Original Article

Asptraqueal mobile app validation for aspiration

Validação do aplicativo móvel Asptraqueal para aspiração

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ABSTRACT | OBJECTIVE: To develop and validate a multimedia application on a mobile platform to guide the step-by-step procedure of endotracheal cannula and upper airway aspiration. **METHODS:** The application was validated by 48 professionals using a Delphi technique. The Content Validity Index and Cronbach's Alpha Index were used for statistical analysis. **RESULTS:** In the initial evaluation, the content elements of the application were rated as "inadequate" to "fully designed." After implementing the recommended adjustments, the Asptraqueal application content was resubmitted for the second cycle with all items rated as "adequate" or "fully adequate." The Content Validity Index ranged from 0.87 to 1.0, this result characterizing the content between excellent and outstanding. The average Cronbach's Alpha coefficient was 0.86, which determines the good internal consistency of the instrument used to validate the application. **CONCLUSION:** The Asptraqueal app was validated for a professional evaluation of the area, for the content of the evaluation between judges. The app developed for endotracheal and airway risk can detect the risk of adverse events.

DESCRIPTORS: Endotracheal intubation. Suction. Mobile applications. Stomatherapy.

RESUMO | OBJETIVO: Construir e validar um aplicativo multimídia em plataforma móvel para guiar passo a passo o procedimento de aspiração da cânula endotraqueal e vias aéreas superiores. **MÉTODOS:** O aplicativo foi validado por 48 profissionais utilizando a técnica Delphi. Para análise estatística foi utilizado o Índice de Validade de Conteúdo e o índice de Alfa de Cronbach. **RESULTADOS:** No primeiro ciclo de avaliação, os itens do conteúdo do aplicativo Asptraqueal foram considerados pelos juízes como “inadequados” a “totalmente adequados”. Após implementados os ajustes sugeridos pelos juízes, o conteúdo do aplicativo Asptraqueal foi reenviado para o segundo ciclo de avaliação, no qual todos os itens foram julgados “adequados” ou “totalmente adequados”. O Índice de Validade de Conteúdo variou entre 0,87 e 1,0, tal resultado caracteriza o conteúdo entre ótimo e excelente. A média do coeficiente Alpha de Cronbach foi 0,86, determinando boa consistência interna do instrumento utilizado para validação do aplicativo. **CONCLUSÃO:** O aplicativo Asptraqueal- App foi validado por profissional com experiência na área, mostrando concordância do conteúdo entre os juízes na segunda avaliação. O aplicativo desenvolvido poderá dar suporte a ações educativas em saúde, contribuindo para que o profissional possa realizar aspiração do tubo endotraqueal e de vias aéreas superiores, com mínimo risco, sem dano e eventos adversos.

DESCRITORES: Intubação endotraqueal. Sucção. Aplicativos móveis. Estomaterapia.

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Introduction

The presence of the intubation cannula or tracheotomy prevents the patient from performing the normal mechanism of clearing the airway when coughing. This results in accumulation of secretions, which contributes to the development of pneumonia. It is worth noting that coughing is a natural reflex of the body to clear irritation of the lungs.[1-3]

Complications caused by this procedure, aspiration of the endotracheal tube and upper airway, include: Bronchial trauma, bronchospasm, pain, discomfort, changes in hemodynamic parameters and cerebral blood flow, increased intracranial pressure, and represents the main entry route for bacteria into the lower airway, contributing greatly to the occurrence of respiratory infections.[4-5]

Therefore, tracheobronchial aspiration consists of inserting a probe into the patient's airway to aspirate secretions. For this purpose, the aspiration probe must be connected to an aspirator with suction or negative pressure and to an aspiration catheter whose caliber is used at a ratio of 1/3 of the tracheal tube, so that there is fluid and gas movement, which promotes adequate oxygenation and prevents airway obstruction.[3,6-8]

Given the high number of patients admitted to the ICU or emergency department who require routine suctioning, it is paramount that the healthcare team develop protocols, algorithms, manuals, and applications and receive adequate training for the care associated with this procedure to minimize adverse effects.[9-12]

Healthcare professionals are following this innovation and have demonstrated through experience with the use of virtual learning environments that interactivity benefits the learning process and improves safe care without harming the patient.[13-14]

The use of clinical practice applications as a plan for computer-assisted support expedites the activities of collecting, registering, storing, processing, and retrieving patient data under the responsibility of medical staff. In addition to providing easy access to data, the application enables administrative instrumentation and supports decision making.[10,15-16]

There are few studies published between 2015 and 2020 to standardize recommendations for tracheobronchial airway suctioning. Therefore, it is important to improve the use of tracheobronchial suctioning technique and airway suctioning technique in terms of avoiding complications to promote patient well-being and comfort.

