Algorithms to prevent pressure injury in COVID-19 patients in prone position

Algoritmos para prevenir lesão por pressão em paciente com COVID-19 em prona

Algoritmos para prevenir la úlcera por presión en pacientes con COVID-19 en prona

Geraldo Magela Salomé[1] https://orcid.org/0000-0002-7315-4866
Camila Bruna de Almeida[1] https://orcid.org/0000-00003-0562-2346
Flavianne Maryana Prudencio[1] https://orcid.org/0000-0002-2744-9794

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Corresponding author
Geraldo Magela Salomé
E-mail: salomereiki@univas.edu.br

Associate Editor (Peer review process):
Juliana Lima Lopes
(https://orcid.org/0000-0001-6915-6781)
Escola Paulista de Enfermagem, Universidade Federal de São Paulo, São Paulo, SP, Brazil

Abstract

Objective: To develop and validate the content of two algorithms to guide frontline professionals in the prevention and treatment of pressure injuries in COVID-19 patients in prone position.

Methods: Study conducted between September and November 2021. A literature review was performed in MEDLINE®, SciELO and Lilacs databases to build the algorithms. Articles published between 2011 and 2021 were searched. The validation of algorithms was performed by 59 health professionals (nurses, physical therapists and physicians) who worked on the frontline of COVID-19. The Delphi technique was used, and Content Validity Index and Cronbach's alpha coefficient were adopted for data analysis.

Results: In the first evaluation cycle, the items of algorithms were considered as "partially adequate to totally adequate" by the judges, and the Content Validity Index ranged between 0.87 and 0.92. Cronbach's alpha coefficient ranged between 0.95 and 0.96, indicating excellent internal consistency of the evaluation questionnaire used by the judges. After implementing the adjustments suggested by judges, the algorithms were sent to a second evaluation cycle, in which all items were judged as "adequate" and "totally adequate", resulting in a Content Validity Index of 1.0.

Conclusion: Algorithms to guide healthcare professionals in the prevention and treatment of pressure injury in COVID-19 patients in prone position were evaluated by nurses, physical therapists and physicians working on the frontline of COVID-19. They achieved consensus on content in the second evaluation cycle.

Resumo

Objetivo: Elaborar e validar o conteúdo de dois algoritmos para orientar profissionais da linha de frente na prevenção e no tratamento da lesão por pressão em paciente com COVID-19 em posição prona.

Métodos: Estudo realizado entre setembro e novembro de 2021. Para a construção dos algoritmos, realizou-se revisão da literatura junto às bases de dados MEDLINE®, SciELO e Lilacs. Foram pesquisados artigos publicados entre 2011 e 2021. A validação dos algoritmos foi feita por 59 profissionais da saúde (enfermeiros, fisioterapeutas e médicos), que trabalhavam na linha de frente da COVID-19, utilizando-se a técnica Delphi. Para a análise de dados, foi adotado o Índice de Validade de Conteúdo e o coeficiente alfa de Cronbach.

Resultados: No primeiro ciclo de avaliação, os itens dos algoritmos foram considerados pelos juízes como "parcialmente adequados a totalmente adequados", e o Índice de Validade de Conteúdo variou entre 0,87 e 0,92. O coeficiente alfa de Cronbach variou entre 0,95 e 0,96, indicando excelente consistência interna do questionário de avaliação utilizado pelos juízes. Após implementados os ajustes sugeridos pelos juízes, os algoritmos foram reenviados para o segundo ciclo de avaliação, no qual todos os itens foram julgados como "adequado" e "totalmente adequado", resultando em um Índice de Validade do Conteúdo de 1,0.

[1]Universidade do Vale do Sapucaí, Pouso Alegre, MG, Brazil.
Conflicts of interest: none to declare.

Conclusão: Os algoritmos para orientar profissionais da saúde na prevenção e no tratamento da lesão por pressão em pacientes com COVID-19 em posição prona foram avaliados por enfermeiros, fisioterapeutas e médicos que estavam na linha de frente de combate à COVID-19, que chegaram a um consenso quanto ao conteúdo no segundo ciclo de avaliação.

Resumen

Objetivo: Elaborar y validar el contenido de dos algoritmos para orientar profesionales de la línea de frente sobre la prevención y tratamiento de la úlcera por presión en pacientes con COVID-19 en posición prona.

