

## Nursing process applied to a patient with SARS-CoV-2 and diabetes mellitus type 2

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### ABSTRACT

**Introduction:** On December 2019, Wuhan, the capital of the province of Hubei (China), became the epicenter of a series of cases of pneumonia whose cause was unknown. The biological agent was identified as a ribonucleic acid betacoronavirus of with coat which is currently named coronavirus 2, the cause of a severe acute respiratory syndrome. **Objective:** Develop a nursing process applied to a patient with the binomial comprised by coronavirus 2 which caused him severe acute respiratory syndrome, and diabetes mellitus type 2. **Methodology:** Descriptive clinical case study, the nursing process was developed, the assessment was guided by the Virginia Henderson conceptual approach; diagnosis, results, and interventions were established. **Presentation of the case:** 44 years old male with coronavirus 2, which causes the severe acute respiratory syndrome, and diabetes mellitus type 2, who was admitted in the Intensive Care Unit for Adults in a tertiary care hospital. **Results:** The diagnosis was "Inefficient cleaning in the airways, hyperthermia, and risk of instable glycemia level". **Conclusion:** Through the interventions expected results were reached; the patient was dismissed from the intensive care unit 18 days after he was admitted.

**Key words:** Nursing process; Severe Acute Respiratory Syndrome; infections due to coronavirus; diabetes mellitus (DeCS).

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**Received:** 05/29/2020

**Accepted:** 12/18/2020

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## Proceso de enfermería aplicado a un paciente con SARS-CoV-2 y Diabetes Mellitus 2

### RESUMEN

**Introducción:** En diciembre de 2019, Wuhan, capital de la provincia de Hubei (China), se convirtió en el epicentro de una serie de casos de neumonía de causa desconocida. El agente biológico identificado es un betacoronavirus de ácido ribonucleico con envoltura que actualmente se denomina coronavirus de tipo 2 causante del síndrome respiratorio agudo severo. **Objetivo:** Desarrollar un proceso de enfermería aplicado a un paciente con el binomio coronavirus de tipo 2 causante del síndrome respiratorio agudo severo y Diabetes Mellitus 2. **Metodología:** Estudio de caso clínico descriptivo, se desarrolló el proceso de enfermería, la valoración fue guiada por el enfoque conceptual de Virginia Henderson, se establecieron diagnósticos, resultados e intervenciones. **Presentación del caso:** Masculino de 44 años de edad con coronavirus de tipo 2 causante del síndrome respiratorio agudo severo y Diabetes Mellitus 2 que ingresó a la Unidad de Cuidados Intensivos Adultos de un Hospital de Tercer Nivel de Atención. **Resultados:** Se identificaron los diagnósticos "Limpieza ineficaz de las vías aéreas, hipertermia y riesgo de nivel de glucemia inestable". **Conclusión:** Mediante las intervenciones se alcanzaron los resultados esperados, el paciente egresó de la unidad de cuidados intensivos 18 días posteriores a su internamiento.

**Palabras clave:** Proceso de enfermería; Síndrome respiratorio agudo grave; Infecciones por coronavirus; Diabetes mellitus (DeCS).

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## Processo de enfermagem aplicado a um paciente com SARS-CoV-2 e diabetes mellitus tipo 2

### ABSTRATO

**Introdução:** Em dezembro de 2019, Wuhan, capital da província de Hubei (China), tornou-se o epicentro de uma série de casos de pneumonia de causa desconhecida. O agente biológico foi identificado como um betacoronavírus de ácido ribonucléico com revestimento, atualmente denominado coronavírus 2, causador de síndrome respiratória aguda grave. **Objetivo:** Elaborar um processo de enfermagem aplicado a um paciente portador do binômio composto pelo coronavírus 2, que lhe causou a síndrome respiratória aguda grave, e diabetes mellitus tipo 2. **Metodologia:** Estudo de caso clínico descritivo, o processo de enfermagem foi desenvolvido, a avaliação foi norteada pela abordagem conceitual de Virginia Henderson; diagnóstico, resultados e intervenções foram estabelecidos. **Apresentação do caso:** Homem de 44 anos com coronavírus 2, causador da síndrome respiratória aguda grave, e diabetes mellitus tipo 2, internado em Unidade de Terapia Intensiva para Adultos de um hospital terciário. **Resultados:** O diagnóstico foi "Limpeza ineficaz das vias aéreas, hipertermia e risco de glicemia instável". **Conclusão:** Por meio das intervenções foram alcançados os resultados esperados; o paciente teve alta da unidade de terapia intensiva 18 dias após sua internação.

