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## Neurosurgical Praxis Guidelines during the COVID-19 Outbreak. Consensus-based on currently available literature.

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## Neurosurgical Praxis Guidelines during the COVID-19 Outbreak. Consensus-based on currently available literature.

### Abstract

**INTRODUCTION:** The World Health Organization recommended several strategies to contain the COVID-19 pandemic, including optimization of care for all patients, especially the seriously ill. Given the strain, the pandemic has posed on healthcare systems around the world, many neurosurgical associations have provided triage recommendations for patients to save resources for the pandemic. We aimed to provide practical recommendations based on specific illnesses requiring surgical procedures commonly performed by neurosurgeons on a life-threatening basis of patient illness. We consider this guideline will help neurosurgeons for the appropriate triage of patients on a daily-situation basis during this pandemic.

**METHODS:** The Mexican Society of Neurological Surgery integrated a special COVID-19 guidelines Committee to develop a guideline based on a three-tier route to a consensus using a modified Delphi Method.

**RESULTS:** We found twenty-nine papers relating to surgical praxis recommendations since the COVID-19 outbreak in December 2019. Five reports made a classification for the priority of emergencies based on illness severity and the time that could be elapsed to provide surgical care to avoid becoming a life-threatening illness. From those, we chose the classification made in Lombardi, Italy related to oncology patients in neurosurgery (Table 1). We adapted the Lombardy Classification to all neurosurgical specialties (Table 2). Appendix 1 shows tables universally applying the modified Lombardy classification to each of the neurosurgical subspecialties. Six papers gave specific recommendations on surgical room setting and personal equipment protection. We made a summary of recommendations in Appendix 2. we recommend adding a compliment to the informed consent of the surgical procedure relating to the COVID-19 outbreak. This complement can be consulted in Appendix 3.

**CONCLUSIONS:** We present the following recommendations provided that we are in a very early stage of the illness knowledge, and further research is needed to increase the certainty of recommendations. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records.

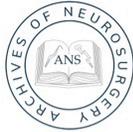


Table 2. The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) [Modified classification for universal neurosurgical application from the priority criteria used for neurosurgical patients dealing with oncological pathology in Lombardy, Italy by Zoia et al. here referred as the Lombardy Classification; adapted with permission from Springer Nature® from Zoia et al. [14]].

- 1) PANDEMIC PRIORITY LEVEL-1 (PPL-1), illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.
- 2) PANDEMIC PRIORITY LEVEL-2 (PPL-2), illness requiring (or) urgent surgical procedure, to be performed within a week\*§ because of potentially life-threatening risk or progressive neurological deficit.
- 3) PANDEMIC PRIORITY LEVEL-3 (PPL-3), illness requiring (or) prioritized surgical procedure, to be performed within a month\*\*§ because of neurological deficit and functional risk.
- 4) PANDEMIC PRIORITY LEVEL 4 (PPL-4), any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ¶§.

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

\*\*PPL-3 patients must be re-evaluated and reclassified every two weeks, and should be managed ambulatory.

¶ PPL-4 patients should be provided with a scheduled follow-up at the discretion of the attending neurosurgeon with proper counseling to identify neurological symptoms that require emergent re-evaluation of illness priority during the pandemic.

§Patients must be re-evaluated and reclassified any time as required by aggravating illness, neurological progressive deterioration or any other patient characteristics urging its treatment.

¶ The use of personal equipment protection (PEP) including an N95 or KN95 mask, goggles, and a sterile biosafety full coverage suit is mandatory for all the personnel involved in the surgical treatment of patients confirmed or suspected to have infection by the pandemic infectious agent.

14. Zoia C, Bongetta D, Veiceschi P, Cenozato M, Di Meo F, Locatelli D, et al. Neurosurgery during the COVID-19, pandemic: update from Lombardy, northern Italy [Internet]. *Acta Neurochir (Wien)*; 2020. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/32222820>. License Number 4845680813443

## Keywords

COVID-19, SARS-CoV2, neurosurgery guideline, AGREE Statement, Surgical Room recommendations, Personal Protection Equipment recommendations, Triage recommendations

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## Cover Page Footnote

Authors declare no conflict of interest. No Funding was received. We have permission for reprint the Lombardi Classification from Springer Nature, and to adapt it and publish the modified version in Archives of Neurosurgery as in open access. The documentation is Provided as adjunct files.

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# Neurosurgical Praxis Guidelines During the COVID-19 Outbreak. Consensus-based on Currently Available Literature<sup>☆</sup>

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<sup>☆</sup> We have permission for reprint the Lombardy Classification from Springer Nature, and to adapt it and publish the modified version in Archives of Neurosurgery as in open access. License Number 4845680813443.

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## Abstract

**Introduction:** The World Health Organization recommended several strategies to contain the COVID-19 pandemic, including optimization of care for all patients, especially the seriously ill. Given the strain, the pandemic has posed on healthcare systems around the world, many neurosurgical associations have provided triage recommendations for patients to save resources for the pandemic. We aimed to provide practical recommendations based on specific illnesses requiring surgical procedures commonly performed by neurosurgeons on a life-threatening basis of patient illness. We consider this guideline will help neurosurgeons for the appropriate triage of patients on a daily-situation basis during this pandemic.

**Methods:** The Mexican Society of Neurological Surgery integrated a special COVID-19 guidelines Committee to develop a guideline based on a three-tier route to a consensus using a modified Delphi Method.

**Results:** We found twenty-nine papers relating to surgical praxis recommendations since the COVID-19 outbreak in December 2019. Five reports made a classification for the priority of emergencies based on illness severity and the time that could be elapsed to provide surgical care to avoid becoming a life-threatening illness. From those, we chose the classification made in Lombardy, Italy related to oncology patients in neurosurgery (Table 1). We adapted the Lombardy Classification to all neurosurgical specialties (Table 2). Appendix 1 shows tables universally applying the modified Lombardy classification to each of the neurosurgical subspecialties. Six papers gave specific recommendations on surgical room setting and personal equipment protection. We made a summary of recommendations in Appendix 2. We recommend adding a compliment to the informed consent of the surgical procedure relating to the COVID-19 outbreak. This complement can be consulted in Appendix 3.

**Conclusions:** We present the following recommendations provided that we are in a very early stage of the illness knowledge, and further research is needed to increase the certainty of recommendations. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records.

**Keywords:** COVID-19, SARS-CoV2, Neurosurgery guideline, AGREE Statement, Surgical room recommendations, Personal protection equipment recommendations, Triage recommendations

## 1. Background

The World Health Organization (WHO) recognized the COVID-19 outbreak as a pandemic on March 11, 2020 [1]. This organism recommended several strategies to contain the disease, including optimization of care for all patients, especially the seriously ill [2]. Given the strain, the pandemic has

### Abbreviations

COVID-19	Coronavirus Disease 19
CSF	Cerebrospinal Fluid
NOM	Official Mexican Norm
RT	Radiotherapy
SARS-CoV2	Severe Acute Respiratory Syndrome by Coronavirus 2
SSA	Health Secretary of Mexico
WHO	World Health Organization

posed on healthcare systems around the world [1], many neurosurgical associations (among other specialties) have provided triage recommendations for patients to save resources for the pandemic [3–8]. As a result, emergency surgeries were prioritized over elective surgeries in a life-threatening stratification of illnesses. Nevertheless, priority criteria were non-standardized over the associations. We aimed to provide practical recommendations based on specific illnesses requiring surgical procedures commonly performed by neurosurgeons on a life-threatening basis of patient illness. We consider this guideline will help neurosurgeons for the appropriate triage of patients on a daily-situation basis during this pandemic.