Métodos: Estudio realizado entre septiembre y noviembre de 2021. Para la elaboración de los algoritmos, se realizó revisión de la literatura en las bases de datos MEDLINE®, SciELO y Lilacs. Se buscaron artículos publicados entre 2011 y 2021. La validación de los algoritmos fue realizada por 59 profesionales de la salud (enfermeros, fisioterapeutas y médicos), que trabajaban en la línea de frente del COVID-19, utilizando el método Delphi. Para el análisis de datos se adoptó el Índice de Validez de Contenido y el coeficiente alfa de Cronbach.

Resultados: En el primer ciclo de evaluación, los ítems de los algoritmos fueron considerados por los jueces como "parcialmente adecuados a totalmente adecuados", y el Índice de Validez de Contenido varió entre 0,87 y 0,92. El coeficiente alfa de Cronbach varió entre 0,95 y 0,96, lo que indica una excelente consistencia interna del cuestionario de evaluación utilizado por los jueces. Después de implementar las mejoras sugeridas por los jueces, se reenviaron los algoritmos para el segundo ciclo de evaluación, en el cual todos los ítems fueron calificados como "adecuado" y "totalmente adecuado", con un resultado del Índice de Validez de Contenido de 1,0.

Conclusión: Los algoritmos para orientar profesionales de la salud sobre la prevención y el tratamiento de la úlcera por presión en pacientes con COVID-19 en posición prona fueron evaluados por enfermeros, fisioterapeutas y médicos que estaban en la línea de frente de combate al COVID-19 y llegaron a un consenso respecto al contenido en el segundo ciclo de evaluación.

Introduction

Individuals with coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), present with asymptomatic infection, mild upper respiratory tract disease, and severe viral pneumonia with respiratory failure, multiple organ failure and even death.[1] The use of ventilation in patients in prone position should be considered in individuals with acute respiratory distress syndrome,[2,3] as this position seeks to improve the distribution of pulmonary stress and tension, and the relationship between ventilation and perfusion, lung mechanics and chest wall mechanics.[4]

The main complication resulting from prone positioning is the development of pressure injuries. These injuries are located over bony prominences and in soft tissues, may be superficial or deep, of ischemic etiology and secondary to an increase in external pressure.[5,6] Patients in prone position develop injuries mainly on the shoulders, nose, cheeks, forehead, mandible and sternum, among others.[5,6] According to a systematic review of the literature including 1,109 patients, those in prone position are at a 22-fold higher risk of developing pressure injuries.[7]

Pressure injuries represent a major challenge in the provision of care to COVID-19 patients hospitalized in the intensive care unit, as they increase hospital expenses, as well as physical and emotional impacts for patients and their families.[8,9]

When nurses perceive that the patient hospitalized in the intensive care unit to be placed in prone position presents risk factors for the development of pressure injuries, they must resort to preventive measures, since pressure injuries are an adverse event that can cause irreversible harm to patients.[9]

The provision of safe and quality care to these patients is directly related to the implementation of systematized care management actions that require planning, organization, execution and continuous evaluation of the care provided to hospitalized patients.

In this sense, the importance of the multidisciplinary team, especially nurses, stands out in the use of systematic actions for pressure injury prevention by managing preventive measures and directing conducts to patients' real needs. In addition to specific scientific knowledge, this requires a lot of sensitivity and a sense of observation regarding the maintenance of the skin integrity of patients under one's care.

Therefore, an algorithm in the form of a protocol with a brief step-by-step description of procedures can be developed. Algorithms are simple, direct, and easily accessible instruments that provide a complete view of clinical practice.[8,9] When using

algorithms in clinical practice, professionals develop the procedure in a standardized, systematized, individualized, personalized manner at a low cost.

The aim of this study was to develop and validate the content of two algorithms to guide frontline professionals in the prevention and treatment of pressure injury in COVID-19 patients in the prone position.

Methods

Study applied in the modality of technology production of the methodological development research type. A literature review in MEDLINE, SciELO and Latin American and Caribbean Literature on Health Sciences (Lilacs) databases was performed to build the algorithms. Articles published between 2018 and 2022 were searched and the review was performed in June 2021. The following controlled health science descriptors were used: "coronavirus infections"; "ventral decubitus"; "pressure injury"; as well as their corresponding terms in Portuguese and Spanish. The search strategy was determined by combining the selected descriptors and the Boolean operator "AND".