**Palavras-chave:** Processo de enfermagem; Síndrome Respiratória Aguda Grave; infecções por coronavírus; diabetes mellitus (DeCS).

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## INTRODUCTION

On December 2019, Wuhan, capital of the province of Hubei (China), became the epicenter of a series of cases of pneumonia of unknown cause <sup>(1)</sup>. The biological agent identified was a coated ribonucleic acid betacoronavirus which is currently named coronavirus 2 of the severe acute respiratory syndrome (SARS-CoV-2), which has a filogenetic semilarity to the SARS (SARS-CoV) (

Structurally, SARS-CoV has a well defined composition, which includes 14 residues of joint which directly interact with the angiotensin-converting enzyme 2 (ECA2). From these aminoacids, 8 have kept in the SARS-CoV-2. Although, the exact underlying physiopathological mechanisms are not known (due to pending lab tests), the genomic similarities with SARS-CoV could help to explain it. However, not until these lab tests start, the accurate mechanism of the SARS-CoV-2 remains hypothetical <sup>(2)</sup>.

Symptoms of SARS-CoV-2 appear after an incubation period of approximately 5, 2 days <sup>(3)</sup>. The most common symptoms at the onset of SARS-CoV-2 disease are fever, cough, and fatigue, while other symptoms include sputum production, headache, hemoptysis, diarrhea, dyspnea, and lymphopenia, rhinorrhea, sneezing, and sore throat. Some of the cases show an infiltrate in the upper lobe of the lung associated with increasing dyspnea with hypoxemia <sup>(3)</sup>. Diagnosis is made by reverse transcriptase polymerase chain reaction (RT-PCR) through identification of SARS-CoV-2 nucleic acids or by viral gene sequencing. It is also possible with samples of pharyngeal/nasopharyngeal exudate, sputum, stool or blood. Another method is virus isolation from respiratory epithelial cell cultures <sup>(4)</sup>.

The main forms of transmission of SARS-CoV-2 are through drops and contact. The transmission through drops > 5-10  $\mu\text{m}$  pf diameter occurs in direct form between infected person and a close contact generally within the diameters 1 to 2 meters of distance and the virus enters by nasal, oral, and ocular mucous. The drops also can contaminate surfaces and objects close to the infected person and objects close to the person infected and transfer directly through the contamination of hands to the person infected and transfer indirectly to the person infected and transmit indirectly through the contamination of the hands which later on can be in contact with the mucous. This contagion via is very important given that the virus shows a feasibility of 3 or more days in surfaces such as plastic, metal or other materials.

Likewise, it can also be transmitted in presymptomatic periods and from asymptomatic individuals. Airborne transmission is less frequent and requires that the virus remains contained in particles < 5  $\mu\text{m}$  in diameter that can aerosolize and remain for prolonged intervals of time in the air and be transmitted to lengths greater than 1 to 2 meters, this is likely in specific conditions and environments in which procedures that produce aerosols are carried out such as endotracheal intubation/extubation, bronchoscopy, sampling of the respiratory system, cardiopulmonary resuscitation, among others <sup>(5)</sup>.

Currently, vaccines have been designed that promote effective and encouraging results for SARS-CoV-2; however, there is still consensus for the promotion of specific therapies and protocols to be approved by the United States Food and Drug Administration (FDA) <sup>(2)</sup>. In the Mexican context, phase 1 has been initiated for the application of the vaccine (first-line health personnel); other vaccines

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continue in clinical trials and compassionate use protocols based on in vitro activity and with limited clinical experience; even the effectiveness of pharmacological treatments for the treatment of patients with this disease continues to be tested <sup>(6)</sup>.

In Mexico, on February 27, 2020, the case of a man with a positive result for the SARS-CoV-2 test was made public. The person presented himself at the National Institute of Respiratory Diseases (Instituto Nacional de Enfermedades Respiratorias - INER) for consultation, with a history of having visited Bergamo, Italy, where he had been in contact with an infected individual. The following day, this was confirmed as the first case of SARS-CoV-2 in Mexico by the Instituto de Diagnóstico y Referencia Epidemiológica (INDRE) <sup>(10)</sup>.

