearing a facemask instead of a respirator)	Low	Self with delegated supervision	None
Prolonged close contact with a patient with COVID-19 (beginning 48 hours before symptom onset) who was not wearing a cloth face covering or facemask (i.e., no source control)			
HCP PPE: None	High	Active	Exclude from work for 14 days after last exposure
HCP PPE: Not wearing a facemask or respirator	High	Active	Exclude from work for 14 days after last exposure
HCP PPE: Not wearing eye protection[b]	Medium	Active	Exclude from work for 14 days after last exposure
HCP PPE: Not wearing gown or gloves[a,b]	Low	Self with delegated supervision	None
HCP PPE: Wearing all recommended PPE (except wearing a facemask instead of a respirator)[b]	Low	Self with delegated supervision	None

HCP=healthcare personnel; PPE=personal protective equipment

CDC Centers for Disease Control and Prevention

ENG/EMG test requires close contact with the patient **<u>who must wear</u>** the mask

Wearing the correct mask

A

Based on this comparison, it is reasonable to consider China KN95, AS/NZ P2, Korea 1st Class, and Japan DS FFRs as "equivalent" to US NIOSH N95 and European FFP2 respirators, for filtering non-oil-based particles such as those resulting from wildfires, PM 2.5 air pollution, volcanic eruptions, or bioaerosols (e.g. viruses). However, prior to selecting a respirator, users should consult their local respiratory protection regulations and requirements or check with their local public health authorities for selection guidance.

Certification/ Class (Standard)	N95 (NIOSH-42C FR84)	FFP2 (EN 149-2001)	KN95 (GB2626-2006)	P2 (AS/NZ 1716:2012)	Korea 1st Class (KMOEL - 2017-64)	DS (Japan JMHLW-Notification 214, 2018)
Filter performance – (must be ≥ X% efficient)	≥ 95%	≥ 94%	≥ 95%	≥ 94%	≥ 94%	≥ 95%
Test agent	NaCl	NaCl and paraffin oil	NaCl	NaCl	NaCl and paraffin oil	NaCl
Flow rate	85 L/min	95 L/min	85 L/min	95 L/min	95 L/min	85 L/min
Total inward leakage (TIL)* – tested on human subjects each performing exercises	N/A	≤ 8% leakage (arithmetic mean)	≤ 8% leakage (arithmetic mean)	≤ 8% leakage (individual and arithmetic mean)	≤ 8% leakage (arithmetic mean)	Inward Leakage measured and included in User Instructions
Inhalation resistance – max pressure drop	≤ 343 Pa	≤ 70 Pa (at 30 L/min) ≤ 240 Pa (at 95 L/min) ≤ 500 Pa (clogging)	≤ 350 Pa	≤ 70 Pa (at 30 L/min) ≤ 240 Pa (at 95 L/min)	≤ 70 Pa (at 30 L/min) ≤ 240 Pa (at 95 L/min)	≤ 70 Pa (w/valve) ≤ 50 Pa (no valve)
Flow rate	85 L/min	Varied – see above	85 L/min	Varied – see above	Varied – see above	40 L/min
Exhalation resistance - max pressure drop	≤ 245 Pa	≤ 300 Pa	≤ 250 Pa	≤ 120 Pa	≤ 300 Pa	≤ 70 Pa (w/valve) ≤ 50 Pa (no valve)
Flow rate	85 L/min	160 L/min	85 L/min	85 L/min	160 L/min	40 L/min
Exhalation valve leakage requirement	Leak rate ≤ 30 mL/min	N/A	Depressurization to 0 Pa ≥ 20 sec	Leak rate ≤ 30 mL/min	visual inspection after 300 L /min for 30 sec	Depressurization to 0 Pa ≥ 15 sec
Force applied	-245 Pa	N/A	-1180 Pa	-250 Pa	N/A	-1,470 Pa
CO_2 clearance requirement	N/A	≤ 1%	≤ 1%	≤ 1%	≤ 1%	≤ 1%

*Japan JMHLW-Notification 214 requires an Inward Leakage test rather than a TIL test.

