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SPECIAL ARTICLE

Contingency plan for the intensive care services for the COVID-19 pandemic☆,☆☆

Plan de contingencia para los servicios de medicina intensiva frente a la pandemia COVID-19

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KEYWORDS
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Abstract In January 2020, the Chinese authorities identified a new virus of the *Coronaviridae* family as the cause of several cases of pneumonia of unknown aetiology. The outbreak was initially confined to Wuhan City, but then spread outside Chinese borders. On 31 January 2020, the first case was declared in Spain. On 11 March 2020, The World Health Organization (WHO) declared the coronavirus outbreak a pandemic. On 16 March 2020, there were 139 countries affected. In this situation, the Scientific Societies SEMICYUC and SEEIUC, have decided to draw up this Contingency Plan to guide the response of the Intensive Care Services. The objectives of this plan are to estimate the magnitude of the problem and identify the necessary human and material resources. This is to provide the Spanish Intensive Medicine Services with a tool to programme optimal response strategies.

PALABRAS CLAVE
Coronavirus;
COVID-19;
SARS-CoV-2;
Pandemia

Resumen En enero de 2020 China identificó un nuevo virus de la familia de los *Coronaviridae* como causante de varios casos de neumonía de origen desconocido. Inicialmente confinado a la ciudad de Wuhan, se extendió posteriormente fuera de las fronteras chinas. En España, el primer caso se declaró el 31 de enero de 2020. El 11 de marzo, la Organización Mundial de la Salud declaró el brote de coronavirus como pandemia. El 16 de marzo había 139 países afectados. Ante esta situación, las Sociedades Científicas SEMICYUC y SEEIUC han decidido la elaboración de este plan de contingencia para dar respuesta a las necesidades que conllevará esta nueva enfermedad. Se pretende estimar la magnitud del problema e identificar las necesidades asistenciales, de recursos humanos y materiales, de manera que los servicios de medicina intensiva del país tengan una herramienta que les permita una planificación óptima y realista con que responder a la pandemia.

Introduction

On 7 January 2020, the Chinese authorities identified a new virus belonging to the family *Coronaviridae* as the cause of an outbreak of pneumonia cases in the city of Wuhan, in the province of Hubei. The virus was subsequently referred to as SARS-CoV-2, and the disease it causes became known as COVID-19.[1]

According to data from the European Center for Disease Prevention and Control (ECDC), between 31 December 2019 and 16 March 2020, the disease had spread to 139 countries, with the declaration of 16,741 cases, including 6507 deaths.[2]

In Spain, information from the Ministry of Health indicated that at 13:00 h on 16 March there were 9191 positive cases in the country, of which 432 corresponded to patients admitted to Intensive Care Unit (ICUs).[3]

In this scenario, the scientific societies SEMICYUC, representing specialists in Intensive Care Medicine, and the SEEIUC, representing nursing professionals dedicated to critical patient care, contemplated the need to develop a contingency plan to address the demands associated with this new disease, with the following objectives in mind:

1 To provide the health authorities and managing bodies and clinicians with a technical document addressing all aspects related to identification of the healthcare needs of seriously ill patients in the face of the pandemic caused by the new SARS-CoV-2 virus, with a view to allowing integral and realistic planning of the Departments of Intensive Care Medicine at national and regional level, and in each hospital.

2 To ensure optimum care of seriously ill COVID-19 patients and of other critical patients with other disease conditions.
3 To limit the nosocomial spread of COVID-19 in order to:
   - o Protect the healthcare and non-healthcare staff in all the ICUs.
   - o Prevent hospitals from amplifying the disease.
   - o Protect non-COVID-19 patients from becoming infected, with a view to maintaining the capacity to provide essential medical care for those not affected by COVID-19.
4 To optimize the human resources of the Departments of Intensive Care Medicine.
5 To designate limited medical care resources in a rational, ethical and organized manner, with a view to affording the greatest possible benefit for the greatest possible number of people.