On January 30, 2020, the World Health Organization (WHO) reported a global public health emergency caused by the sudden onset of SARS-CoV-2, subsequently, on March 11, 2020, the WHO qualified SARS-CoV-2 as a pandemic <sup>(11)</sup>. In this sense, nursing has always had an important role in the prevention and control of infections, isolation actions for the protection of the health of immunocompromised individuals and it also has a role of great importance due to its impact on public health <sup>(12)</sup>; therefore, in the situation of a pandemic considered as a global problem, the participation of the workforce of this group of professionals is required. This is how this group of professionals is involved demonstrating responsibility and sense of service in the response to SARS-CoV-2 and will continue to be in the first line of patient care <sup>(13)</sup>.

## **Objective**

The objective of the present study was to develop a nursing process applied to a patient with severe acute respiratory syndrome coronavirus 2 binomial and Diabetes Mellitus 2 (DM-II).

## **METHODOLOGY**

A descriptive clinical case study was developed in the ICU of a hospital located in northeastern Mexico during the month of April 2020 for a patient with SARS-CoV-2 and DM-II. It was structured according to the five stages of the EP and with the use of Virginia Henderson's conceptual philosophical approach, which gives the nursing professional a complementary and supplementary role in the satisfaction of the 14 basic needs of the human being with the objective of achieving the independence of the person considering as a basis the individual characteristics of the person who requires nursing intervention <sup>(14)</sup>. The selection of this philosophical conceptual model is based on the fact that its main focus is on the evaluation within the context of the EP <sup>(14)</sup>. Moreover, to facilitate the execution of the evaluation and to specify the areas to be evaluated, the organization and hierarchy of human needs proposed by Maslow and taken up by Henderson were considered; therefore, this philosophical conceptual model was considered adequate for its application in this EP <sup>(15)</sup>.

Fourteen (14) basic needs were evaluated; however, only the most important in terms of severity expressed by the patient under study were considered, which were "oxygenation, maintaining body temperature in normal ranges and safety". Diagnoses, interventions and outcomes were established based on the North American Nursing Diagnosis Association (NANDA), nursing intervention classification

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(NIC). and nursing outcome classification (NOC) <sup>(15-17)</sup>.

## **PRESENTATION OF THE CASE**

### ***Personal background***

Male patient, 44 years old, resident of Monterrey, Nuevo Leon, Mexico, single, Catholic, with DM-II for one year, untreated, amputation of the little toe of the right foot.

### ***Assessment***

Admitted on April 12, 2020, to the admission service, conscious and oriented in space, time and person, with a medium-linear biotype and mesomorphic constitution. On admission he presented cough with expectoration with an evolution of 7 days, he went to the health service for presenting dyspnea and moderate hypoxia (90% O<sub>2</sub>), with alteration in vital signs Temperature: 38.5° C (hyperthermia), Blood pressure: 99/54 mm/Hg, Heart rate: 79x', Breathing rate (BR): 30x' (tachypnea), Oxygen saturation: 84% (moderate hypoxia), Weight: 70 Kg, Height: 1.71 meters, Body mass index (BMI): 23.94. The RT-PCR test for SARS-CoV-2 was performed by nasopharyngeal swabbing, obtaining a positive result, and for this reason it was decided to admit him to the hospital, after this assessment it was decided to transfer him directly to the ICU where the invasive procedure was performed. He was sedated, orointubated with ventilatory support in assist-control (AC) mode, volume-cycled, with parameters of FR 26x', PEEP 10, FiO<sub>2</sub> 50%, VT 420ml. He presents abundant mucopurulent secretions; orogastric tube and formula for enteral feeding designed for diabetic patient at 20 ml/hour; with central venous catheter of three lumens in right subclavian vein, permeable and with propofol ministrations at

50 µg/Kg/min, dexmedetomidine infusion at 1 µg/Kg/min, norepinephrine at 3 µg/Kg/min, human rapid insulin at 4 units/hour, liquid plan based on NaCl solution at 0.9% NaCl solution at 41 ml/hour, invasive blood pressure monitoring in the radial artery of the right upper limb, audible peristalsis, transurethral shunt with golden yellow diuresis at 0.5 ml/kg/hour.