The inclusion criteria for the selection of publications were primary studies published in Portuguese, English and Spanish, available in full. Exclusion criteria comprised theses, dissertations, monographs, technical reports, case reports and articles that did not converge with the object of study after reading the abstract, as well as repeated publications. In the selection of articles identified during the literature review, the titles and abstracts were first read independently by two authors to ensure that the texts addressed the study topic and met the established inclusion criteria. In case of doubt about the selection, the publication was initially included and the decision on its selection was made only after reading its content in full.

The categories of the Agency for Healthcare Research and Quality, which cover six levels, were used to classify the level of evidence of studies: Level 1: evidence resulting from the meta-analysis of multiple randomized controlled clinical trials; Level 2: evidence obtained from individual studies with experimental design; Level 3: evidence from quasi-experimental studies; Level 4: evidence from descriptive studies (non-experimental) or qualitative approach; Level 5: evidence from case reports or experience reports; Level 6: evidence based on expert opinion.[10]

A total of 15,415 articles were identified after the search in health sciences databases. After reading the articles, 13 were selected for the construction of algorithms to guide health professionals in the prevention of pressure injury in COVID-19 patients in prone position (Figure 1).

Two algorithms were built from this survey, each comprising three main procedural steps (Figures 2 and 3).

Articles selected in the integrative literature review (13 articles) and classified according to the level of evidence are shown in chart 1.

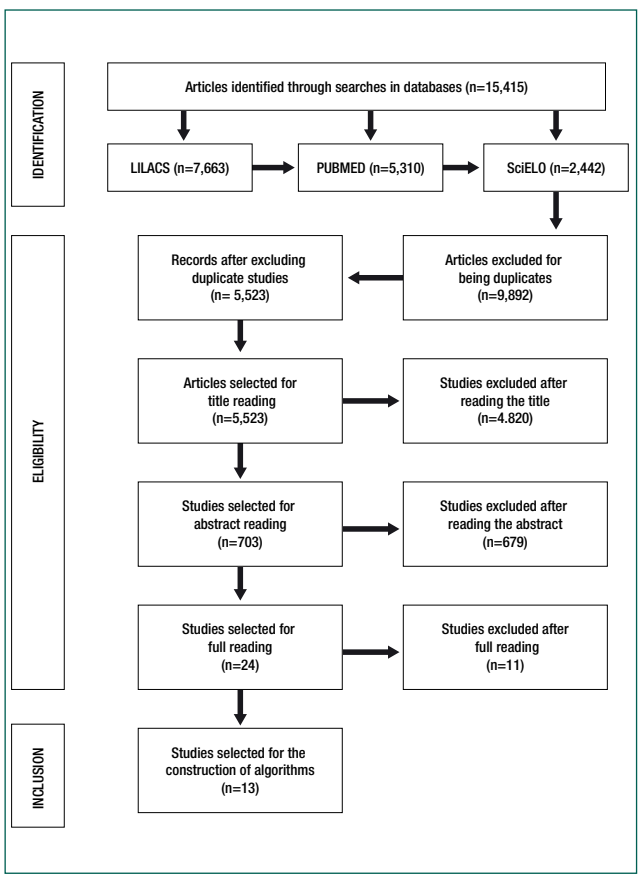

Figure 1. Flowchart of the process of identification, selection and inclusion of studies selected for the construction of algorithms, prepared based on the PRISMA recommendation