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P100 and ffP3

GVS Eclipse P100 (USA)

Rating: 99.97% (minimum)

GVS Eclipse P3 (Europe)

Rating: 99.95% (minimum)

Personal protective equipment – Body protection

A

Wearing personal protective equipment may be useful for self-protection and to **<u>avoid cross-contamination between patients</u>**.

Double gloves (medium under, large over) are useful for dressing/undressing procedures

https://www.ecdc.europa.eu/sites/default/files/documents/COVID-19-guidance-wearing-and-removing-personal-protective-equipment-healthcare-settings-updated.pdf

Avoid touching your face while doing the test or undressing

disposable cap

disposable gown

gloves (double)

disposable shoe covers

Face Protection

A

Type F

Type:Disposable Goggles
Lenses: PET
Frame/Plug: PVC
Size: approx.183 x 80mm/7.21x3.15"

Goggles – convenient for ease of movement and providing space for glasses; easily mist up even if aerated

Face shield - must cover the whole face, providing less ease of movement; reduced fogging of the glasses

Guidance for clinical neurophysiology examination throughout the COV-ID-19 pandemic. Latin American chapter of the IFCN task force - COVID-19

ClinNeurophysiology
21 April 2021

Appropriate use
Personal Protective Equipament
PPE

Table 1. Recommendations of rational and appropriate use of Personal Protective Equipment (PPE) in health personnel and patients during clinical neurophysiology studies. Adaptation of the WHO recommendations (World Health Organization, 2020c).

Area	Staff or Patient	Activity	Personal Protection Equipment
Health Care Environment			
In-hospital Environment			
Patient's Room	Healthcare Professionals including technicians.	Providing care direct to patients with COVID-19.	Medical mask Apron or Gown Gloves Goggles Full-face screen
		Procedures in patients with COVID-19 generating aerosols	Mask N95 or FFP2 standard or similar. Gloves Goggles Full-face screen. Apron or Gown
	Cleaners	Providing care direct to patients with COVID-19.	Medical mask Apron or Gown Hard work Gloves Goggles Full-face shield Work covered shoes
Other areas for patient transit. (e.g. corridors).	All the staff, including HP	Any activity that doesn't involve direct contact with COVID-19 patients	No PPE required.

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Body parts

Any differences in performing the tests?

A

Lower limbs

- Distance from the face is maximal and the patients may wear face mask and gloves

- Surgical mask and face protections are recommended for the examiner
- Head cap, disposable gown and double gloves may be useful for the examiner

Upper limbs (not shoulders)

A

- The distance to the face is reduced and patients may wear face mask **but not gloves (careful cleaning/disinfection of hands)**
- Surgical mask and face protections are recommended
- Head cap, disposable gown and double gloves may be useful for the examiner.

Shoulder, chest, back

A

- Distance to the face is reduced and patients may wear face mask and gloves
- Surgical mask or ffP2/KN95 and face protections are recommended
- Head cap, disposable gown and double gloves may be **recommended** for the examiner

A

Cranial nerves

- Performed on the face and the patients **cannot wear face mask**, gloves are worn.
- FfP2/KN95 mask and face protections are necessary
- Head cap, diposable gown and double gloves are recommended for the examiner.
- The patient may have a cough reflex!

Perineal EMG

A

- Probable contamination of the perineal area
- Performed near the anatomic area, the patients must wear face mask and gloves.
- Surgical mask or ffP2/KN95 and face protections are recommended
- Head cap, gown and double gloves rcecommended the examiner

Botulinum toxin injections

A

- Same recommendations for ENG and EMG tests
- Depending on the part of the body that is injected

Safety behaviors

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- While wearing PPE: avoid touching already worn PPE
- Remove gloves if torn or damaged
- Change the second pair of gloves between one patient and another
- Carry out hand hygiene before putting on new gloves
- When removing PPE, be careful to avoid any contact between the dirty components and the area of the face or skin that is not intact
- Decontaminate PPE as non-disposable goggles and face shields