Previsions for the COVID-19 pandemic

The planning of possible scenarios is based on the use of FluSurge 2.0. This software was developed by the Centers for Disease Control and Prevention (CDC), and offers a free access spreadsheet to perform approximate calculations of the service demands in situations of a moderate to severe pandemic.[4] The tool allows us to modify the population at risk, the available hospital resources and the assumptions referred to the epidemiologic course of the pandemic—yielding an approximate estimate of the needs in that context. Accordingly, the programme estimates the number of hospital admissions and deaths, the number of hospitalized persons, the number of patients requiring admission to the ICU, the number of these individuals who require mechanical ventilation, and the degree of saturation of the available services for dealing with these patients.

It is important to mention that FluSurge 2.0 was specifically designed to consider the possible effect of an influenza virus pandemic, and has only been validated in that context. Its application to the COVID-19 pandemic must be assessed with caution.

The calculation of the possible scenarios requires a series of initial assumptions regarding the characteristics of the pandemic. The estimates used are based on the published series corresponding to the Chinese outbreak,[5,6] the Italian experience with the disease,[7] and the experience gained from influenza virus H1N1.[8]

The assumptions were a mean hospital stay of 11 days, a mean ICU stay of 14 days, 11% of hospitalized patients requiring admission to the ICU, and 6.5% requiring mechanical ventilation.

Considering an attack rate (proportion of people within a population who suffer contagion by a given disease) of 35% and a duration of the pandemic of 12 weeks (data which are adjusted to the evolution of the most severely affected Spanish Autonomous Communities), the following is contemplated:

- o 278,435 hospital admissions in 12 weeks.
- o Peak demand in week 7.
- o Need for over 9000 ICU beds in the moments of greatest demand.
- o Need for over 5000 respirators in the weeks of greatest demand.

The contemplated scenario is conceived to plan the needs in the event the containment measures are insufficient. The following is recommended:

- o Planning according to the actual situation in each moment.
- o Reassessment of the evolution in response to the containment measures.

Pandemic response phases

It is advisable to adjust the response according to the evolution of the pandemic.[9,10]

Phase 0. Preparation

- o Normal care activity.
- o Development of protocols and contingency plan.
- o Study of the availability of beds.
- o Prevision of equipment.
- o Staff training.

Phase 1. Start of the pandemic

- o Cancelation of elective surgeries.
- o Preparation of additional spaces as ICU beds.
- o Full staffing. Release from out-ICU activities.
- o Sectorization of work teams.

Phase 2. Saturation of the ICU

- o Suspension of all elective activity.
- o Organization of shifts.
- o Sectorization of patients with COVID-19.
- o Strict admission criteria.

Phase 3. Collapse of the ICU and of the hospital

- o Prioritize the care of patients most likely to recover.
- o Nurse-to-patient ratio according to availability.
- o Prioritize general benefit over particular benefit.

Human and technical resource requirements

Coronavirus committees

Coronavirus committees are working groups at national, regional and local level (pertaining to the hospital) that prepare the necessary resources and action plans in the face of all the possible scenarios.

The committees have the following objectives:

- o Define and agree the contingency plan with the administration.
- o Guarantee acquisition of the material.
- o Establish the necessary protocols.

- Plan the spaces.
- Define transfer procedures.
- Organize the working teams.

The role of the intensivist in the committees is essential for:

- Preparing the critical patient care areas and circuits.
- Defining circuits for in- and out-hospital transfer.
- Informing of the situation and needs in the ICU.

Technical resources

The following recommendations are made:

- Critical patients with COVID-19 are to be treated in an ICU by specialists in Intensive Care Medicine.
- Each ICU box or space must be equipped with a ventilator for advanced invasive ventilation.
- There must be a transfer ventilator for every 10 patients.
- All these aspects must be taken into account when generating extraordinary ICU spaces in other areas of the hospital.
- It is advisable to maintain grouping and isolation by cohorts.
- Grouping by cohorts should prevail over the concept of rooms with closed doors.
- If an ICU has open and closed boxes, it is advisable to initially use the closed boxes.
- If necessary, the physical space of the ICU should be expanded.

Human resources

Each center requires a care modification plan contemplating the distribution of workloads, care responsibilities and working hours or shifts.