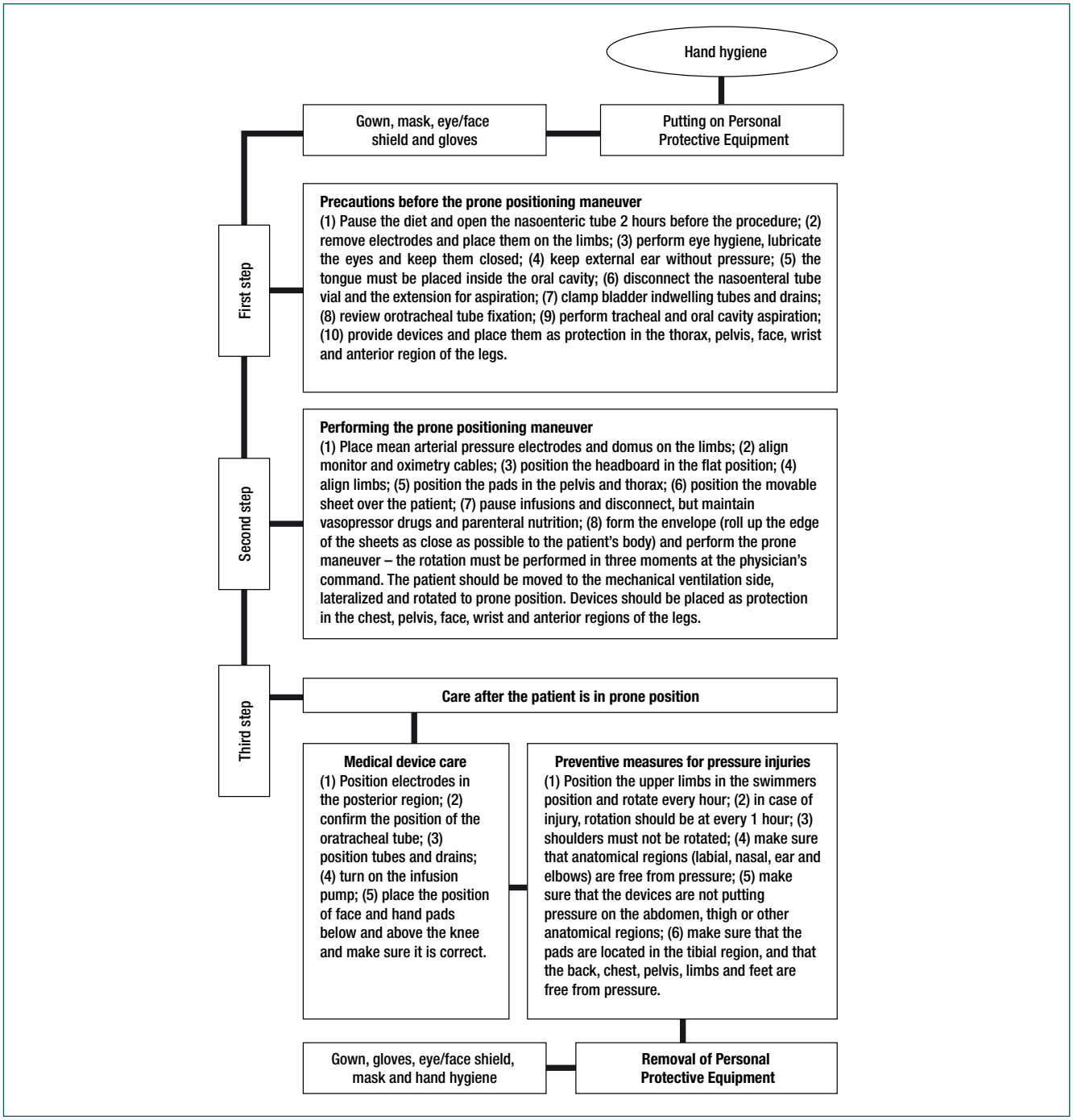

Figure 2. Algorithm for pressure injury prevention in COVID-19 patients in prone position. Care before, during and after the prone positioning maneuver.

First algorithm

For the first algorithm, after professionals perform hand hygiene and put on PPE, the first step corresponds to the care taken by them before prone positioning the patient. We sought to present well-defined instructions on care prior to prone positioning and address issues related to medical devices, diet administration, limb positioning, body hygiene and pressure injury prevention devices. The second step was focused on the technique to place the patient in prone position. It described the prone positioning technique and care with medical devices that professionals should have during the maneuver. The third step included preventive measures after