Tricks for neck and hands

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Self-made neck protection

Use of double gloves – reduced exposure to disinfectants

C


EXAME
Dr. Carlo D. Marrone


COVID-19 Personal Protective Equipment (PPE) for Healthcare Personnel
Preferred PPE – Use
N95 or Higher Respirator
Face shield or goggles
N95 or higher respirator
When respirators are not available, use the best available alternative, like a facemask.
One pair of clean, non-sterile gloves
Isolation gown
Acceptable Alternative PPE – Use
Facemask
Face shield or goggles
Facemask
N95 or higher respirators are preferred but facemasks are an acceptable alternative.
One pair of clean, non-sterile gloves
Isolation gown

C

HOW TO PUT ON AND TAKE OFF

Personal Protective Equipment (PPE)

How to put on PPE (when all PPE items are needed)

Step 1
- Identify hazards & manage risk. Gather the necessary PPE.
- Plan where to put on & take off PPE.
- Do you have a buddy? Mirror?
- Do you know how you will deal with waste?

Step 2
- Put on a gown.

Step 3a OR **Step 3b**
- Put on face shield.
- Put on medical mask and eye protection (e.g. eye visor/goggles)

Note: If performing an aerosol-generating procedure (e.g. aspiration of respiratory tract, intubation, resuscitation, bronchoscopy, autopsy), a particulate respirator (e.g. US NIOSH-certified N95, EU FFP2, or equivalent respirator) should be used in combination with a face shield or an eye protection. Do user seal check if using a particulate respirator.

Step 4
- Put on gloves (over cuff).

How to take off PPE

Step 1
- Avoid contamination of self, others & the environment
- Remove the most heavily contaminated items first

Remove gloves & gown
- Peel off gown & gloves and roll inside, out
- Dispose gloves and gown safely

Step 2
- Perform hand hygiene

Step 3a
If wearing face shield:
- Remove face shield from behind
- Dispose of face shield safely

Step 3b
If wearing eye protection and mask:
- Remove goggles from behind
- Put goggles in a separate container for reprocessing
- Remove mask from behind and dispose of safely

Step 4
- Perform hand hygiene

A

AAEM instructions

PPE Guidance for All Patient Interactions During COVID-19

A

Patient With Positive or PUI COVID

- For healthcare worker
- N95 Mask
- Face Shield or protective goggles
- Gown
- Shoe covers
- Gloves
- Hair covering optional
- If N95 can't be worn PAPR (powered air-purifying respirators) suit

For the patient – not in a waiting room with other patients, examined in an isolation room if possible

- **Surgical mask if possible**

Thoroughly clean all equipment, room, etc. after procedure and before seeing any other patient. Regarding EDX testing, see AANEM's document Special Precautions While Performing EDX Testing for further information.

PPE Guidance for All Patient Interactions During COVID-19

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All Other Patients

For healthcare worker

- Surgical Mask
- Face Shield or protective goggles (strongly recommended)
- Gloves

For the patient – follow social distancing rules for waiting patients (i.e. having patients wait in car until ready for procedure. No additional people enter the building with the patient unless the patient needs assistance)
Surgical mask if possible

Sociedade Brasileira de Neurofisiologia Clínica (SBNC)

C

March 18th 2020

- ✓ Máscaras cirúrgicas fornecem apenas proteção de barreira contra grandes gotículas, não filtrando pequenas partículas presentes no ar (não se destinando a proteção dos profissionais de saúde).Entretanto, nas escassez de máscaras – N95, recomendamos que ao examinar sintomáticos respiratórios, os profissionais de saúde utilizem máscaras cirúrgicas, descartando as mesmas tão logo finde o atendimento.

- ✓ O papel da máscara cirúrgica é basicamente para controlar o paciente sintomático respiratório, evitando a contaminação da área circulante quando o mesmo tosse ou espirra (deve ser oferecida máscara cirúrgica aos pacientes que se apresentam na recepção e apresentem sintomas respiratórios).

- ✓ Nos casos em que o profissional for examinar pacientes em unidades de Terapia Intensiva, com confirmação ou suspeita de infecção pelo COVID-19, recomendamos a utilização de: máscaras - N95, Protetor Facial que cubra a região frontal e lateral da face (óculos de uso pessoal e lentes de contato, não são considerados métodos adequados de proteção), uso de aventais descartáveis e luvas.