## 2. Methods

The Mexican Society of Neurological Surgery proposed to develop these guidelines based on currently available information since starting of the COVID-19 outbreak. To meet this purpose, the President of the Society urged for the formation of a Special COVID-19 guidelines Committee integrated by the Presidents (leaders) of the different sections (specialties) and members of the Advisory, Scientific, and Directive Committees of the Society. A three-tier route to consensus was made in this modified Delphi Method. The first stage included a comprehensive review of current literature since the initial COVID-19 Outbreak in December 31st, 2019 to June 1st, 2020, carried out by each of the members conforming to the Special COVID-19 guidelines committee. Consulted databases included PubMed and Google® Scholar; specific medical, surgical and neurosurgical association websites were also consulted (including the World health organization, The American Association of Neurological Surgeons, The American College of Surgeons, The European Association of Neurological Surgeons); other medical association websites consulted were the result of searching COVID-19 guidelines on common search engines such as Google® (provided that some guidelines are only published in medical association websites and not in scientific journals); those sites are cited in references. The search words included COVID-19, SARS-CoV2, COVID-19 outbreak, COVID-19 pandemic, triage recommendations, neurosurgery practice guidelines, surgical recommendations, subspecialty (spine, pediatrics, functional neurosurgery, oncology, radiosurgery, vascular, epilepsy, endovascular surgery recommendations, surgical room recommendations, personal equipment protection recommendations,

surgical safety recommendations, and the different combinations among them. The second tier included a symposium to discuss gathered information to agree on the crucial point of the guidelines, including a position on a recommendation to defer or continue elective surgery, triage protocol for patient care, a classification system for staging priority of emergencies, optimal surgical room setting up during outbreak and protection equipment recommendations during the outbreak. The third tier included using the selected classification method to allocate subspecialty illnesses and procedures in each category. It will help decide whether to proceed or defer neurosurgical care based on the patient's needs and severity while protecting patients and physicians from unneeded exposure until the outbreak is contained. After completing the three-tier consensus, a manuscript containing a summary of information was developed and made readily available for all members while this paper was published. The current guidelines adhere to the AGREE statement [9].

## 3. Results

We found twenty-nine papers [4–8,10–33] relating to surgical praxis recommendations since the COVID-19 outbreak in December 2019. Five reports [4,13,14,17,31] made a classification for the priority of emergencies based on illness severity and the time that could be elapsed to provide surgical care to avoid becoming a life-threatening illness. From those, we chose the priority criteria used for neurosurgical patients dealing with oncological pathology made in Lombardy, Italy by Zoia et Al., here referred as the Lombardy Classification [14] (Table 1). We adapted (with permission from Springer Nature®) the Lombardy Classification by Zoia et al. [14] to all neurosurgical specialties resulting in the classification for

Table 1. Priority criteria used for neurosurgical patients dealing with oncological pathology in Lombardy, Italy by Zoia et al. (here referred as the Lombardy Classification) reproduced with permission from Springer Nature from Zoia et al. [14].

Dealing with oncological pathology, priority criteria have been defined:

- 1) Class A ++ (requiring immediate treatment): patients with intracranial or spinal oncological pathology that need emergency treatment (rapidly evolving intracranial hypertension with deteriorating state of consciousness, acute hydrocephalus, spinal cord compression with rapid tetra- or paraparesis).
- 2) Class A + (requiring treatment within a maximum of 7-10 days): patients with oncological pathology (intracranial tumors with mass effect or with progressive neurological deficit, without deterioration of consciousness).
- 3) Class A (requiring treatment within a month): patients with oncological neurosurgical pathology that appears radiologically of suspected malignant nature or with oncological pathology that determines a neurological deficit.

Table 2. The classification for Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) [Modified classification for universal neurosurgical application from the priority criteria used for neurosurgical patients dealing with oncological pathology in Lombardy, Italy by Zoia et al. here referred as the Lombardy Classification; adapted with permission from Springer Nature® from Zoia et al. [14]].

- 1) PANDEMIC PRIORITY LEVEL-1 (PPL-1), illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.
- 2) PANDEMIC PRIORITY LEVEL-2 (PPL-2), illness requiring (or) urgent surgical procedure, to be performed within a week\*§ because of potentially life-threatening risk or progressive neurological deficit.
- 3) PANDEMIC PRIORITY LEVEL-3 (PPL-3), illness requiring (or) prioritized surgical procedure, to be performed within a month\*\*§ because of neurological deficit and functional risk.
- 4) PANDEMIC PRIORITY LEVEL 4 (PPL-4), any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ¶§.

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

Ø PPL-4 patients should be provided with a scheduled follow-up at the discretion of the attending neurosurgeon with proper counseling to identify neurological symptoms that require emergent re-evaluation of illness priority during the pandemic.

§Patients must be re-evaluated and re-classified any time as required by aggravating illness, neurological progressive deterioration or any other patient characteristics urging its treatment.

¥ The use of personal equipment protection (PEP) including an N95 or KN95 mask, goggles, and a sterile biosafety full coverage suit is mandatory for all the personnel involved in the surgical treatment of patients confirmed or suspected to have infection by the pandemic infectious agent.

Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) (Table 2). Appendix 1 shows tables applying the PANDEMIC Classifications to each of the neurosurgical subspecialties; additional references were consulted to correctly prioritize illnesses on each of the tables [34–68]. Other specific cases, not mentioned in these tables, but potentially life-threatening or at functional risk, are left to be classified at the discretion of the treating neurosurgeon. Elective procedures are to be re-scheduled under surveillance up until the outbreak is controlled. The current guidelines apply to every patient, either if the patient's test results COVID-19 positive or negative; this is in accordance to protect patients and physicians from unneeded exposure, every specific case should be revised by the attending neurosurgeon, who has the ultimate decision.

Six papers [15,24–28] gave specific recommendations on surgical room setting and personal equipment protection. We made a summary of recommendations in Appendix 2.

Finally, performing an emergent surgery in a patient theoretically increases the risk of COVID-19 infection by immunocompromise if exposed. Given that our country does not perform broad screening and that a significant number of people are asymptomatic, we consider this issue to be of utmost importance. Besides, even if broad screening were performed, it would represent a transversal screening, and status could change unnoticed overtime. To solve this issue, we recommend adding a compliment to the informed consent of the surgical procedure relating to the

COVID-19 outbreak. This complement can be consulted in Appendix 3.

Our main limitation is represented by the early stage of the outbreak and the knowledge we have about COVID-19. The current guidelines follow the WHO recommendations to contain the outbreak and provide optimization of care to those severely ill, aiming to avoid unnecessary exposure and collapse of the healthcare systems. The present guidelines will serve as a cornerstone to fight the pandemic while increasing knowledge is gathered. Further research on the socioeconomic and health impact of COVID-19 will help increase the certainty and precision of the recommendations provided, as well as to provide updates in case required as the outbreak is contained or the WHO recommendations change. To counter these limitations, we submitted the manuscript to peer-review under the journal reviewing process.

The guideline is intended to be used in a voluntary basis, by no means it represents a mandatory application. Institutions are encouraged to review the guidelines and use them under their own responsibility, and understanding it is based on the very little knowledge we have about COVID-19 disease provided that we are in an early stage of the pandemic. Therefore, no monitoring auditing criteria to its application is provided.

#### 4. Conclusions

We present the following recommendations provided that we are in a very early stage of the illness knowledge, and further research is needed

to increase the certainty of recommendations. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records.

### Conflicts of interest

Authors declare no conflict of interest.

### Funding

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### Publication comment

#### *Publication comment # 1*

The COVID-19 disease has undoubtedly changed many paradigms regarding communal life. Today we realize that interdependence is the fuel that allows the growth and development of all the societies, from families to countries and continents. The home confinement to which the SARS COV-2 virus has forced us has stopped the economic, social, scientific, and global growth. This situation has also affected the quality of medical care. Firstly, due to hospitals saturation by patients suffering from this terrible disease, and secondly, due to the risk of continuing to spread it when medically treating asymptomatic infected patients suffering from other problems.