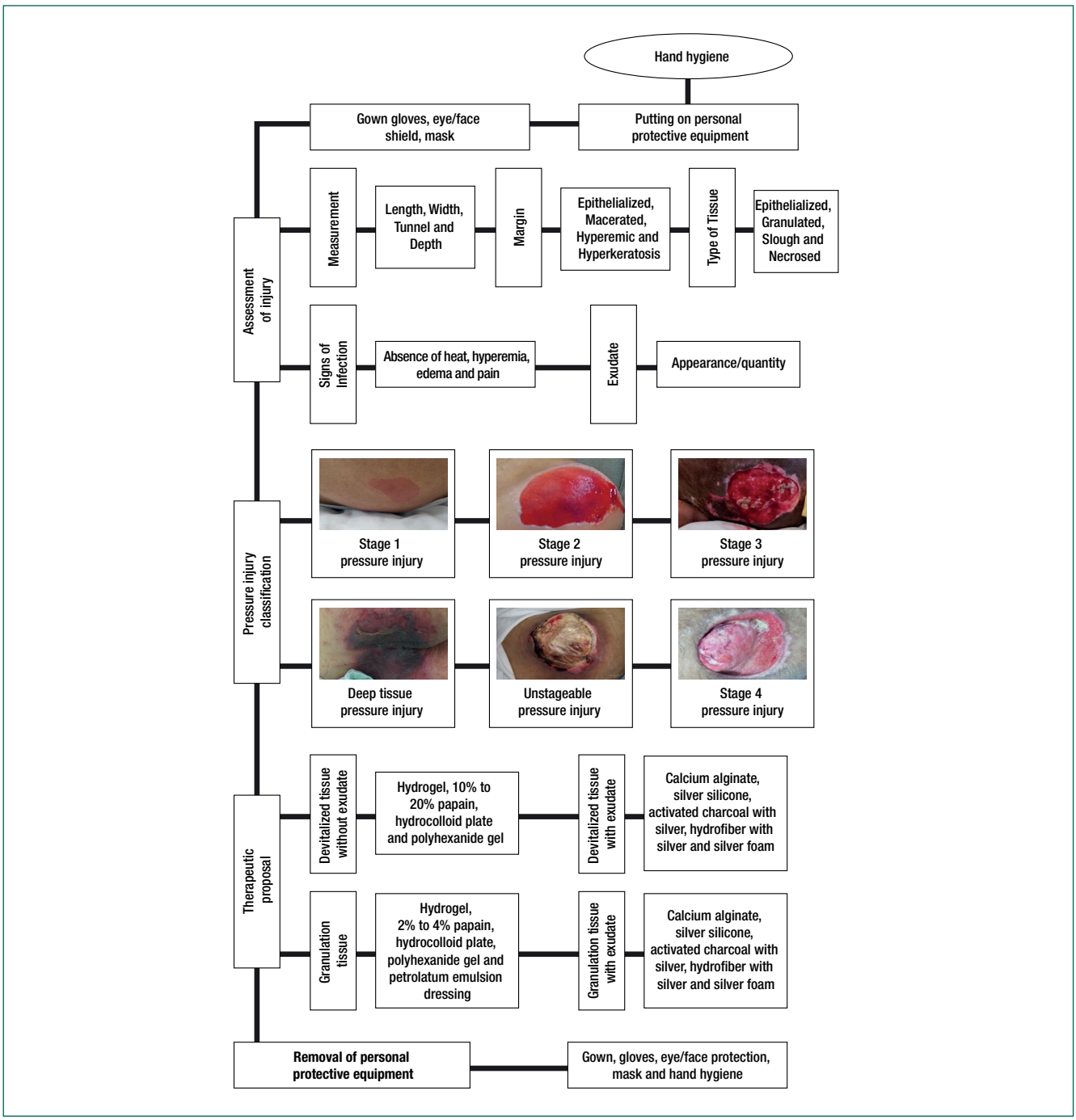

Figure 3. Algorithm for pressure injury prevention in COVID-19 patients in prone position. Evaluation and classification of pressure injuries and therapeutic proposal.

positioning the patient. At this step, the care with medical devices taken by professionals after placing the patient in prone position and the preventive measures against the development of pressure injuries after prone positioning were described. The algorithm ends with the health professional taking off the PPE.

Second algorithm

In the second algorithm, after professionals perform hand hygiene and put on PPE, clinical evaluation of the pressure injury was described, including measurement technique, type of tissue in the wound bed, type and amount of exudate, conditions of the adjacent skin, presence of edema, detachment/

Chart 1. Characteristics of articles selected through the integrative literature review for the construction of algorithms