### ***Auxiliary examinations***

RT-PCR SARS-CoV-2: Positive 121.07 mg/L. Blood biometry: leukocytosis 20.10 K/uL, neutropenia 18.0 K/uL, eosinopenia 0.00 K/uL, lymphopenia 0.58 K/uL. Blood chemistry: blood glucose 207 mg/dL. Coagulation times: prothrombin time 12.9 sec, thromboplastin time 31.7 sec. Arterial blood gases: pH 7.46, pCO<sub>2</sub> 29 mm/Hg, pO<sub>2</sub> 67 mm/Hg, HCO<sub>3</sub> 20.3 mmol/L, Na<sup>+</sup> 149 mmol/L, K<sup>+</sup> 3.6 mmol/L, Lactate 1.0 mmol/L. Cabinet studies: X-ray with evidence of bilateral bronchial alveolar infiltrates and ground glass opacity.

### ***Main evidence of needs assessment***

1. Need for oxygenation: Dyspnea, artificial airway (orointubation), breathing rate (BR: 26x'), retention of secretions (abundant mucopurulent), moderate hypoxemia (oxygen saturation: 90%).
  2. Need to maintain body temperature in normal ranges: temperature: 38.5° C, Leukocytes 20.10 K/uL, heart rate: 79x', blood pressure: 99/54 mm/Hg.
  3. Safety need: Male sex, age 44 years, DM-II for one year and six months, amputation of the little toe of the right foot, blood glucose of 207 mg/dL.
- After sedation and vasopressor weaning, the patient remains conscious. Orintubated

referred to the operating room, returns with tracheostomy tube with 21% oxygen, maintains oxygen saturation up to 94%, scarce hyaline secretions. He continues aspiration of secretions with a closed system. After the administration of pharmacological and non-pharmacological therapy, the patient remains afebrile until discharge. Metabolically, after removal from human rapid insulin infusion, the

patient remains euglycemic. Meanwhile, the discharge plan and the new treatment for the management of DM-II are prepared.

### **Nursing care plan**

See tables 1 to 3.

Table1. Nursing Care Plan 1. Altered Need: Oxygenation

Diagnosis: (00031) Ineffective airway clearance, related to foreign body in the airway (orointubation), retention of secretions, manifested by altered breathing rate (BR: 26x'), excessive amount of sputum (abundant mucopurulent).	
<b>Results</b>	<b>Nursing Interventions Type of Intervention and Level of Relationship</b>
<p><b>Selected result:</b> (0410) Respiratory status: airway patency</p> <p><b>Selected indicator:</b> (41012) <u>Ability to clear secretions</u> Measuring Scale: 1 to 5 (*) (41020) <u>Sputum Accumulation</u> Scale of Measurement: 1 to 5 (+) Target score: Keep: 3, increase: 4</p> <p><b>Indicators not applicable:</b> (41002) Anxiety, (41003) Choking, (41004) Breathing rate, (41005) Respiratory rate, (41007) Pathologic breath sounds, (41011) Fear, (41013) Nasal flaring, (41014) Panting, (41015) Dyspnea at rest, (41016) Mild exertional dyspnea, (41017) Depth of inspiration, (41018) Use of accessory muscles, (41019) Coughing, (41021) Agonal respirations</p>	<p><u>(3160) Airway suction</u> Use universal precautions and include personal protective equipment. Monitor patient's oxygenation status (oxygen saturation levels). Determine the need for suction Use closed system suction (0840) Change of position Laying on a suitable therapeutic mattress Monitor oxygenation status before and after change of position, as appropriate. Place in the specific therapeutic position (prone position). Place supports in edematous areas.</p> <p><b>Type of intervention:</b> Interdependent, <b>Relationship level:</b> substitute nurse</p>
<p><b>Notes:</b> (*) 1 = Severe deviation from normal range, 2 = Substantial deviation from normal range, 3 = Moderate deviation from normal range, 4 = Slight deviation from normal range, 5 = No deviation from normal range. (+) 1 = Serious, 2 = Substantial, 3 = Moderate, 4 = Slight, 5 = None. (+) 1 = Grave, 2 = Sustancial, 3 =</p>	<p><b>Evolution note:</b> Orintubated referred to the operating room where a tracheostomy tube with 21% oxygen was installed, oxygen saturation maintained up to 94%, scarce hyaline secretions.</p>

Moderado, 4 = Leve, 5 = Ninguno.