The following is recommended in reference to intensivists[11]:

- *Normal work shift*:
  - An intensivist for every three patients.
  - In the event of saturation, other non-intensivist physicians (including residents in training) may be incorporated, coordinated by an intensivist.
- *Duty shift*:
  - Two intensivists or an intensivist plus a fourth- or fifth-year resident for every 12 beds.
  - In the event of saturation, other non-intensivist physicians (including residents in training) may be incorporated, coordinated by an intensivist.

The following is recommended in reference to nursing staff[12]:

- A nursing professional per shift for every two critical patients.
- Reinforcement with one nurse for every 4–6 beds as support in moments of maximum workload (prone positioning, intubation, transfers, etc.).
- A nursing assistant (NA) for every 4 beds.
- Reinforcement per shift for every 8–12 beds for organization and cleaning of material, support and replacement.

Staff training[9]

- The SEMICYUC will generate training material: charts, diagrams, posters, etc.
- Each hospital should organize training sessions with at least the following contents:
  - Epidemiology of COVID-19.
  - Impact upon activity.
  - Transmission.
  - Diagnosis of COVID-19.
  - Personal protection measures: personal protective equipment (PPE), procedures and isolation.

Internal communication. Transmission of information

We recommend the following[13]:

- Definition of an information transmission protocol.
- Avoid close contact during the transmission of information.
- Take special care in transmitting the therapeutic plan and the anticipation of changes.
- Use structured transmission, for example based on SBAR (Situation-Background-Assessment-Recommendation).
- Adequate completion the patient clinical history.

Communication with and information for patients and relatives

- In those ICUs with cases of COVID-19, it is advisable for the families of all the admitted patients to be informed of the fact on a daily basis, as well as of the moment in which there no longer are any such cases—without providing any other type of information that may affect the intimacy of such patients and their families.
- In those ICUs with cases of COVID-19, it is advisable for the families of the admitted patients to receive the usual daily information from the team outside the Unit.
- The patients with COVID-19 are to be isolated, with absolute restriction of accompaniment/visits. Only in situations analyzed on an individualized basis by the medical team, due to strict necessity (e.g., in imminent death situations) or based on other clinical, ethical and/or humane considerations, will limited, controlled, brief and supervised visits be allowed, after instructing the relatives on how to wear and remove the PPE, with due help and supervision.
- The families are to be advised to minimize patient accompaniment as far as possible, regardless of whether the patient has COVID-19 or not.
- Visits to patients without COVID-19 in Units where COVID-19 cases are present are to be adapted to the architectural characteristics of the Unit.

Optimized use of resources

Coronavirus is mainly transmitted by respiratory droplets measuring over 5 μm in size and through direct contact with the secretions of infected individuals. It may also be transmitted by the aerosols produced during therapeutic procedures. We therefore recommend the following[14–17]:

- The precautions for the treatment of all patients under study as probable cases or with confirmed infection must include the standard measures referred to contact and the transmission of droplets.
- Strict hand hygiene is mandatory.
- All the professionals must be trained in the use of PPE.
- Ideally, the patients should remain isolated in an individual room, and if possible under negative pressure.
- Priority should be placed on patient grouping (cohorting) in a specific area.
- The generated waste is regarded as class III waste.
- The PPE is to be removed within the box, except for the respiratory and eye protection.
- The clothing and utensils require no special treatment.

Personal protective equipment

Such equipment must include[14]:

- Protective clothing and gloves.
- Respiratory protection.
- Protection of the eyes and face.

The following recommendations are made with regard to respiratory protection[14,16]:

- Patients with confirmed infection and cases under investigation should wear surgical masks, if possible.
- Use two high efficacy antimicrobial filters (inspiratory and expiratory arms) in the case of invasive mechanical ventilation.[18]
- Use closed aspiration systems.
- In the case of noninvasive ventilation, it is advisable to use antiviral filters and preferably double tubing equipment.
- Avoid manual ventilation with bag mask. If done, use a high efficacy antimicrobial filter.
- Avoid active humidification, aerosol therapy and circuit disconnections.[18]
- When entering the room, or within a perimeter of 2 m from the patient, if aerosol-generating procedures are not going to be carried out, it is advisable to wear[15]:
  - A gown (disposable paper gowns are allowed).
  - Mask (surgical mask or FFP2 if available, and always ensuring the existence of a sufficient stock).
  - Gloves.
  - Anti-splash safety goggles.
- If an aerosol-generating procedure is to be carried out, it is advisable to wear[16,18]:
  - An FFP2mask or preferably FFP3 mask, if available.
  - Adjusted integral eye protection or complete face mask.
  - Gloves.
  - Impermeable long-sleeved gown.
- The current recommendation is to use the mask only once. Although clear evidence is lacking, in the event of a scarcity of masks, they can be reused by the same professional for a maximum of 8 h of continuous or intermittent activity. Extended use of the mask is allowed provided it is not stained or humid.[19]

Optimization of PPE use

Rational PPE use is required, with minimization of the exposure times. The following recommendations are made in this regard:

- Promote recording, control and monitoring measures that do not require entering the room of the patient.
- Plan the tasks and remain in the room as briefly as possible.
- Group those tasks requiring entry to the box.
- Adjust the perfusions to make the changes during scheduled entry to the box.
- Perform care, explorations, etc., with the fewest persons possible.
- Avoid per protocol aspiration.
- Unify sampling to avoid unnecessary entries.
  - Prepare the sample for transport in the box.
  - Clean the outer part of the tube with surface disinfectant or a small towel impregnated with disinfectant.
  - Sample transport is to be done personally, avoiding transport systems such as pneumatic tubes.
- The professionals in charge of the patient must supervise any intervention upon the patient by staff not belonging to the Unit.

Indications of admission to the ICU in patients with SARS-CoV-2 pneumonia

General criteria for admission to the ICU

We recommend the use of objective ICU admission criteria based on the recommendations of the American Thoracic Society (ATS), the Infectious Diseases Society of America (IDSA)[20] and the recent evidence of the analysis of the SARS-CoV-2 (COVID-19) epidemic in China[21] (Table 1). Admission to the ICU is to be considered in the presence of one major criterion or three or more minor criteria.

Optimization in case of saturation

- In cases of saturation or overwhelming workload, priority must center on those patients most likely to recover.
- The ICU triage or screening protocols referred to pandemics should only be activated if the ICU resources in a large geographic area have become or are going to become overwhelmed despite all reasonable efforts to expand resources or obtain additional resources.
- It is essential to have guidelines on the adequacy of therapeutic effort.

Inclusion/exclusion criteria[22–25]

- A screening instrument capable of objectively classifying the patients is advised.

Table 1 Major and minor criteria of admission to the Intensive Care Unit (ICU).

Major criteria
Septic shock with need for vasoactive amine drugs
Respiratory failure requiring mechanical ventilation
Minor criteria
Respiratory frequency > 30 rpm with conventional oxygen therapy
PaO_2/FiO_2 < 250 with conventional oxygen therapy
Bilateral lung infiltrates
Altered consciousness
Elevation of urea (>20 mg/dl)
Leukopenia (<4000 cells/mL) and lymphocytopenia
Thrombocytopenia (<100,000/mL)
Hypothermia (<36 °C)
Hypotension requiring aggressive therapy with fluids
D-dimer > 1 μg/l

- While not validated, the only measure proposed to date is based on the use of the SOFA score.[22]
- Following the first assessment, the patients are to be re-evaluated on days 2 and 5, which is when reclassification may be made.
- The following are exclusion criteria for admission:
  - Poor prognosis despite admission to the ICU.
  - Need for resources that cannot be provided.
  - Failure to meet severity criteria.
- Application can be made of the specific recommendations on admission exclusion referred to mass casualty events.[25]

Expansion plan

The expansion plan includes the transformation and preparation of additional spaces for the care of critical patients in situations of ICU bed collapse, as well as an increase in the number of staff members with expertise in the care of critical patients.

Expansion of the departments of intensive care medicine

The possible locations for the stay of critical patients must be equipped with[22,26,27]:

- Medicinal gases.
- Respirators for invasive and noninvasive mechanical ventilation.
- Possibility of high-flow oxygen therapy.
- Possibility of advanced monitoring.
- Possibility of continuous extrarenal replacement therapy techniques.
- Points for hand hygiene.
- Availability of central monitoring (telemetry) would be desirable.