Authorship		Title	Journal/Year/Vol/ Number	Level of evidence
01	Ballout RA, Foster JP, Kahale LA, Badr L. [11]	Body positioning for spontaneously breathing premature babies with apnea.	Cochrane Database Syst Rev 2017, Edition 1. Doi: 10.1002/14651858.	01
02	Smith V, Devane D, Nichol A, Roche D. [12]	Care bundles for improving outcomes in patients with COVID-19 or related conditions in intensive care - a rapid scoping review	Cochrane Database Syst Rev 2020, Edition 12. Doi: 10.1002/14651858.	01
03	Gillespie BM, Walker RM, Latimer SL, Thalib L, Whitty JA, McInnes E, Chaboyer WP. [13]	Repositioning for pressure injury prevention in adults.	Cochrane Database Syst Rev 2020, Edition 6. Doi: 10.1002/14651858.	01
04	Chua EX, Zahir SM, Ng KT, Teoh WY, Hasan MS, Ruslan SR, et al. [14]	Effect of prone versus supine position in COVID-19 patients: a systematic review and meta-analysis	J Clin Anesth. 2021;74:110406 Doi: 10.1016/j.jclinane.2021.110406.	01
05	Araújo MS, Santos MM, Silva CJ, Menezes RM, Feijão AR, Medeiros SM.[15]	Prone positioning as an emerging tool in the care provided to patients infected with COVID-19: a scoping review	Rev Lat Am Enfermagem. 2021;29:e3397. Doi: 10.1590/1518-8345.4732.3397.	01
06	Althunayyan S, Almutary AM, Junaidallah MA, Heji AS, Almazroua F, Alsofayan YM, et al.[16]	Prone position protocol in awake COVID-19 patients: a prospective study in the emergency department.	J Infect Public Health. 2022;15(4):480-5. Doi: 10.1016/j.jiph.2022.02.008.	03
07	Brazier DE, Perneta N, Lithander FE, Henderson EJ.[17]	Prone positioning of older adults with COVID-19: a brief review and proposed protocol.	J Frailty Aging. 2022;11(1):115-20. Doi: 10.14283/jfa.2021.30.	04
08	Smart H.[18]	Strategies for pressure injury prevention in patients requiring prone positioning.	Adv Skin Wound Care. 2021;34(7):390-1. Doi: 10.1097/01.ASW.0000753736.09708.98. 34125730.	04
09	Tacia LL, Foster M, Rice J, Elswick D.[19]	Pressure injury prevention packets for prone positioning.	Crit Care Nurse. 2021;41(3):74-6. DOI: 10.4037/ccn2021785. 34061192.	04
10	Santos VB, Aprile DC, Lopes CT, Lopes JL, Gamba MA, Costa KA, et al.[20]	COVID-19 patients in prone position: validation of instructional materials for pressure injury prevention.	Rev Bras Enferm. 2021;74(Suppl 1):e20201185. Doi: 10.1590/0034-7167-2020-1185.	04
11	Dirkes S, Dickinson S, Havey R, O'brien D.[21]	Prone positioning: is it safe and effective?	Crit Care Nurs Q. 2012;35(1):64-75. Doi 10.1097/CNQ.0b013e31823b20c6. 22157493.	04
12	Moore Z, Patton D, Avsar P, McEvoy NL, Curley G, Budri A, et al.[22]	Prevention of pressure ulcers among individuals cared for in the prone position: lessons for the COVID-19 emergency.	J Be careful. 2020; 29(6): 312-320. Doi: 10.12968 / jowc.2020.29.6.312.	04
13	Mitchell DA, Seckel MA. [23]	Acute Respiratory Distress Syndrome and Prone Positioning. PMID: 30523012..	AACN Adv Crit Care. 2018 Winter;29(4):415-425. doi: 10.4037/aacnacc2018161.	04

depth and presence of inflammation/infection. Next, the different stages of pressure injuries were presented, allowing their classification. The third step included the therapeutic approaches to treat pressure injuries, including the type of treatment and standardization of dressings, according to the type of tissue in the wound bed, type and amount of exudate and presence of inflammation/infection. The second algorithm ends with the health professional taking off the PPE.