Source: NANDA <sup>(16)</sup>, NIC <sup>(17)</sup>, NOC<sup>(18)</sup>.

Table 2. Nursing Care Plan 2. Altered need: maintain body temperature in normal ranges.

Diagnosis: (00007) Hyperthermia, related to illness, manifested by temperature: 38.5° C.	
Results	Nursing Interventions Type of Intervention and Level of Relationship
<p><b>Selected result:</b> <i>(0800) Thermoregulation</i></p> <p><b>Selected indicator:</b> <i>(80019) Hyperthermia</i></p> <p>Measurement scale: 1 to 5 (*) Target Score: Maintain: 4, Increase: 5</p> <p><b>Indicators not applicable:</b> <i>(80001) Increased skin temperature, (80003) Headache,</i> <i>(80004) Muscle pain,</i> <i>(80005) Irritability,</i> <i>(80006) Drowsiness,</i> <i>(80007) Skin color change,</i> <i>(80008) Muscle contracture,</i> <i>(80009) Presence of goose bumps when cold,</i> <i>(80010) Sweating with heat,</i> <i>(80011) Shivering with cold,</i> <i>(80012) Radial pulse rate,</i> <i>(80013) Breathing rate,</i> <i>(80014) Dehydration,</i> <i>(80015) Referred thermal comfort,</i> <i>(80017) Apical heart rate,</i> <i>(80018) Decreased skin temperature,</i> <i>(80020) Hypothermia,</i> <i>(80021) Heat cramps,</i> <i>(80022) Heat stroke,</i> <i>(80023) Frostbite.</i> Golpe de calor, (80023) Congelación.</p> <p><b>Notes:</b> (* ) 1 = Serious, 2 = Substantial, 3 = Moderate, 4 = Slight, 5 = None.</p>	<p><i>(3900) Temperature regulation</i></p> <p>Use universal precautions Wear appropriate personal protective equipment. Install a continuous central temperature monitoring device. Use a cooling mattress, circulating water blankets, ice packs, etc. Administer antipyretic drugs.</p> <p><b>Type of intervention:</b> Interdependent, <b>Relationship level:</b> substitute nurse</p> <p><b>Evolution note:</b> Remains normothermic.</p>

Source: NANDA <sup>(16)</sup>, NIC <sup>(17)</sup>, NOC <sup>(18)</sup>.

Nursing Care Plan 3. Altered need: safety.



Table 3. Nursig plan care 3. Altered need: safety.

Diagnosis: (00179) Risk of unstable blood glucose level, related to DM-II for one year and six months, amputation of right little toe, inadequate blood glucose control (blood glucose 207 mm/Hg).	
Results	Nursing Interventions Type of Intervention and Level of Relationship
<p><b>Selected result:</b> <i>(2300) Blood glucose level</i></p> <p><b>Indicador seleccionado:</b> <i>(230001) Blood glucose concentration.</i></p> <p>Measurement Scale: 1 to 5 (*) Target Score: Maintain: 4, Increase: 5</p> <p><b>Indicators not applicable:</b> (230004) Glycosylated hemoglobin, (230005) Fructosamine, (230007) Glucose in urine, (230008) Ketones in urine. (230004) Hemoglobina glucosilada, (230005) Fructosamina, (230007) Glucosa en orina, (230008) Cetonas en orina.</p> <p><b>Notes:</b> (*) 1 = Severe deviation from normal range, 2 = Substantial deviation from normal range, 3 = Moderate deviation from normal range, 4 = Slight deviation from normal range, 5 = No deviation from normal range.</p>	<p>(2300) Blood glucose level Hand washing Use universal precautions Wear appropriate personal protective equipment. Monitoring blood glucose levels Administer insulin, as prescribed Provide assistance in adjusting a regimen to prevent and treat hyperglycemia (insulin).</p> <p><b>Type of intervention:</b> Interdependent,</p> <p><b>Relationship level:</b> substitute nurse</p> <p><b>Evolution note:</b> Weaned from human rapid insulin infusion, remains euglycemic.</p>

Source: NANDA <sup>(16)</sup>, NIC <sup>(17)</sup>, NOC <sup>(18)</sup>.