As recomendações acima foram elaboradas com auxílio do Dr Jefferson Abrantes, CRM DF 17759, neurologista, neurofisiologista, intensivista titulado. Mestre e doutor em neurologia pela Universidade Federal do RJ.

Fonte disponível em : https://www.cdc.gov/coronavirus/2019-ncov/hcp/healthcare-supply-ppe-index.html

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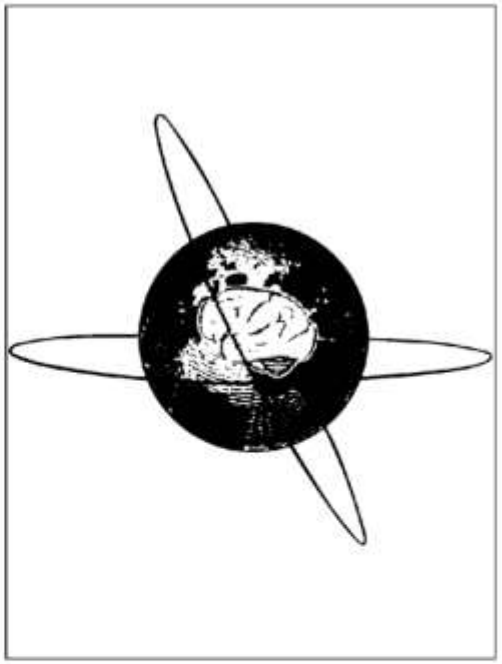

Journal Pre-proofs

Review

Guidance for clinical neurophysiology examination throughout the COV-ID-19 pandemic. Latin American chapter of the IFCN task force - COVID-19

Daniel San-Juan, Christian Ramos Jiménez, Cecilia Ximénez Camilli, Luis Adrián de la Cruz Reyes, Enya Gabriela Aguirre Galindo, Gustavo Eduardo Ramos Burbano, Maria Magdalena Penela, Monica Beatriz Perassolo, Armando Tello Valdéz, Jorge Gutierrez Godoy, Ana Lucila Moreira, Paulo Andre Teixeira Kimaid

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NF Staff

Guidance for clinical neurophysiology examination throughout the COV-ID-19 pandemic. Latin American chapter of the IFCN task force - COVID-19
Clinical Neurophysiology
23 April 2020

C

6.1. Recommendations for neurophysiology staff with risk factors for COVID-19

Pregnant women and patients over 60 years of age with comorbidities such as obesity, diabetes mellitus, systemic high blood pressure, cardiovascular disease, chronic lung disease or immunosuppression states have an increased risk of contracting the disease and dying (D. Wang *et al.*, 2020; Yi *et al.*, 2020). For this reason, CN staff with the above risk factors should avoid conducting CN studies as much as possible and take extreme precautions when there is no other option.

Guidance for clinical neurophysiology examination throughout the COV-ID-19 pandemic. Latin American chapter of the IFCN task force - COVID-19

Clinical Neurophysiology

23 April 2020

C

Personnel NF laboratory

It is important to the CN technologist to know the policies to contain COVID-19 infection. As a first instance, technical staff should have theoretical knowledge of the infectious agent (COVID-19). In this way, they will be aware of the infection mechanism of the virus and will be able to recognize the means or routes of contagion. The CN technologist should also follow the health institution's hygiene recommendations.

C

Sterilization x Disinfection x Cleaning

According to the U.S. CDC, sterilization is the process that destroys or eliminates all microscopic life forms and is performed in hospitals or clinics using physical or chemical methods, e.g. dry heat, ethylene oxide gas, steam under pressure, hydrogen peroxide plasma and liquid chemicals. Disinfection is the process that eliminates most or all microorganisms, except bacterial spores on inanimate objects, these are eliminated in health facilities by using chemical liquids or wet pasteurization. Cleaning is the removal of visible dirt (e.g. organic and inorganic material) from objects and surfaces and is usually done manually or mechanically using water with detergents or enzymatic products (Centers for Disease Control and Prevention, 2016).