Content validation of algorithms

The algorithms were validated using the Delphi technique, in which opinions from evaluators (judges) with specific knowledge in a given area are obtained by using questionnaires according to which the content of instruments is analyzed and evaluated in search of consensus among evaluators. Two or three evaluation cycles are usually required, and more may be needed.[24] The content validation of algorithms was performed by nurses, physical therapists and physicians who worked on the frontline of COVID-19. Criteria for inclusion of judges were: degree in nursing, physical therapy or medicine and being on the frontline of COVID-19 care. An invitation letter was sent to 79 health professionals, including the initial personal presentation, clarifications on the research topic, opinion of the Institutional Research Ethics Committee, explanations about the importance of the professional evaluator for the study and a step-by-step for the effective participation of judges. An eight-day period was established to complete the questionnaire for each round of evaluation and return the answers. Fifty-nine professionals agreed to participate in the study and returned the questionnaire within the requested period. Professionals who did not respond to the questionnaire within eight days were excluded. For the validation of algorithms, a specific questionnaire comprising the identification of the evaluator (four questions) and the evaluation of algorithms (15 questions) was sent to judges. The following topics were evaluated: graphic presentation, ease of reading, vocabulary, sequence of algorithm content, definition of prone position, nursing care with the patient before prone positioning, types of devices that should be used to prevent and treat pressure injuries, description of positioning technique, care of medical devices and preventive measures for pressure injury after prone positioning. A three-point Likert scale was used in the algorithm evaluation questions. The response options

were "totally adequate", "adequate" and "partially adequate". The Content Validity Index was used to measure the degree of agreement between judges on specific aspects of the developed algorithms that were examined through the evaluation questionnaire. The Content Validity Index value was calculated as the sum of the number of "adequate" and "totally adequate" responses divided by the total number of responses. The Content Validity Index must be greater than or equal to 0.80 (80% agreement between judges) when six or more judges participate in the validation of the instrument.[25] The Cronbach's alpha coefficient was used to assess the internal consistency of the evaluation questionnaire. The study was approved by the Institutional Research Ethics Committee under opinion number 4,845,558 (Certificate of Presentation of Ethical Appreciation: 47568821.6.0000.5102), and was performed from July 15 to August 1, 2021.

Results

The Cronbach's alpha coefficient varied between 0.95 and 0.96, indicating that all questions of the questionnaire used in the cycles of evaluation of the content of algorithms contributed favorably to an excellent internal consistency ($\alpha > 0.91$) of the instrument (Table 1).

In the first evaluation cycle, the items evaluated were classified between "partially adequate" and "totally adequate". The Content Validity Index ranged between 0.87 and 0.92. The material was revised based on suggestions presented by judges and there was a second evaluation cycle, in which all items were considered "adequate" or "totally adequate", resulting in a Content Validity Index of 1.0 that reflects 100% consensus among judges.

Discussion

The validated algorithms were developed after the literature review. These instruments can help health professionals who care for individuals hospitalized in an intensive care unit with clinical conditions indicative of placement in the prone position by offering preventive measures and therapeutic approaches for the treatment of pressure injuries. Algorithms are important educational materials for dealing with various problems in care and service management in intensive care units. A study validated by scientific evidence demonstrates that the algorithms have guidelines of a technical, organizational and political nature as their foundation, and focus on the standardization of clinical and preventive conducts when coping with COVID-19.[9,26]

The algorithm developed in this study proved to be an indispensable tool for the standardization of techniques and quality management in the health area, constituting an important means of communication and organization of work processes, thereby

Table 1. First and second evaluation of the content of algorithms by judges according to the Delphi technique and the resulting Content Validity Indexes and Cronbach's alpha coefficient

Evaluated items	First evaluation				Second evaluation				Cronbach's alpha
	PA	AD	TA	CVI	PA	AD	TA	CVI	
Is the content suitable for the target audience?	1(1.7)	14(23.7)	44(74.6)	0.90	0(0)	11(18.6)	48(81.4)	1.0	0.95
Is the text sequence logical and coherent?	0(0)	25(42.4)	34(57.6)	0.88	0(0)	12(20.3)	47(79.7)	1.0	0.96
Does the content facilitate learning?	1(1.7)	13(22.0)	45(76.3)	0.89	0(0)	9(15.3)	50(84.7)	1.0	0.96
Is the vocabulary accessible?	0(0)	6(10.2)	53(89.8)	0.90	0(0)	25(42.4)	34(57.6)	1.0	0.95
Is the language easy to assimilate?	0(0)	28(47.5)	31(52.5)	0.90	0(0)	28(47.5)	31(52.5)	1.0	0.95
Does the content clarify doubts about the topic?	0(0)	9(15.3)	50(84.7)	0.89	0(0)	6(10.2)	53(89.8)	1.0	0.95
Graphic presentation	0(0)	13(22.0)	46(78.0)	0.87	0(0)	13(22.0)	46(78.0)	1.0	0.96
Precautions before prone positioning	0(0)	12(20.3)	47(79.7)	0.91	0(0)	9(15.3)	50(84.7)	1.0	0.95
Prone positioning technique	0(0)	10(16.9)	49(83.1)	0.92	0(0)	10(16.9)	49(83.1)	1.0	0.95
Care of devices after prone positioning	0(0)	12(20.3)	47(79.7)	0.91	0(0)	12(20.3)	47(79.7)	1.0	0.95
Pressure injury prevention measures after prone positioning	0(0)	9(15.3)	50(84.7)	0.92	0(0)	9(15.3)	50(84.7)	1.0	0.95
Pressure injury classification	0(0)	22(37.3)	37(62.7)	0.88	0(0)	22(37.3)	37(62.7)	1.0	0.95
Pressure injury assessment technique	1(1.7)	19(32.2)	39(66.1)	0.92	0(0)	10(16.9)	49(83.1)	1.0	0.95