Therefore, it is important to highlight the importance of developing an application that allows healthcare professionals to consult quickly, so that they can provide assistance with the least possible risk, without causing harm and adverse events during the performance of this procedure.

The aim of this study is to develop and validate an application for healthcare professionals that provides step-by-step instructions for endotracheal tube and upper airway suctioning.

Method

This is a methodological study focused on the development, evaluation and improvement of methodological and technological tools and strategies. This study was conducted in the period from May to September 2020. It was approved by the Human Research Ethics Committee (CAAE: 97127218.4.0000.5102).

The incremental software development lifecycle model was chosen for the development of the application, following the PRAXIS protocol as the basis for the software development process.

The development and validation of the Asptraqueal application was developed in five phases:

Phase 1- Conception: identifying the need for the development of the application. The authors have found in their clinical practice in the care of patients requiring airway aspiration that many professionals and caregivers have difficulty performing the procedure correctly because they do not know the aspiration technique. This leads to risk, harm, and lack of patient safety.

Phase 2- Development of the prototype Asptraqueal application: The elaboration phase included two steps: integrative literature review and selection of articles for the construction of the Asptraqueal application.

The integrative literature search using the health sciences databases, Cochrane Library, SciELO (Scientific Eletronic Library Online), LILACS (Latin American and Caribbean Literature on Health Sciences), MEDLINE (National Library of Medicine-USA), using the descriptors in Health Science / Medical Subject Headings (DeSC/MeSH): endotracheal intubation, endotracheal intubation AND suction, articles published from 2010 to 2020, in Portuguese, English and Spanish.

Two basic inclusion criteria were established for the selection of publications to be included in the review: 1) only primary studies directly related to the topic; 2) they must be complete, as we wanted to compile all studies that met the established criteria. We excluded book chapters, dissertations, monographs, technical reports, reference works, and articles that did not match the proposed object of study after reading the abstract, as well as publications that were repeated in the databases and virtual library.

To classify the level of evidence of the selected studies, the Agency for Healthcare Research and Quality categories were used, which comprise six levels:

- Level 1: evidence from meta-analysis of multiple randomized controlled trials;
- Level 2: evidence obtained in individual studies with an experimental design;
- Level 3: evidence from quasi-experimental studies;
- Level 4: evidence from descriptive (non-experimental) studies or qualitative approach;
- Level 5: evidence from case or experience reports;
- Level 6: evidence based on expert opinion.

Phase 3- Building the software: The creation was done in collaboration with a system analyst, considering the specifics of computer technology required to create the desired product. After approval by the researchers, the development of the application began.

The testing procedure was carried out according to the steps described below:

Usability test: it was tested whether the user can use the software intuitively from the start screen to the result. The authors of the project used the software five times, performing the following: Patient registration, performance of endotracheal suctioning (closed and open system), upper airway and measurements of cuff pressure control, exchange, fixation of cannula or tracheostomy, notes.

Performance test: responsiveness after each command was evaluated. During the use of the software, the system analyst and the author of the project reviewed the initialization time, the screen changes, the termination of the software considering each screen: access to the software, registration of a new patient, performance of endotracheal suction (closed and open system), upper airway, measurements of balloon pressure control, exchange, fixation of the cannula or tracheostomy, notes.

Compatibility test with the theoretical framework: This test was divided into two stages - in the first stage, the information was checked at the semantic and syntactic level of the software content. In the second stage, the system was tested with the functional or black box test. This test was performed by the system analyst.

For the functional testing of the software, some devices were selected that were characterized by Android technology, mobile devices and had Wi-Fi for wireless network access, on which the usability and compatibility tests were performed. The entire testing process was performed by both the author and the system analyst.