For all of the above, precise rules must be established to know which conditions have priority to be treated in these difficult times. The Mexican Society of Neurological Surgery, led by its president, Dr. José Antonio Soriano Sánchez, presents in this valuable article, the guidelines that all neurosurgeons must follow when facing patients during this pandemic. The work is based on a meticulous review of international publications in this regard, but faithfully adapting it to our reality. It is essential to add that regardless of whether doctors follow these

guidelines, they must always have the appropriate equipment to protect themselves. A sick doctor not only represents a great individual health threat but also means one less warrior that could help more people in this brutal fight against the pandemic.

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#### *Publication comment #2*

“...I read with great interest the manuscript by Soriano Sánchez and colleagues “Neurosurgical Praxis Guidelines during the COVID-19 Outbreak. Consensus-based on currently available literature”. With these guidelines, the Mexican Society of Neurological Surgery supplied compelling insights to neurosurgeons on a broad range of illnesses about the decision making that is required during the current worldwide health crisis. This article provides relevant information about the management of neurosurgical patients during the COVID-19 pandemic, not only to health professionals as individuals but at the level of institutions and related societies. Although the guidelines are based on the Lombardi classification, the guidelines proposed by Soriano Sánchez et al. provide a larger number of recommendations based on a more detailed description of neurosurgical subspecialties than the precedent classification. I am certain that these guidelines will prove to be helpful not only during the current sanitary situation but also in future medical emergencies and disasters.

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## APPENDIX 1

**Spine surgery.** The classification for Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) applied to Spine Surgery, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.	<ul style="list-style-type: none"> <li>• Rapidly progressive~ and/or acute myelopathy of any cause: (infection, tumor, fracture, deformity and/or herniated disc)</li> <li>• Cauda equina syndrome from any cause: (infection, tumor, fracture and/or herniated disc)</li> <li>• Acute radiculopathy with a motor deficit of any cause: (infection, tumor, fracture and/or herniated disc)</li> <li>• Spine instability at risk of causing neurological injury from any cause: (traumatic, tumor and/or infectious)</li> <li>• Acute or unstable fractures (osteoporosis/metastatic) with neurological deterioration, and/or intractable pain refractory to medical treatment)</li> <li>• Epidural abscess that requires surgical decompression.</li> <li>• Surgical, deep, and/or dehiscent wound infections with soft tissue involvement or systemic spread of infection.</li> <li>• Acute osteomyelitis/discitis with negative blood culture and positive acute phase reactants</li> <li>• Cerebrospinal fluid fistula</li> <li>• Immediate postsurgical complications with neurological deterioration or intractable pain refractory to medical and/or algological treatment.</li> <li>• All types of Spinal Trauma</li> </ul>
PANDEMIC PRIORITY LEVEL-2 (PPL-2) *§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.	<ul style="list-style-type: none"> <li>• Chronic cervical or thoracic myelopathy with neurological progression of any cause: (tumor, traumatic and/or degenerative)</li> <li>• Spinal infection (eg, discitis, osteomyelitis, epidural abscess) that does not respond to medical treatment</li> <li>• Compression of neural structures with or without deformity (scoliosis with a neurological deficit (distinguished from “severe neurological deficit” that is classified as PPL-1)</li> <li>• Intractable pain associated with functional limitation and/or excessive opioid use (herniated disc, fractures and/or progressive deformity).</li> </ul>
PANDEMIC PRIORITY LEVEL-3 (PPL-3) **§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.	<ul style="list-style-type: none"> <li>• Degenerative diseases of the spine associated with pain and functional limitation susceptible to post-contingency management (herniated disc, spinal stenosis, spondylolisthesis)</li> <li>• Revision surgery in patients with pain that responds to algological medical treatment. (failed lumbar surgery, adjacent segment disease)</li> <li>• Deformity correction surgery (scoliosis, kyphosis)</li> </ul>
PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> <li>~ the loss of toilet training, provides poor functional prognosis.</li> </ul>

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

ø PPL-4 patients should be provided with a scheduled follow-up at the discretion of the attending neurosurgeon with proper counseling to identify neurological symptoms that require emergent re-evaluation of illness priority during the pandemic.

§ Patients must be re-evaluated and re-classified any time as required by aggravating illness, neurological progressive deterioration or any other patient characteristics urging its treatment.

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**Functional, epilepsy and peripheral nerve surgery.** The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) applied to Functional Epilepsy and Peripheral Nerve Surgery, provided in relation to the COVID-19 pandemic. Neuroendoscopy. The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) applied to Neuroendoscopy, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.	<ul style="list-style-type: none"> <li>• Super-refractory multifocal status epilepticus</li> <li>• Super-refractory focal status epilepticus</li> <li>• Continuous partial epilepsy</li> <li>• Status epilepticus of febrile infection related to an epileptic syndrome</li> <li>• Hardware infection</li> <li>• Sudden battery failure</li> <li>• Traumatic plexus injury</li> <li>• Open traumatic injuries of peripheral nerves</li> </ul>
PANDEMIC PRIORITY LEVEL-2 (PPL-2) *§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.	<ul style="list-style-type: none"> <li>• Stereostatic biopsies</li> <li>• Disconnection and lesion surgeries for epilepsy</li> </ul>
PANDEMIC PRIORITY LEVEL-3 (PPL-3) **§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.	<ul style="list-style-type: none"> <li>• Parkinson's, abnormal movements</li> <li>• Psychosurgery</li> <li>• Non-lesional epilepsy surgery</li> <li>• Plexus Exploration</li> </ul>
PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

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\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

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**Neuroendoscopy.** The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) applied to Neuroendoscopy, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.	<ul style="list-style-type: none"> <li>• Hydrocephalus</li> <li>• Syringobulbia/syringomyelia with progressive neurological deterioration</li> <li>• Ventricular shunt dysfunction</li> <li>• Ependymitis</li> </ul>

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*(Neuroendoscopy continued)*

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
	<ul style="list-style-type: none"> <li>• Germinal matrix hemorrhage</li> <li>• Intraventricular hemorrhage in adults</li> <li>• Endoscopic assistance in intraventricular tumors with or without hydrocephalus.</li> <li>• Intra-sellar tumors with a risk of death or loss of the mink</li> <li>• Migrated or lateral spinal hernias with neurological deficit or excessive symptoms</li> </ul>
PANDEMIC PRIORITY LEVEL-2 (PPL-2) *§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.	• N/A
PANDEMIC PRIORITY LEVEL-3 (PPL-3) **§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.	• Endoscopic assistance in tumors without mass effect or neurological deterioration.
PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§	• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.

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**Neurotrauma.** The classification for Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) applied to Neurotrauma, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.	<ul style="list-style-type: none"> <li>• Acute subdural hematoma <ul style="list-style-type: none"> <li>○ Thickness &gt;10 mm</li> <li>○ Midline deviation &gt; 5 mm</li> <li>○ Midline deviation of &lt;5 mm and thickness of &lt;10 mm accompanied by 2-point Glasgow impairment in 1 h</li> <li>○ Asymmetric pupils</li> <li>○ Fixed and dilated pupils</li> <li>○ Intracranial pressure &gt;20 mmHg</li> </ul> </li> <li>• Subacute and chronic subdural hematoma</li> <li>• Patients with a subacute or chronic subdural hematoma of any thickness that causes a mass-effect, midline displacement or neurological signs and symptoms</li> <li>• Epidural hematoma</li> <li>• Glasgow Coma Scale &lt;8 and anisocoria</li> </ul>

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(Neurotrauma continued)