Results expressed by n (%); Cronbach's alpha coefficient - Excellent internal consistency ($\alpha > 0.91$); PA - Partially adequate; AD - Adequate; TA - Totally adequate; CVI - Content Validity Index

contributing to the decision-making of professionals in the choice of dressing used in the prevention and treatment of pressure injuries in COVID-19 patients in prone position.[9,27] This instrument was also important for the organization of processes, guidance of decision-making and the guarantee of safe care with as little risk as possible, without damage and adverse events.

Educational materials, such as protocols in the form of algorithms, are also effective methods to assist in the teaching and learning process in health and clinical practice, increasing professionals' autonomy and improving clinical practices.[28,29] Algorithms must be built after a literature review, so the educational technology developed is evidence based, allowing its implementation in clinical practice, as well as the provision of systematized, individualized and personalized care with less risk to the patient, without damage or adverse events.[28-30]

Expert judges in the field with experience in the treatment of COVID-19 patients approved the content of algorithms by consensus, indicating that such instruments have the potential to be used by the target audience, bringing advantages to health professionals. The algorithms present the correct technique for putting the patient in prone position and information on evaluation of the patient's skin before and after positioning, preventive measures and the dressing indicated for the treatment of pressure injuries.[29-31]

The use of an algorithm by professionals on the frontline of COVID-19 during care of these patients provides agility in the search for information, supports decision-making and diagnosis, and enables remote monitoring. This type of instrument must be developed with simple, clear and objective language, allowing the effectiveness of the educational technology, its greater reach among professionals and ease of understanding and execution of the procedure.[32]

In this study, the Delphi technique was used to evaluate the content of algorithms. The participation of experts in the validation process is essential to avoid inaccurate results that lead to erroneous conclusions.[32,,33] In several studies, the content of educational technology was validated using the Delphi technique and evaluators' suggestions were incorporated into the instrument. This procedure contributes to its greater effectiveness and the implementation of the material in the institution, allowing that the target audience understands its content and feels encouraged to use it.[34-35]

The validation of an algorithm with a Content Validity Index above 0.91 by professionals with experience in the area means that information contained in the instrument was considered as relevant. This is extremely important for the use of such technology as a tool in clinical practice and health education. Scientific validation by the target audience gives credibility to the material.[9,35,36,37]

The algorithms developed are intended to guide healthcare professionals on the frontline of COVID-19 in assistance to patients in a timely, effective, systematic, individualized, personalized way, with the least possible risk, without damages and adverse events, providing safe care.

The limitation of this study was related to the low number of expert responses. However, according to criteria proposed by the Brazilian Association of Technical Standards ISO/IEC 25062:2011, the number of judges included in the sample was considered adequate.

Conclusion

After the literature review, algorithms were developed to guide health professionals in the prevention and treatment of pressure injuries in COVID-19 patients in prone position. They were also validated by nurses, physical therapists and physicians working on the frontline to combat the disease, and consensus regarding content was achieved among judges in the second evaluation. The algorithms developed in this study contribute to innovation in the work of nurses, physicians and physical therapists, especially assisting in clinical decision-making and in preventive measures for pressure injuries in patients in prone position. In addition, it is expected that the tool will provide subsidies to keep the professional updated about the theoretical-practical approach to the content.

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Collaborations

Salomé GM, Almeida CB and Prudencio FM contributed to the study design, data analysis and interpretation, article writing, relevant critical review of the intellectual content and approval of the final version to be published.

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