Phase 4- Validation of the Asptraqueal-app: in choosing the number of evaluators, we followed the guidelines of Pasquale[17] who recommends six to twenty or more evaluators for content validation. Sixty professionals participated in this study.

The inclusion criteria were: Nurses and physical therapists with a bachelor's degree who consented to participate in the study by signing the free and informed consent statement. Professionals who agreed to participate in the research but did not respond and/or submit the questionnaire within eight days were excluded.

To validate the application, reviewers were emailed an invitation letter that included: an initial personal introduction and explanation of the research topic, a statement from the institutional research ethics committee, explanations of the importance of the professional reviewer to the research, and step-by-step instructions for effective reviewer participation. A deadline of eight days was set for completion of the questionnaire and submission of responses, calculated from the date the invitation was sent.

The specific questionnaire was divided into two parts: sociodemographic data of the evaluators with four questions and evaluation of the content of the application with 13 questions on the following topics: thematic content, graphic presentation, sequence, clarity and understanding of the information, endotracheal tube and airway aspiration technique, open and closed system, balloon measurement technique, material used for aspiration.

The judges evaluated the content of the application using the Delphi technique. To evaluate the application, the questions were answered using a Likert scale. The responses that the judges rated were classified as inadequate, partially adequate, adequate, and completely adequate.

Responses rated inadequate or partially adequate were not excluded. Corrections suggested by the judges were made to these questions, and the application was returned for the second round with a new assessment by the judges. Once the judges reached 100% agreement, validation was complete. This type of process is called the Delphi technique.

In the Delphi technique, the raters are experts in the field and consensus must be reached between 50 and 100% of the raters. In addition, the anonymity of the evaluators must be guaranteed. After making corrections to the rater's suggestions, the researchers must re-evaluate the instrument until a consensus is reached among all experts.

Data were compiled in a Microsoft ® Office 365, version 1812 spreadsheet and analyzed using descriptive statistics after coding and tabulation. The data were analyzed and correlated to determine the Cronbach's alpha coefficient to estimate the reliability of the instrument. The higher the covariances or correlations between items, i.e., the closer the determined value is to one, the greater the homogeneity of the items and the consistency with which they measure the same dimension or theoretical construct. Cronbach's alpha test $\alpha > 0.70$.

The Content Validity Index value for content validation of the application was calculated using the sum of the number of concepts "appropriate and completely appropriate" divided by the total number of responses. The Content Validity Index value must be greater than or equal to 0.80.

Results

Asptraqueal-App

The multimedia application on mobile platform, called "Asptraqueal-App", has 81 screens and 52 pictures, describing the techniques of endotracheal tube and upper airway suction. The application was registered at the National Institute of Industrial Property of the Ministry of Development, Industry and Foreign Trade (process number BR512018052435-4 and is available for free at http://www.aspiapp.com.br/

The opening of the application is defined by the logo of the Professional Master in Applied Health Sciences of the University of Sapucaí Valley and the name of the authors. Examples of screenshots of the application are presented in figures 1 and 2.

Figure 1. Examples of application screens. (*a*) Patient registration; (*b*) Endotracheal suction techniques menus, (*c*) Open suction system, (*d*) Closed suction system