Guidance for clinical neurophysiology examination throughout the COV-ID-19 pandemic. Latin American chapter of the IFCN task force - COVID-19

Clinical Neurophysiology

23 April 2020

C

Cleaning

In general, cleaning and disinfection measures should be implemented on any surface that had contact with the patient. Hospital grade cleaning agents are recommended (Table 2) and it is suggested that the bathrooms be cleaned at least twice a day and when needed. Dirty surfaces should first be cleaned with a detergent and then applied to the hospital grade disinfectant, in accordance with the manufacturer's recommendations for volume and contact time. After contact time has elapsed, the disinfectant is rinsed with clean water. SARS-CoV2 will be inactivated after 5 minutes of contact with household laundry disinfectants (World Health Organization, 2020d).

A

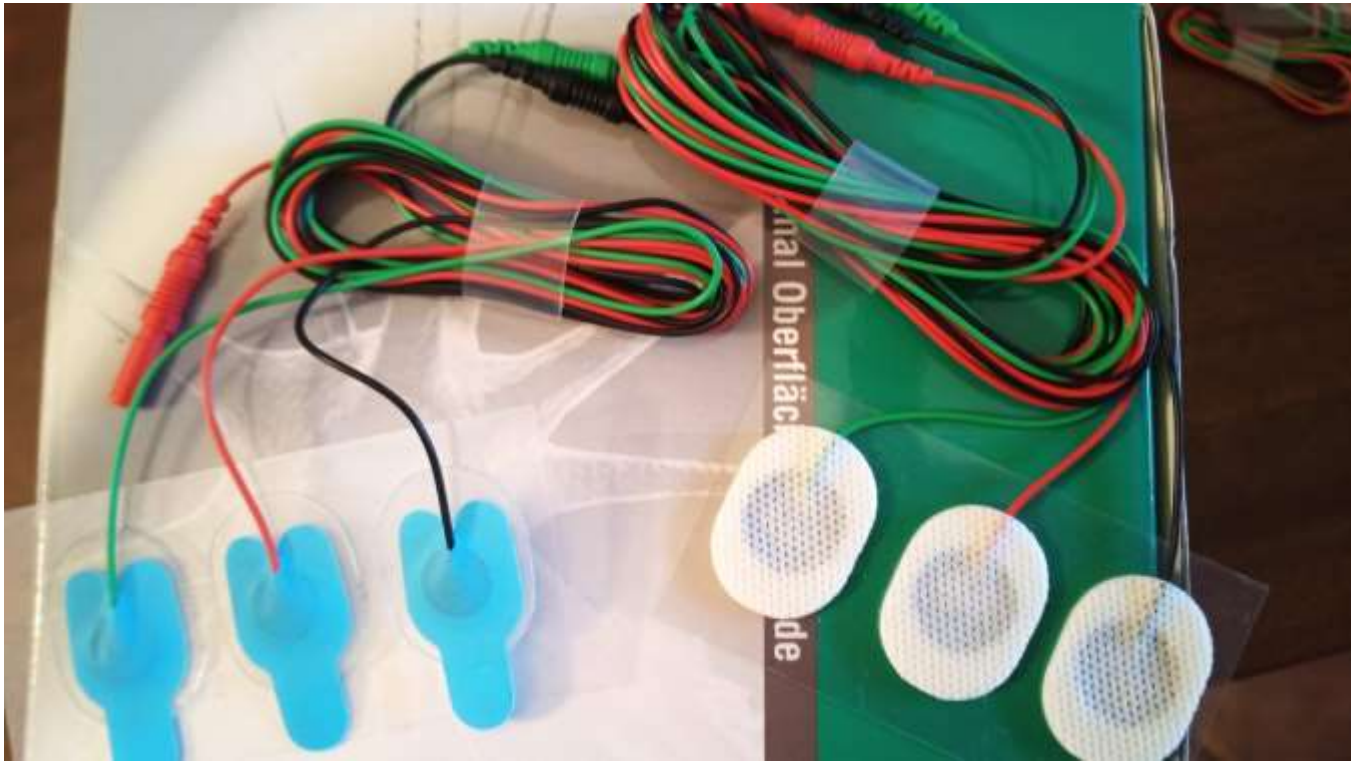
Which tools are preferred?