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
	<ul style="list-style-type: none"> <li>• Hematoma volume &gt; 30 cm<sup>3</sup></li> <li>• Hematoma volume of &lt;30 cm<sup>3</sup> accompanied by               <ul style="list-style-type: none"> <li>○ Thickness &gt; 15 mm</li> <li>○ Midline deviation &gt; 5 mm</li> <li>○ Glasgow equal to or less than 8</li> <li>○ Motor deficit</li> </ul> </li> <li>• Absence of cisterns at the base</li> <li>• 2-point Glasgow decline in 1 h</li> <li>• Intraparenchymal hematoma</li> <li>• Frontal or temporary hematoma with a volume greater than 20 cm<sup>3</sup> associated with:               <ul style="list-style-type: none"> <li>○ Glasgow Coma Scale from 6 to 8 points</li> <li>○ Midline offset greater than 5 mm</li> <li>○ Compression of the mesencephalic cisterns</li> </ul> </li> <li>• Any injury with a volume greater than 50 cm<sup>3</sup></li> <li>• Temporal lobe hematoma greater than 30 ml with or without deviation from the midline</li> <li>• Sinking fracture</li> <li>• Presence of open and depressed fracture in a baby or child</li> <li>• Depression of the fracture segment greater than 5 mm below the internal theca in an adult patient</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-2 (PPL-2)</p> <p>*§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.</p>	<ul style="list-style-type: none"> <li>• Asymptomatic chronic subdural hematoma without midline deviation.</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-3 (PPL-3)</p> <p>**§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.</p>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-4 (PPL-4)</p> <p>∅§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ∅§</p>	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

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**Radioneurosurgery.** The classification for Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) applied to Radioneurosurgery, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.	<ul style="list-style-type: none"> <li>• Brain metastases of any cranial origin and location, including ocular (melanomas, ocular micrometastases) in the context that are highly symptomatic and have a life expectancy greater than 3-6 months.</li> <li>• Spinal metastasis (any origin) that generates compression symptoms that are not a candidate for surgery.</li> <li>• Palliation of pain in spinal metastases that do not respond to pain relievers prescribed by pain clinic for a reasonable amount of time (joint management with pain clinic) including pain from (any origin) multiple myeloma with a life expectancy greater than 3 or 6 months.</li> <li>• For pain relief in cancer patients with a thalamotomy or hypophysectomy procedure.</li> <li>• Anaplastic gliomas and glioblastomas (including recurrences)</li> <li>• Pituitary adenomas with malignant transformation</li> <li>• Anaplastic meningiomas</li> <li>• Anaplastic ependymomas</li> <li>• Malignant pediatric pathology (glioblastomas, medulloblastomas, ependymomas grade III)</li> <li>• Cranial and spinal malignant bone tumors. (boost &amp; RT) with aggressive behavior and rapid growth. (Individualize case)</li> </ul>
PANDEMIC PRIORITY LEVEL-2 (PPL-2) *§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.	<ul style="list-style-type: none"> <li>• Low-grade gliomas that are considered, in a rigorous evaluation, to be treated for aggressive behavior. (including recurrences)</li> <li>• Uncontrolled trigeminal neuralgia with multiple medications for a prolonged period of time (individualize case)</li> </ul>
PANDEMIC PRIORITY LEVEL-3 (PPL-3) **§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

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\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

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**Cerebrovascular surgery and/or endovascular therapy.** The classification for Priority Associated with Neurosurgical illnesses During pandemics (The PANDEMIC Classification) applied to Cerebrovascular Surgery and/or Endovascular Therapy, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
<p>PANDEMIC PRIORITY LEVEL-1 (PPL-1)</p> <p>illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.</p>	<ul style="list-style-type: none"> <li>• Aneurysmal subarachnoid hemorrhage</li> <li>• Intracranial hemorrhage of any cause with mass effect and progressive neurological deterioration:                             <ul style="list-style-type: none"> <li>○ Arterial hypertension</li> <li>○ Arteriovenous malformation</li> <li>○ Dural fistula</li> <li>○ Pial Fistula</li> <li>○ Cavernous Angioma</li> </ul> </li> <li>• Cerebral Infarction with the need for decompression (within the first 48 h and with Glasgow greater than 8 in a patient younger than 65 years)</li> <li>• Carotid or vertebral vascular dissection</li> <li>• Open and/or Interventional thrombectomy</li> <li>• Cerebral infarction in A period of reperfusion</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-2 (PPL-2)</p> <p>*§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.</p>	<ul style="list-style-type: none"> <li>• Unruptured intracranial aneurysms with alarm data such as headache, chronic headache, or blebs.</li> <li>• Unruptured Arteriovenous malformations with intranidal aneurysm, drainage vein stenosis</li> <li>• Incidental posterior fossa aneurysm</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-3 (PPL-3)</p> <p>**§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.</p>	<ul style="list-style-type: none"> <li>• Arteriovenous malformations with:                             <ul style="list-style-type: none"> <li>○ Epilepsy difficult to control</li> <li>○ Limited but recurrent bleeding.</li> </ul> </li> <li>• Pial and dural arteriovenous fistulas with flow theft that conditions rapidly progressive deterioration of functions.</li> <li>• Incidental intracranial aneurysms without symptoms.</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-4 (PPL-4)</p> <p>∅§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ∅§</p>	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

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**Neuro-oncology.** The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) applied to Neurooncology, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
<p>PANDEMIC PRIORITY LEVEL-1 (PPL-1)</p> <p>illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.</p>	<ul style="list-style-type: none"> <li>• Gliomas with a high degree of malignancy (III or IV) and/or metastasis with clinical data of acute intracranial hypertension and facial-caudal deterioration, or those with evidence of imaging herniation with or without symptoms.</li> <li>• Benign or malignant tumors with data of acute intracranial hypertension and facial-caudal deterioration or those patients with data of image herniation with or without symptoms.</li> <li>• Pituitary adenoma with tumor apoplexy and sudden loss of sight in one or both eyes and/or acute neurological deficit (paralysis of cranial nerves III, IV, or VI). It is recommended in the case of being COVID-19 positive or if there is doubt that it is, DO NOT perform endoscopic approaches. Craniotomy or sublabial, transeptal, transsphenoidal approach with the use of a microscope is recommended. The use of high-speed milling systems by the transnasal route is not recommended. Endoscopic approaches are recommended only if it is certain that the patient is COVID-19 negative.</li> <li>• Single or multiple brain abscess, subdural empyema or hydrocephalus secondary to valve dysfunction with or without suspected ependymitis.</li> <li>• Patients with a post-surgical, post-traumatic, or spontaneous high-output cerebrospinal fluid fistula that did not resolve with conservative measures.</li> <li>• Any immediate post-surgical complication that causes acute neurological impairment or a new neurological deficit.</li> <li>• Skull base tumors that compress the brainstem and/or cause a progressive neurological deficit or compromise the function of the cranial nerves.</li> <li>• Craniofacial tumors that compromise the airway and invade the paranasal sinuses with respiratory distress should be operated immediately, with all the protective measures for medical-surgical personnel, even if the COVID-19 result is not yet available.</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-2 (PPL-2)</p> <p>*§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.</p>	<ul style="list-style-type: none"> <li>• Gliomas with a high degree of malignancy (III or IV) or metastasis with rapid growth, whether or not they have a neurological deficit, as well as cerebral edema that must be managed before entering surgery but cannot wait three weeks for resolution.</li> <li>• Pituitary tumors with a rapidly progressive visual deficit with or without complete compression of the third ventricle and secondary compensated hydrocephalus. Except in cases where it is suspected or is certain that it is Prolactinoma, in which case only hydrocephalus will resolve. It is recommended in the case of being COVID-19 positive or if there is doubt that it is, DO NOT perform endoscopic approaches. Craniotomy or sublabial, transeptal, transsphenoidal approach with the use of a microscope is recommended. The use of high-speed milling systems by the transnasal route is not recommended. Endoscopic approaches are recommended only if it is certain that the patient is COVID-19 negative.</li> <li>• Posterior fossa tumors with obstruction of cerebrospinal fluid circulation with or without secondary hydrocephalus or with significant mass effect on the brainstem with or without neurological deterioration, mainly cystic tumors, except for the epidermoid tumor.</li> <li>• Ventricular tumors that cause obstruction of the circulation of the cerebrospinal fluid and/or cause hydrocephalus. Solve hydrocephalus urgently and study the patient to schedule surgery for tumor resection.</li> <li>• Ventricular tumors that produce mass-effect, alteration of the neurological state, and compromise the diencephalon, the midbrain</li> </ul>