On an orientative basis, the spaces that can be used to expand the number of ICU beds are[28]:

- Intermediate care units attended by intensivists: the nurse-to-patient ratios must be adjusted to those of a conventional ICU.
- Resuscitation units and post-anesthesia recovery units. Scheduled surgery must be suspended. The patients are to be attended by intensivists.
- Critical care or intermediate care areas of the emergency rooms.
- Habilitation of space close to the ICU, with new provision of equipment.
- Transformation of conventional hospitalization areas, day hospitals or ambulatory major surgery areas.
- In the event of oversaturation, transfer to another center with available space must be considered.

If 100% saturation of the Departments of Intensive Care Medicine is anticipated, we recommend centralization of the resources, with:

- Development of an inter-hospital transfer protocol.
- Creation in each Autonomous Community of a critical patients coordinator for the integral management of all critical care beds in each Community.

Staff expansion

We recommend the following[29,30]:

- Establish a census of all specialists in Intensive Care Medicine, including also:
  - Physicians with on-duty contracts.
  - Intensivists dedicated to other tasks within the hospital.
  - Unemployed physicians.
  - Newly retired physicians.
- Establish a census of other staff physicians or residents that may be able to care for less seriously ill patients, coordinated by the Department of Intensive Care Medicine.
- Prolong substitution contracts.
- Establish a plan for physician staff provision and distribution of workloads in all the hospitals.
- Establish a census of the nursing staff with knowledge and experience in the care of critical patients.
- Develop a plan for the reallocation of experienced nursing staff towards critical care areas.
- Take into account the previsions referred to peak care burden.
- If medical or nursing staff members that do not carry out their regular work in critical care become necessary, they should receive prior training.
- Such training should focus on two main areas: intensive care medicine or nursing and control of infections.

Transfers

Inter-hospital transfer

- Staff required: attending physician, attending nurse and emergency care technician.
- The adequate PPE for the attending staff is that recommended for situations of aerosol generation risk.
- To be taken into account during transfer:
  - Isolation of the staff in charge of driving the transfer vehicle.
  - The relatives cannot travel with the transfer vehicle.

- Limitation of the number of caregivers in the transfer vehicle.

Intra-hospital transfer

- o A transfer circuit protocol is to be established: itinerary, elevator, number of intervening persons, PPE.
- o Steps for transfer:
  1. Inform the receiving Department, cleanliness and safety.
  2. Prepare the material.
  3. Use PPE.
  4. Notify the receiving Department of the start of transfer.
  5. Block the elevator for transfer and disinfection.
  6. Security staff with surgical masks are to precede the team to clear the zone.
  7. Disinfection of the zones of transfer.
  8. Return.

Conflicts of interest

None.

Appendix A. Steering Committee of the SEMICYUC

Chairman: Ricard Ferrer Roca. Vice-chairman: Alvaro Castellanos Ortega. Secretary: Josep Trenado Alvarez. Vice-secretary: Virginia Fraile Gutiérrez. Treasurer: Alberto Hernández Tejedor. Chairman of the Scientific Committee: Manuel Herrera Gutiérrez. Vice-chairwoman of the Scientific Committee: Paula Ramírez Galleymore. Representative of the working groups: M. Angeles Ballesteros Sanz. Representative of the Autonomous Societies: Pedro Rascado Sedes. Representative of the physicians in training: Leire López del Oliva Calvo. Previous Chairwoman: Maria Cruz Martín Delgado.

Appendix B. Steering Committee of the SEEIUC

Chairwoman: Marta Raurell Torreda. Vice-chairwoman: Miriam del Barrio Linares. Secretary: Marta Romero García. Treasurer: Maria Teresa Ruiz García. Director of the journal: Maria Pilar Delgado Hito. Member of the working groups: Juan José Rodríguez Mondejar. Member of the Industry: Carmen Moreno Arroyo. Member of international relations: Alicia San José Arribas. Research member: Maria Jesus Frade Mera.

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