NCS – felters strong disinfection or use steel

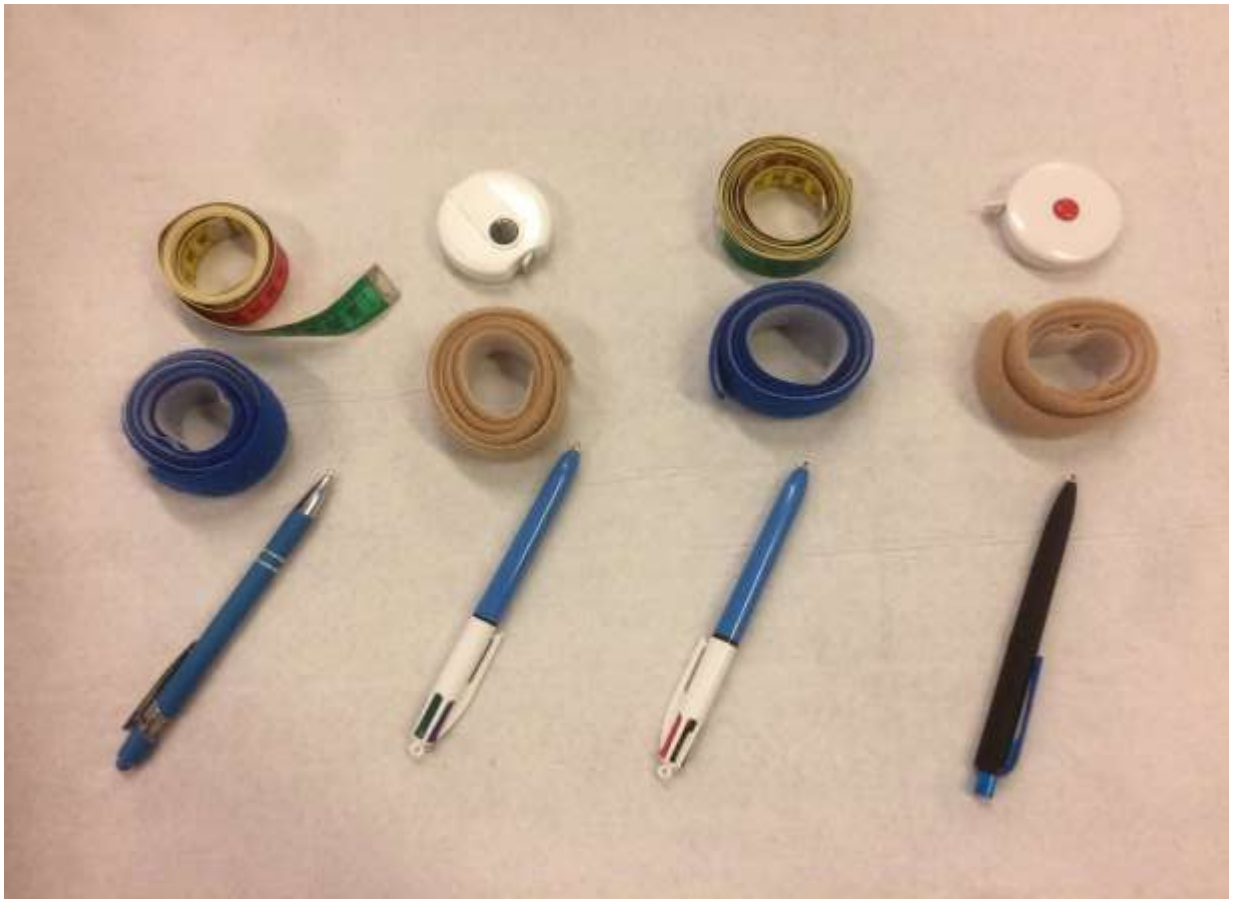
A

Single use disposable adhesive electrodes

A



Measuring and marking instruments



One set for each patient may be useful to avoid losing time in disinfection

Maintenance and cleaning

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Equipment Maintenance & Cleaning

- Perform hand hygiene frequently
- Remove all unnecessary and disposable items from machine
- Use antiseptic wipes to clean all surfaces before starting a study and between patients
- Disinfect EMG machine and electrodes per institutional guidelines
- Consider using disposable electrodes
- Consider clear plastic bag to cover EMG equipment

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Table 2. Survey of medical grade disinfectants. Severe acute respiratory syndrome coronavirus 2 is sensible to all this medical grade disinfectants (Acosta-Gnass and Stempliuk, 2008), considering that it is a RNA virus with an external lipid membrane.