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(Neuro-oncology continued)

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
	<p>or the IV ventricle. If hydrocephalus is caused, it will be resolved urgently, and the patient must be studied to schedule surgery for tumor resection.</p> <ul style="list-style-type: none"> <li>• Patient with a post-surgical, post-traumatic, or spontaneous low-output cerebrospinal fluid fistula that did not resolve with conservative measures.</li> <li>• Infection or dehiscence of surgical wound.</li> <li>• Craniofacial tumors that compromise the airway and invade the paranasal sinuses without respiratory distress should be operated only once the negative COVID-19 test is obtained.</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-3 (PPL-3) **§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.</p>	<ul style="list-style-type: none"> <li>• Skull base tumors that cause disabling pain such as trigeminal neuralgia, and the patient does not respond to any medical treatment or radiosurgery.</li> <li>• Patient with low-flow spontaneous or posttraumatic cerebrospinal fluid fistula that is active only intermittently.</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§</p>	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as inpatients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

Ø PPL-4 patients should be provided with a scheduled follow-up at the discretion of the attending neurosurgeon with proper counseling to identify neurological symptoms that require emergent re-evaluation of illness priority during the pandemic.

§Patients must be re-evaluated and re-classified any time as required by aggravating illness, neurological progressive deterioration or any other patient characteristics urging its treatment.

¥ The use of personal equipment protection (PEP) including an N95 or KN95 mask, goggles, and a sterile biosafety full coverage suit is mandatory for all the personnel involved in the surgical treatment of patients confirmed or suspected to have infection by the pandemic infectious agent.

**Pediatrics neurosurgery.** The classification for Priority Associated with Neurosurgical illnesses During pandEMICs (The PANDEMIC Classification) applied to Peaditrics Neurosurgery, provided in relation to the COVID-19 pandemic.

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
<p>PANDEMIC PRIORITY LEVEL-1 (PPL-1) illness requiring (or) emergent surgical procedure, to be performed within 24 h because of life-threatening risk.</p>	<ul style="list-style-type: none"> <li>• Of the newborn at term and preterm.</li> <li>• Broken myelomeningocele (includes myeloschisis).</li> <li>• Posthemorrhagic hydrocephalus of prematurity with rapidly progressive growth of the cephalic girth.</li> <li>• Congenital hydrocephalus. With head circumference equal to or greater than 45 cm</li> <li>• Other symptomatic hydrocephalus or cerebrospinal fluid collections with signs and symptoms of intracranial hypertension.</li> <li>• Acute hydrocephalus of etiology to be determined.</li> <li>• Obstructive hydrocephalus, secondary to midline tumor (anterior, middle, or posterior fossa).</li> </ul>

(continued on next page)

*(Pediatrics neurosurgery continued)*

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
	<ul style="list-style-type: none"> <li>• Hydrocephalus secondary to valve dysfunction.</li> <li>• Post-traumatic or post-infectious hygromas, with a thickness greater than 10 mm, that produce symptoms and signs of intracranial hypertension.</li> <li>• Broken arachnoid cysts with acute intracystic bleeding that condition symptoms and signs of intracranial hypertension</li> <li>• Cranioencephalic trauma               <ul style="list-style-type: none"> <li>○ Acute, subacute, or chronic subdural hematomas greater than 10 mm, with midline deviation and producing symptoms and signs of intracranial hypertension.</li> <li>○ Epidural hematoma: Glasgow modified for the pediatric patient &lt;12 points, with anisocoria and/or hemiparesis, thickness &gt; 10 mm with deviation of midline structures, hemoglobin depletion &lt;12 gr.</li> <li>○ Exposed skull fracture c/without CSF fistula or exposure of brain tissue.</li> <li>○ Sunken fracture greater than &gt; 5 mm</li> </ul> </li> <li>• Vascular               <ul style="list-style-type: none"> <li>○ Parenchymal hematoma secondary to rupture of arteriovenous malformation with a deviation of midline or aneurysmal structures</li> </ul> </li> <li>• Neuro-oncology               <ul style="list-style-type: none"> <li>○ Tumors of the posterior fossa that condition the displacement of the brain stem. Except for brainstem gliomas and other midline gliomas.</li> <li>○ Tumors in the cerebral hemispheres that due to their volume (&gt;3 or 4 cm in diameter), or perilesional edema produce a deviation of the structures of the midline with neurological deficit and/or intracranial hypertension. Except for midline gliomas (hypothalamic, visual or thalamic).</li> </ul> </li> <li>• Pediatric column               <ul style="list-style-type: none"> <li>○ Fracture with or without vertebral dislocation with spinal compression that conditions neurological deficit.</li> <li>○ Intra-spinal tumors that condition intra or extramedullary medullary compression, with progressive neurological deterioration (progressive decrease in the strength of the lower extremities and/or urinary retention secondary to the neuropathic bladder) that puts the function at risk.</li> </ul> </li> <li>• Infections               <ul style="list-style-type: none"> <li>○ Infected surgical wounds</li> <li>○ Subdural empyema</li> <li>○ c) Brain abscess equal to or greater than 3 cm in diameter.</li> </ul> </li> </ul>
<p>PANDEMIC PRIORITY LEVEL-2 (PPL-2)</p> <p>*§ illness requiring (or) urgent surgical procedure, to be performed within a week*§ because of potentially life-threatening risk or progressive neurological deficit.</p>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
<p>PANDEMIC PRIORITY LEVEL-3 (PPL-3)</p> <p>**§ illness requiring (or) prioritized surgical procedure, to be performed within a month**§ because of neurological deficit and functional risk.</p>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>

*(continued on next page)*

(*Pediatrics neurosurgery continued*)

PANDEMIC CLASSIFICATION	ILLNESS/PROCEDURE
PANDEMIC PRIORITY LEVEL-4 (PPL-4) ø§ any illness not meeting the above criteria is considered an elective surgical procedure, and should be delayed under surveillance until the outbreak is controlled ø§	<ul style="list-style-type: none"> <li>• Illnesses requiring elective procedures are not specified. For specific situations not covered in this document, we encourage individual hospitals to trust in the local neurosurgeon criteria. Provided that situations and patient characteristics are highly variable, the local neurosurgeon will always have the last word in every case as he/she is in close contact with the patient and its medical records to properly classify the priority.</li> </ul>

\*PPL-2 patients must be offered surgical treatment as soon as possible according to hospital capacity and should be managed as in-patients. In the case that no surgical treatment has been provided within a week, the patient must be re-evaluated and re-classified either as Class PPL-1 or PPL-2 according to the current medical status. At the discretion of the attending neurosurgeon when no surgical treatment is expected to be provided soon, certain PPL-2 patients can be managed as outpatient provided that treatment is not affected, appropriate follow-up and counseling about when to seek emergent care is given, the morbidity risk does not increase, and no factors that prevent proper surveillance are identified (for example, living alone with no caregiver or family member to provide in-home surveillance, limited access to the healthcare system, suspecting difficulty following the medical recommendations provided, among other causes).

\*\*PPL-3 patients must be re-evaluated and re-classified every two weeks, and should be managed ambulatory.

Ø PPL-4 patients should be provided with a scheduled follow-up at the discretion of the attending neurosurgeon with proper counseling to identify neurological symptoms that require emergent re-evaluation of illness priority during the pandemic.

§Patients must be re-evaluated and re-classified any time as required by aggravating illness, neurological progressive deterioration or any other patient characteristics urging its treatment.

¥ The use of personal equipment protection (PEP) including an N95 or KN95 mask, goggles, and a sterile biosafety full coverage suit is mandatory for all the personnel involved in the surgical treatment of patients confirmed or suspected to have infection by the pandemic infectious agent.

## APPENDIX 2

Bioprotection protocol in neurological surgery.  
For the pandemic COVID-19.