## DISCUSSION

In her writings, Virginia Henderson considered that people possess real and potential capacities and resources to achieve independence and satisfy their basic needs, with the purpose of preserving their own health in an optimal state <sup>(19)</sup>. Sometimes these capacities and resources diminish, are reduced completely or incompletely, temporarily or permanently. It is then when a dependency appears, as in the case described previously.

The particular SARS-CoV-2 pneumonia occurs mostly as an inflammation of the alveolar tissue, resulting in a dry, apparently non-exudative consolidating cough. However, up to 34% of SARS-CoV-2 patients manifested productive cough, in which secretion clearance techniques are favorable.

Elimination techniques of secretions will be determined to patient with bronchial exudates destined to patients with bronchial exudates, and only when it is difficult the expulsion of secretions by their own (20), as in the case of patient with intubation or tracheotomy or intubation or tracheostomy canula.

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It was of vital importance to monitor vital signs, especially oxygen saturation by pulse oximetry (SpO<sub>2</sub>), in order to safeguard the patient. Priority was given to remote monitoring by means of remote monitors<sup>(20)</sup>. Evidence regarding the use of prone positioning in patients with SARS-CoV-2 is limited. However, the tendency of SARS-CoV-2 to damage peripheral and dorsal lung zones provides optimal circumstances for a positive oxygenation response to prone positioning<sup>(11)</sup>. The prone decubitus suggested by Barrantes and Vargas<sup>(21)</sup> rearranges pleural pressures becoming more uniform, as well as the pressure gradient being close to zero, so that lung volume is distributed in an analogous manner. In addition, it produces a significant alveolar recruitment on dorsal areas, consequently, oxygenation improves, a fact that coincides with what occurred in this clinical case and that proposed by Vasquez<sup>(22)</sup>. The responsibility for these postural changes falls on the nursing team, which should be prepared to minimize the risks and be aware of the implications associated with the procedure<sup>(21)</sup>.

Hyperthermia is present in 43.8% of patients on admission and is the most common symptom, present in 64.7 to 98% of hospitalized patients<sup>(1, 2, 23)</sup>. Patients with hyperthermia should be actively monitored. First-line treatment for fevers includes antipyretic therapy with paracetamol<sup>(24)</sup>. According to Montero's EP<sup>(25)</sup>, the administration of antipyretics has a positive effect on the evolution of the patient's body temperature control, a situation that coincides with this case.

The worldwide epidemic of SARS-CoV-2 has immediate implications for the therapy of common metabolic disorders such as DM-II. Insulin is the glucose-lowering therapy of choice for acute coronavirus-related illness in

the hospital, as it has been widely used for decades to control glucose in critically ill hospitalized subjects with DM-II.

Among the agents available for the treatment of acute illness complicated by DM-II, insulin has been the most commonly used agent in humans with bacterial or viral infections and in critically ill hospitalized patients. However, there is little information on the potential benefits or risks of insulin in the context of acute coronavirus infection<sup>(26)</sup>.

As for cases involving SARS-CoV-2, the reports are scarce, but they conclude that the nursing care provided in this EP in conjunction with the protocols to be followed with a patient with this respiratory diagnosis<sup>(27)</sup> cover the scope of care for the favorable evolution of the patient with SARS-CoV-2.

It is recommended to consider this clinical case as a proposal that serves as a reference for nursing care practice when providing care to people with SARS-CoV-2 and DM-II in order to accomplish results that guide a quality practice based on patient safety under the Henderson assessment system to provide a philosophical nursing support to the physical assessment, this will allow professionals to gradually assess the level of dependence of patients experiencing this clinical situation.

## CONCLUSIONS

The results stated improved considering the interventions based on the established diagnoses, in the case of diagnosis 1 the results started from 1 (severe deviation from the normal range) and 1 (severe) to 4 (slight deviation from the normal range) and 4 (slight), respectively, in diagnosis 2 the results behaved as follows: 1 (severe) to 5 (none), while in diagnosis 3 the results ranged from 1 (severe deviation from normal range) to 5 (no severe

deviation from normal range). The expected results were achieved for the patient's discharge from the ICU 18 days after hospitalization with a moderate degree of dependence. It is concluded that the EP presented is effective for the treatment of patients with SARS-CoV-2 and with underlying pathology DM-II.

## CONFLICTS OF INTEREST

None.

## FINANCING

There was no financing.

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