Compound	Concentration	Level of Disinfection	B	VL	VH	M	H	E	Mechanism of Action
Chlorine	100 ppm	Intermediate/ low	+	+	+	+	+		IE, DP, IAN
Iodine	30-50 ppm	Intermediate	+	+	+	+ -	+ -	-	RP
Hydrogen Peroxide	3-25%	Intermediate	+	+	-	+	+	-	ROH
Alcohols	60-95%	Intermediate	+	+	-	+	+	-	DP
Phenols	0.4-5%	Intermediate / low	+	+	+ -	-	+ -	-	IE
Quaternary Ammonias	0.4-1.6%	Low	+	+	-	-	+ -	-	IE, DP
Peracetic Acid	0.001-0.2%	Alto	+	+	+	+	+	+	Oxidant
Chlorhexidine	0.05%	Low	+	+	+ -	-	+	-	Cytoplasmic
Glutaraldehyde	2%	Chemical Sterilizing	+	+	+	+	+	+	Alkylation of DNA, RNA

Note: B-bacteria, VL-lipophilic viruses, VH-hydrophilic viruses, M-mycobacteria, H-fungal, E-spores, IE-enzymatic inactivation, DP-denaturation of proteins, IAN-inactivation of nucleic acids.

https://www.epa.gov/pesticide-registration/list-n-disinfecants-use-against-sars-cov-2

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Electromyography

- The use of needle electrode is already considered a risky procedure
- Cleaning and disinfection of the cable

ENMG test in Covid-19 room

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- A precaution, if possible, is to perform the EMG examination in a Covid-19 room and to power the equipment with an **Uninterruptible Power Supply (UPS)** to avoid that the power cable is necessary (usually touches the ground), and to wear high protection mask (ffP3 or N100) and full head/body protection if you works with a patient who creates aerosols (type NIV without helmet).
- if available, use dedicated equipment that is left in the intensive department.
- Careful cleaning and disinfection after use

Instrument cleaning and protection

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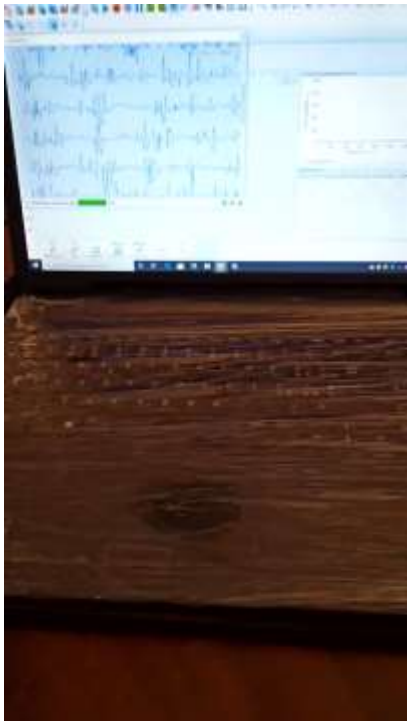

Specific alcohol-based wipes are available for disinfection.
A cling film (PVC) may be used to cover the amplifier, the keyboard, etc. in order to easily disinfect and not damage the machine and erase characters.
The argument is debated by some colleagues who prefer one way or another.

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Electronic devices

2. In outpatient or intrahospital specialized clinics, the procedures should be performed at that site.

Select and wear the appropriate PPE (Table 1) (American Clinical Neurophysiology Society, 2020b). For electronic devices such as cell phones, tablets, touch screens, remote controls, and keyboards, eliminate visible contamination if present.

1. Follow the manufacturer's instructions for all cleaning and disinfection products.
2. If no manufacturer guidance is available, consider using alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touchscreens. Dry surfaces thoroughly to prevent fluid build-up (Centers for Disease Control and Prevention, 2020b).
3. Consider using washable cases for electronic devices.

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Before starting the diagnostic study, the CN technologist should:

?? 1. Obtain the responsible physician's approval for the CN study.