- 1) We are entering a phase of community transmission, where the number of daily tests performed is insufficient to meet our population needs. As a result, all patients with suggestive symptoms should be considered COVID-19 positive until proven otherwise and should apply all protective measures for positive patients, even without a confirmatory diagnosis. In the case of asymptomatic patients, all should be considered suspicious, and the protection measures listed below will also be taken, if possible.
- 2) It is recommended to reduce the activity and daily clinical practice to the minimum necessary and suspend scheduled activities such as consultation and elective surgeries, adhering to the classification of urgent surgeries in this COVID-19 pandemic as referred to on [appendix 1](#).

Patient care before and after operating room.

- 1) It is recommended to wear exclusive clothing for the hospital and change it when leaving the hospital.
- 2) Frequent cleaning of cell phones, pens, and other accessories should be carried out.
- 3) Inpatient care at a distance greater than 1.5 m away, a 3-layer mouthpiece must be used; under these circumstances, the use of the N95 NIOSH mask or NK95 is not necessary, nor the use of surgical gown and hat. If there is no contact with the patient or any potentially contaminated surface, the use of gloves is unnecessary.
- 4) When patient care with less than 1.5 m away is required (neurological exploration), full protection is advised. It is recommended to use N95 NIOSH/NK95 mouth covers, surgical or disposable gown (labeled with moderate or high protection barrier), cap, hermetic goggles, protection mask, and gloves (it is not necessary to use a second pair).
- 5) The gown must overlap enough at the back to ensure that it completely covers the entire surface of the body, especially the back, and take special care that when the person who wears it bends or sits down, it remains wholly covered at the rear.

- 6) The procedure for putting on and taking off Personal Protective Equipment (PPE) must be known. Personnel training is recommended in order to avoid contamination at the time of carrying out the procedure.
- 7) Full protective suits, while providing 360-degree protection, are recommended for personnel transporting patients. They should be very familiar with the process of removing the suit due to the increased risk of contamination.
- 8) Access to soap, sanitary napkins, and antibacterial gel should be widely available without limitations in all areas.
- 9) It is suggested not to wear a beard since the virus can remain there for up to 12 h, and the sealing of the masks is not adequate.

#### Care of the patient within the operating room.

- 1) All personnel must be trained and know the biosecurity measures.
- 2) An operating room and an exclusive anesthesia machine should be used for Covid-19 positive patients.
- 3) It should be ensured that an exhaustive cleaning protocol is carried out in the operating room at the end of the previous surgical procedure, with a waiting time of at least 30 min before using it.
- 4) Ideally, we recommend to have an operating room with negative pressure ventilation; however, we do not have this technology in many hospitals, so sufficient time should be left between cases for adequate air exchange, generally 30 min. In this situation, it is recommended that the room has a laminar flow that works properly, as well as a positive pressure system so that air movement occurs from the cleanest area to the least clean area. (from the inside out).
- 5) Clinical records and telephones should be left out of the operating room.
- 6) All devices used in the operating room (for example, a microscope or electrocautery) will be protected with disposable covers.
- 7) An exclusive circulating agent will be assigned outside the operating room to provide the required material through the whole procedure.
- 8) Avoid as far as possible to be less than 1.5 m from the patient when performing intubation and extubation of the patient. (All personnel not required for the said procedure must remain outside the room)
- 9) Clean the surface after the intubation process before continuing with the routine of the surgical procedure.
- 10) It is recommended to have the presence within the operating room of only the personnel necessary to carry out the surgical procedure. The personnel who will be inside (anesthesiologists, circulating nurses) move as little as possible to avoid forming air currents inside the operating room.
- 11) It is recommended to reduce to at most the procedures in which there is an emission of aerosol particles. To meet this goal, tracheotomies, access to the paranasal sinuses, endoscopic transsphenoidal procedures, drilling within or near the nasal cavity (cranial surgery at risk of opening paranasal sinuses), and the use electrocoagulation should be avoided as far as possible.
- 12) Carry out the usual hand washing before surgery and carry out hand washing at the end of the surgical procedure.
- 13) Use waterproof surgical clothing (fields and sheets) and disposable equipment (bipolar forceps and electrocautery cables) whenever possible.
- 14) Use standard PPE for patients with a high risk of contagiousness: waterproof surgical gown, hermetic goggles, and N95 NIOSH/NK95 surgical masks (without an exhalation valve). For surgical procedures, it is recommended to use a second pair of gloves to avoid contamination if they break.
- 15) Ensure adequate disposal of the surgical material used, the protective equipment, and the airways' material.
- 16) All personnel should bathe and change after the procedure.
- 17) These recommendations were developed in order to provide a management guide for Covid-19 patients undergoing Neurosurgical management.

### APPENDIX 3

Annex of informed consent for the risk of contagious of infecto-contagious diseases in specific COVID-19. (In accordance with nom 004/SSA3/2012).

Risks.

You are informed that during your hospital stay and during the time of your intervention, procedure and/or treatment that it is: \_\_\_\_\_,

You will be at risk of contracting COVID-19 due to the current pandemic. The COVID-19 illness, is the result of a highly contagious viral infection, a virus who was first reported in Wuhan, China and that has currently spread as a pandemic infection. It is characterized by fever, dry cough, headache, fatigue, runny nose, conjunctivitis, anosmia, dysgeusia, and in severe cases, respiratory distress. It has a mortality rate of 4–5% in the groups at higher risk due to complications and the clinical evolution of the infection. High-risk patients include people over 60 years-of-age, with associated comorbidity such as systemic arterial hypertension, diabetes mellitus, obesity, patients with immunosuppression, patients with treatments with immunosuppressants, smokers, patients with lung disease of any origin (COPD, asthma and others), among others. Young people or people of any age are not exempt from being in the 4–5% of this case fatality.

Frequency of complications.

Complications associated with COVID-19 infection.

1. Acute Respiratory Distress Syndrome from 15 to 33%, in children it develops faster. Average Probability
2. Acute Liver Damage from 14 to 53% of severe cases with elevated transaminases. Average Probability
3. Cardiovascular Complications: Low probability
4. Acute cardiac damage of 7–20% with elevated cardiac markers, patients without acute cardiac damage has a better prognosis.
5. Cardiomyopathy 33%.
6. Fulminant myocarditis, myopericarditis, cardiac tamponade.
7. Secondary Infections from 6 to 10%. Low probability
8. Acute Respiratory Failure in 8%. Low probability

It is the primary cause of mortality and is rapidly progressive in children.

1. Septic Shock from 4 to 8%. Low probability
2. Cytokine release syndrome. Low probability
3. Disseminated intravascular coagulation of 71% in patients who do not survive. Low probability
1. Rhabdomyolysis. Prognosis associated with COVID infection 19

General Mortality Rate: 5%.

Associated with comorbidities such as those mentioned bellow, it reaches 49%

1. Age: Over 60 years of age 6.4%
2. Diabetes Mellitus 7.3%
3. Lung or respiratory damage of 6.3%
4. Systemic Arterial Hypertension of 6%
5. Cancer of 5.6%
6. Cardiovascular disease 10.5%

The leading cause of death: Respiratory failure secondary to Acute Respiratory Distress Syndrome.

Prognosis based on the patient's clinical condition.

Poor prognosis factors:

1. Low albumin
2. High reactive C protein
3. Thrombocytopenia
4. Multi-organ failure.

I fully understand the information on COVID-19 disease, the risk of being infected, complications, prognosis, including its fatality. In accordance with NOM 004 / SSA3 / 2012, I do accept the procedure and/or treatment proposed for my disease.

\_\_\_\_\_  
Name and signature of the Patient or Legally Responsible Person

\_\_\_\_\_  
Name and signature of the reporting Physician

\_\_\_\_\_  
Name and signature of the Witness    Name and signature of the Witness

\_\_\_\_\_  
Place and date.

I fully understand the information on COVID-19 disease, the risk of being infected, complications, prognosis, including its fatality. In accordance with NOM 004 / SSA3 / 2012, I do not accept the procedure and/or treatment proposed for my disease.

\_\_\_\_\_  
Name and signature of the Patient or Legal Responsible

\_\_\_\_\_  
Name and signature of the reporting Physician

\_\_\_\_\_  
Name and signature of the Witness    Name and signature of the Witness

\_\_\_\_\_  
Place and date

## References

- [1] Guest JL, del Rio C, Sanchez T. The three steps needed to end the COVID-19 pandemic: bold public health leadership, rapid innovations, and courageous political will. *JMIR Public Heal Surveill* 2020;6(2):e19043.
- [2] [Internet] WHO. Critical preparedness , readiness and response actions for COVID-19. World Health Organization (WHO); 2020. p. 1–3. Available from: <https://apps.who.int/iris/rest/bitstreams/1272587/retrieve>.
- [3] Christopher M, Edward Bono, Dohring J, John G, Finkenberg MD, Ghogawala Zoher, et al. NASS guidance document on elective, emergent and urgent spine procedures and treatments [Internet]. North American Spine Society; 2020 [cited 2020 Apr 4]. p. 1–3. Available from: <https://www.spine.org/Portals/0/assets/downloads/Publications/NASSInsider/NASSGuidanceDocument040320.pdf>.
- [4] Siddiqui S. CMS adult elective surgery and procedures Recommendations: hospital with [Internet]. Cent medicare medicaid Serv; 2020. p. 19–20. Available from: <https://www.cms.gov/files/document/covid-elective-surgery-recommendations.pdf>.
- [5] American College of Surgeons. COVID-19: recommendations for management of elective surgical procedures [Internet]. American College of Surgeons; 2020 [cited 2020 Apr 10]. p. 2. Available from: [https://www.facs.org/-/media/files/covid19/recommendations\\_for\\_management\\_of\\_elective\\_surgical\\_procedures.ashx](https://www.facs.org/-/media/files/covid19/recommendations_for_management_of_elective_surgical_procedures.ashx).
- [6] American College of Surgeons. Covid 19 : elective case triage guidelines for surgical care [Internet] *Am Coll Surg* 2020;21. March 24:2020. Available from: [https://www.facs.org/-/media/files/covid19/guidance\\_for\\_triage\\_of\\_nonemergent\\_surgical\\_procedures.ashx](https://www.facs.org/-/media/files/covid19/guidance_for_triage_of_nonemergent_surgical_procedures.ashx).
- [7] Fraser JF, Arthur AS, Chen M, Levitt M, Mocco J, Albuquerque FC, et al. Society of NeuroInterventional Surgery recommendations for the care of emergent neurointerventional patients in the setting of covid-19. *J Neurointerventional Surg* 2020;1–3.
- [8] American Association of Neurological Surgeons. COVID-19 and neurosurgery [Internet] Available from: <https://www.aans.org/-/media/Files/AANS/Covid-19-And-Neurosurgery.ashx?la=en&hash=1F6A9799E251126284E480F7B76E884277E316E1>.
- [9] Brouwers MC, Kerkvliet K, Spithoff K. The AGREE Reporting Checklist: a tool to improve reporting of clinical practice guidelines [Internet] *BMJ* 2016;1–2. Mar 8;352:1152. Available from: <http://www.bmj.com/lookup/doi/10.1136/bmj.i1152>.
- [10] Nelson R. Guidelines on delaying cancer surgery during COVID-19 [Internet] *Medscape* 2020;1–14. Available from: <https://www.medscape.com/viewarticle/927568>.
- [11] Burke JF, Chan AK, Mummaneni V, Chou D, Lobo EP, Berger MS, et al. Letter: the Coronavirus disease 2019 global pandemic: a neurosurgical treatment algorithm. *0(0) Neurosurgery* 2020 Apr 3:1–7 [Internet] Available from: <https://academic.oup.com/neurosurgery/advance-article/doi/10.1093/neuros/nyaa116/5815125>.
- [12] Brindle ME, Gawande A. Managing COVID-19 in surgical systems [Internet] *Ann Surg* 2020 Jul;272(1):e1–2. Available from: [https://journals.lww.com/annalsofsurgery/Documents/Managing\\_COVID\\_in\\_Surgical\\_Systems\\_v2.pdf](https://journals.lww.com/annalsofsurgery/Documents/Managing_COVID_in_Surgical_Systems_v2.pdf).
- [13] Bono CM, Dohring EJ, Finkenberg JG, Ghogawala Z, Kauffmann CP, Kreiner S, et al. NASS guidance document on elective, emergent, and urgent procedures [Internet]. North American Spine Society; 2020. p. 1–3. Available from: <https://www.spine.org/Portals/0/assets/downloads/Publications/NASSInsider/NASSGuidanceDocument040320.pdf>.
- [14] Zoia C, Bongetta D, Veiceschi P, Cenzato M, Di Meco F, Locatelli D, et al. Neurosurgery during the COVID-19 pandemic: update from Lombardy, northern Italy [Internet]. *Acta Neurochir (Wien)*; 2020. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/32222820>.
- [15] Tan Y tang, Wang J wen, Zhao K, Han L, Zhang H qiu, Niu H quan, et al. Preliminary recommendations for surgical practice of neurosurgery department in the central epidemic area of 2019 Coronavirus infection. *Curr Med Sci* 2020;40(2).
- [16] Dietz J, Yao Ka, Kurtzman S, Willey S, Boolbol S, Bleicher R, et al. Recommendations for prioritization, treatment and triage of breast cancer patients during the COVID-19 pandemic: executive summary. The COVID-19 pandemic breast cancer consortium. March. 2020. p. 1.
- [17] EANS. EANS triage elective surgery acuity scale-COVID-19 [Internet]. EANS. 2019. p. 3. Available from: <https://cdn>.