2. Obtain as much information as possible about the patient's condition including COVID-19 status.

3. Verify equipment, material and supplies necessary to perform the examination.

4. Determine the appropriate PPE level, see Table 1 and Figures 1-2.

5. Remove all disposable items that are not needed from the neurodiagnostic equipment.

6. Pick up hair, remove jewelry and makeup, watches and unnecessary personal items. If lenses are required, attach them to the face.

7. Clean all surfaces of the neuro-diagnostic equipment.

8. It is advisable to cover the equipment with a clear plastic liner, taking care not to block the computer fans. It is important also to cover the cables especially those that may have contact with the ground.

9. Wash hands with the appropriate technique (minimum 20 seconds).

10. Wear the appropriate PPE equipment (Table 1) Figure 2 (Liang, 2020).

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After the diagnostic study

1. Dispose the non-reusable CN (e.g. electrodes) material.
2. Plan the cleaning procedure for equipment and reusable material. See *section 13*.
3. Remove the PPE equipment (Figure 2) following the recommendations of its dispensing or reuse in the area where you conducted the study, it can be a separate room, but avoid walking in other areas.
4. Wash hands with appropriate technique.
5. Proceed to the disinfection process of diagnostic equipment and electrodes with a new appropriate PPE equipment. Table 1.
6. Remove the PPE. Figure 2.
7. Perform hand hygiene.

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Laundry and medical waste

In general, the management of laundry and medical consumable waste should also be performed in accordance with hospital or clinic routine procedures (Raymond Y.W. Chinn, MD, HICPAC Advisor, Sharp Memorial Hospital, San Diego, California)(Centers for Disease Control and Prevention, 2020d).

Air cleaning/disinfection

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The best systems are those with multi-factorial filtering and sterilization and in particular those with the following composition:
HEPA filters of level H13-H14 capable of retaining with efficiency of 99.97% particles (therefore also viral) of size equal to 300nm, associated with activated carbon filters and UVC lamps without external dispersion with powers equal to or greater than 1200uw / cm2 and frequencies of 185nm - 254nm and 280nm possibly all associated using multiple emitters.

"There is no evidence that ozone performs a sterilizing function against the new coronavirus and consequently protects against contracting the infection." Italian Ministry of Health 8 May 2020

Health Effects	Risk Factors	Health Standards*
Potential risk of experiencing: Decreases in lung function Aggravation of asthma Throat irritation and cough Chest pain and shortness of breath Inflammation of lung tissue Higher susceptibility to respiratory infection	**Factors expected to increase risk and severity of health effects are:** Increase in ozone air concentration Greater duration of exposure for some health effects Activities that raise the breathing rate (e.g., exercise) Certain pre-existing lung diseases (e.g., asthma)	The **Food and Drug Administration** (FDA) requires ozone output of indoor medical devices to be no more than 0.05 ppm. The **Occupational Safety and Health Administration** (OSHA) requires that workers not be exposed to an average concentration of more than 0.10 ppm for 8 hours. The **National Institute of Occupational Safety and Health** (NIOSH) recommends an upper limit of 0.10 ppm, not to be exceeded at any time. EPA's National Ambient Air Quality Standard for ozone is a maximum 8 hour average outdoor concentration of 0.08 ppm • See - the
(* ppm = parts per million)		

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Questions

- Rescheduling the exams if a patient is not in the right condition
- **Impact on the examination length – 15-30 minutes more**
- Impact on the daily number of patients
- EMG/ENG sessions dedicated to a specific body district?
- Ease while doing tests wearing PPE
- **Increase in special waste**
- **Disinfection and recycling of PPE?**
- **Costs will increase with the use of disposable electrodes and PPE (+/- 15-20 euros each patient)**
- Long-term exposure to disinfectants: side effects?
- **Theory vs. reality: all we showed you is possible or necessary ?**

Thank you for your attention

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Special thanks to all the people who gave us precious advices and shared their experiences:

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A special thought goes to my former colleagues from the IRCCS C. Mondino Pavia

In memoriam
Prof. Arrigo Moglia
20/01/1947 – 15/04/2020

Italian health workers Covid-19 victims
162 doctors, 40 paramedics