- [ymaws.com/www.eans.org/resource/resmgr/documents/corona/eans\\_advice2020\\_corona.pdf](https://www.eans.org/resource/resmgr/documents/corona/eans_advice2020_corona.pdf).
- [18] The Hong Kong Neurosurgical Society. Experience sharing of covid-19 and neurosurgery in Hong Kong. The Hong Kong Neurosurgical Society; 2020. p. 3.
- [19] Castillo AE, Parra B, Tapia P, Acevedo A, Lagos J, Andrade W, et al. Phylogenetic analysis of the first four SARS-CoV-2 cases in Chile. *J Med Virol* 2020;(March):1–5.
- [20] [Internet] COVID-19 transmission-based isolation precautions for healthcare workers. Kansas Health System; 2020. Available from: <https://www.kansashealthsystem.com/-/media/Project/Website/PDFs-for-Download/COVID19/PPE-Recommendations-Schematic.pdf>.
- [21] Wong J, Goh QY, Tan Z, Lie SA, Tay YC, Ng SY, et al. Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore [Internet] *Can J Anesth* 2020;1–14. Available from: <https://doi.org/10.1007/s12630-020-01620-9>.
- [22] Achard V, Tsoutsou P, Zilli T. Radiotherapy in the time of the Coronavirus pandemic: when less is better [Internet] *Int J Radiat Oncol Biol Phys* 2020;1. Available from: <https://doi.org/10.1016/j.ijrobp.2020.03.008>.
- [23] World Health Organization (WHO). Operational guidance for maintaining essential health services during an outbreak [Internet]. World Health Organization; 2020 [cited 2020 Apr 9]. p. 1–10. Available from: <https://www.who.int/publications-detail/covid-19-operational-guidance-for-maintaining-essential-health-services-during-an-outbreak>.
- [24] American College of Surgeons. Covid 19: considerations for optimum surgeon protection before, during, and after operation. 2020. Available from: <https://www.facs.org/covid-19/ppe>.
- [25] CDC. Coronavirus disease [Internet]. 2019 (COVID-19): healthcare supply of personal protective equipment, vol. 2019. Centers for Disease Control and Prevention; 2020 [cited 2020 Apr 1]. p. 1–5. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirator-use-faq.html>.
- [26] Livingston E, Desai A, Berkwitz M. Sourcing personal protective equipment during the COVID-19 pandemic [Internet] *J Am Med Assoc* 2020 May 19;323(19):1912. Available from: <https://jamanetwork.com/journals/jama/fullarticle/2764031>.
- [27] Dexter F, Parra MC, Brown JR, Loftus RW. Perioperative COVID-19 defense [Internet] *Anesth Analg* 2020;16(3):1. Available from: <http://journals.lww.com/10.1213/ANE.0000000000004829>.
- [28] Considerations CDC. For the COVID-19 Response Considerations to inform product release decisions [Internet] [cited 2020 Apr 1]. Centers for Disease Control and Prevention; 2020. p. 3–6. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/release-stockpiled-N95.html>.
- [29] Mossa-Basha M, Meltzer CC, Kim DC, Tuite MJ, Kolli KP, Tan BS. Radiology department preparedness for COVID-19: radiology scientific expert panel [Internet] *Radiology* 2020 Mar 16;80(2):200988. Available from: <http://pubs.rsna.org/doi/10.1148/radiol.202000988>.
- [30] Zou J, Yu H, Song D, Niu J, Yang H. Advice on standardized diagnosis and treatment for spinal diseases during the Coronavirus disease 2019 pandemic. *Asian Spine J* 2020; 14(2):258–63.
- [31] Wright JL, Alcorn SR, McNutt T, Han-Oh S, Gonzalez R, Lin L, et al. An integrated program in a pandemic: Johns Hopkins radiation oncology department [Internet] *Adv Radiat Oncol* 2020 Apr:1–7. <https://doi.org/10.1016/j.adro.2020.03.014>. Available from: .
- [32] Papachristofilou A, Finazzi T, Kohler G, Dott C, Zimmermann F. Contingency plans in a radiation oncology department amid the 2019-nCoV outbreak in Switzerland. *Adv Radiat Oncol* 2020;1–5.
- [33] American College of Surgeons. Covid 19 : elective case triage guidelines for surgical care. Orthopaedics [Internet] *Am Coll Surg* 2020:1–2. March 24:2020. Available from: [https://www.facs.org/-/media/files/covid19/guidance\\_for\\_triage\\_of\\_nonemergent\\_surgical\\_procedures\\_orthopaedics.ashx](https://www.facs.org/-/media/files/covid19/guidance_for_triage_of_nonemergent_surgical_procedures_orthopaedics.ashx).
- [34] Epilepsy Foundation. COVID-19 and epilepsy [Internet]. Epilepsy Foundation; 2020 [cited 2020 Apr 3]. p. 1–4. Available from: [https://www.epilepsy.com/sites/core/files/atoms/files/COVID19\\_and\\_Epilepsy\\_FAQ\\_040920\\_v3.pdf](https://www.epilepsy.com/sites/core/files/atoms/files/COVID19_and_Epilepsy_FAQ_040920_v3.pdf).
- [35] Eljamel S. Problem based neurosurgery. World Scientific Publishing Company; 2011.
- [36] Klekamp J. Surgery of the spinal tumors. Springer; 2017.
- [37] Ozek M. The spina bifida. Management and outcome. Springer; 2008.
- [38] Agrawal A, Britz G. In: Agrawal A, Britz G, editors. Pediatric vascular neurosurgery [internet]. 1st ed. Cham: Springer International Publishing; 2016 Available from: <http://link.springer.com/10.1007/978-3-319-43636-4>.
- [39] Ullman J. Atlas of emergency neurosurgery. Thieme. 2015.
- [40] Jallo G. Handbook of pediatric neurosurgery. Thieme. 2018.
- [41] Abend NSA, Helfaer MA, editors. Pediatric neurocritical care. Demos Medical Publishing; 2013.
- [42] Abend NSA, Helfaer MA. Pediatric neurocritical care. Demos Medical Pub; 2013.
- [43] Miller CD. Neurocritical care monitoring. Demos Medical Publishing; 2015.
- [44] Biller J. Stroke in children and young adults. Saunders/Elsevier; 2009.
- [45] Bendok B, NAidech AM, Walker MT. Hemorrhagic and ischemic stroke: medical, imaging, surgical and interventional approaches. Thieme. 2011.
- [46] Hon KL, Leung AKC, Torres AR. Febrile infection-related epilepsy syndrome (FIREs): an overview of treatment and recent patents. *Recent Pat Inflamm Allergy Drug Discov* 2018;12(2):128–35.
- [47] Prahabakar H. Textbook of neuroanesthesia and neurocritical care. Springer; 2019.
- [48] Cinalli G, Ozek MM, Sainte-Rose C. In: Cinalli G, Ozek MM, Sainte-Rose C, editors. Pediatric hydrocephalus [internet]. Cham: Springer International Publishing; 2018. Available from: <http://link.springer.com/10.1007/978-3-319-31889-9>.
- [49] Gilbert DL, Gartside PS, Glauser TA. Efficacy and mortality in treatment of refractory generalized convulsive status epilepticus in children: a meta-analysis. *J Child Neurol* 1999; 14(9):602–9.
- [50] Giustina E Della, Giustina E Della. Textbook of pediatric neurosurgery. Textbook of Pediatric Neurosurgery 2018: 1–20.
- [51] Erbguth F. Management of refractory and super-refractory status epilepticus. *Med Klin Intensivmed Notfallmed* 2019; 114(7):628–34.
- [52] Kramer U, Chi CS, Lin KL, Specchio N, Sahin M, Olson H, et al. Febrile infection-related epilepsy syndrome (FIREs): pathogenesis, treatment, and outcome: a multicenter study on 77 children. *Epilepsia* 2011;52(11):1956–65.
- [53] Nei M, O'Connor M, Liporace J, Sperling MR. Refractory generalized seizures: response to corpus callosotomy and vagal nerve stimulation. *Epilepsia* 2006;47(1):115–22.
- [54] Raimondi A. Pediatric neurosurgery. 2nd. Thieme; 2007.
- [55] Wesson D. Pediatric trauma. Taylor & Francis; 2006.
- [56] Wester K. Arachnoid cysts. Clinical and surgical management. Academic Press; 2018.
- [57] Hocker S, Tatum WO, LaRoche S, Freeman WD. Refractory and super-refractory status epilepticus - an update. *Curr Neurol Neurosci Rep* 2014;14(6).
- [58] Wilson M. Damage control neurosurgery. Duchesne J: damage control in trauma care. An evolving comprehensive approach. Springer; 2018.
- [59] Shorvon S, Walker M. Status epilepticus in idiopathic generalized epilepsy. *Epilepsia* 2005;46(SUPPL. 9):73–9.
- [60] A definition and classification of status epilepticus - report of the ILAE task force on classification of status epilepticus. *Epilepsia* 2015;56(10):1515–23.
- [61] Rabadán A. Neuroethics scope at a glance. *Surg Neurol Int* 2015;6(1):183.
- [62] Akhaddar A. Atlas of infections in neurosurgery and spinal surgery [Internet]. Cham: Springer International Publishing;

2017. Available from: <http://link.springer.com/10.1007/978-3-319-60086-4>.
- [63] Goodrich JT. Pediatric neurosurgery. Thieme; 2008.
- [64] Hamilton G. Handbook of bleeding and coagulation for neurosurgery. Thieme. 2015.
- [65] Hall W. Neurosurgical infectious disease. Thieme; 2014.
- [66] Greenberg M. Handbook of neurosurgery. Thieme. 2010.
- [67] Alexopoulos A, Lachwani DK, Gupta A, Kotagal P, Harrison AM, Bingaman W, et al. Resective surgery to treat refractory status epilepticus in children with focal epileptogenesis. *Neurology* 2005;64(3):567–70.
- [68] Andrews BT, Hammer Gregory B, Aans PC. Pediatric neurosurgical intensive care. AANS; 1997.