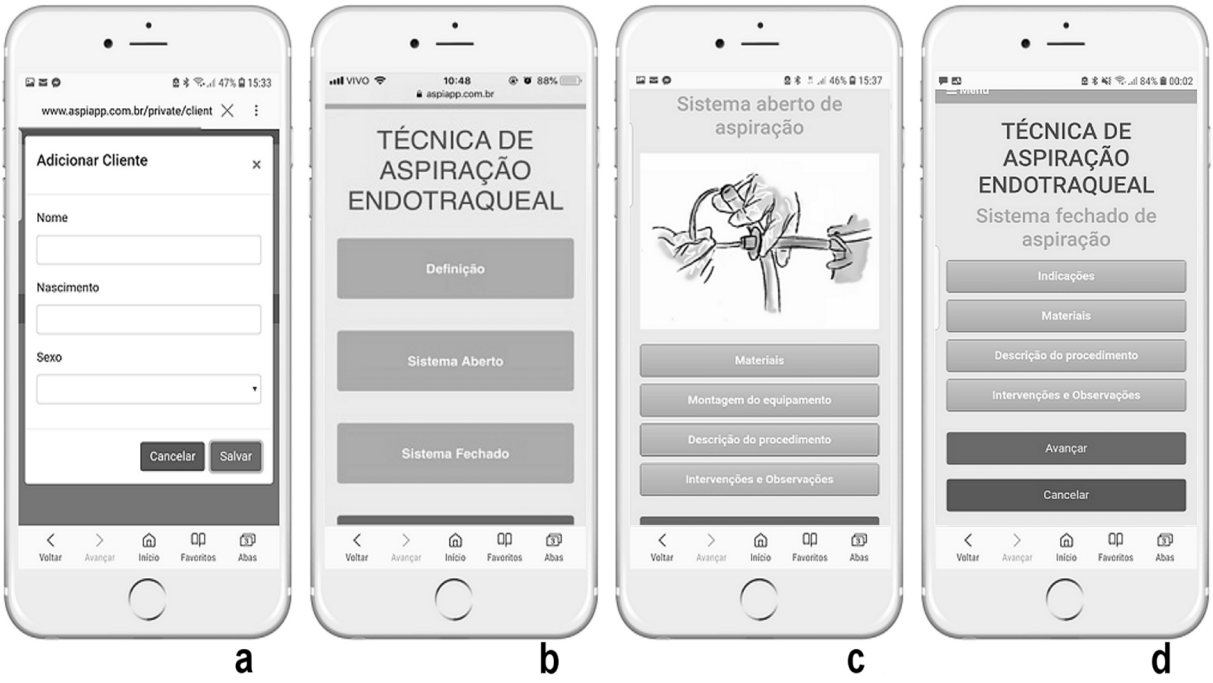

Figure 2 - Examples of application screens. (*a*) Optional data; (*b*) Partial text on cuff pressure measurement and illustration; (*c*) Illustrations of the tracheostomy fixation technique; (*d*) Screen for making notes. OCT, Orotracheal Cannula

After clicking the Enter icon, the user can enter the name of the registered patient and start the procedure. If the patient is not yet registered, the user must register them by entering their name, date of birth, and gender (Figure 3a). The user must then click Enter, which will open the Endotracheal Suction and Upper Airway Suction Technique Descriptions screen, where the user must select the technique they wishes to perform.

On the Endotracheal Suction Techniques screen (Figure 3b), the user can select the type of technique (open or closed system) and then has the option to select the type of material, equipment for suction, description of the procedure, and interventions (Figures 3c and 3d). The open system procedure consists of 25 screens and the closed system procedure consists of 15 screens.

After performing the procedures, the user can choose between Exit and Continue. The Next option leads to the Optional Data screen (Figure 4a), where the tracheal tube or tracheostomy cuff pressure measurement technique (consisting of eight screens) can be accessed (Figure 4b). The user can also review the techniques for fixation of the orotracheal tube (OCT) or tracheostomy (Figure 4c).

After finishing the endotracheal suctioning procedures, the user can perform the upper airway secretion suctioning procedure (consisting of eight screens). When the procedure is completed, the practitioner must access a screen to make annotations and review any previous annotations on the patient (Figure 4d).

During the initial evaluation, the judges rated the content of the application as inadequate to completely adequate. After the evaluators suggested corrections, the application was resent to the judges and rated as adequate and completely adequate (Table 1).

Table 1. Evaluation of the application content by the judges, according to the Delphi Technique

Questions	First evaluation							
	Inadequate		Partially adequate		Adequate		Totaly adequate	
	n	%	n	%	n	%	n	%
Graphical presentation	0	0	1	1.5	23	34.3	43	64.2
Ease of reading	0	0	7	10.4	32	47.8	28	41.8
Algorithm sequence	0	0	1	1.5	21	31.3	45	67.2
Vocabulary	0	0	0	0	17	25.4	50	74.6
Interventions for patient safety	1	1.5	2	3.0	18	26.9	46	68.7
Open suction technique	0	0	1	1.5	18	26.9	48	71.6
Closed system suction technique	0	0	5	7.5	30	44.8	32	47.8
Aspiration equipment set up	0	0	2	3.0	17	25.4	48	71.6
Pressure measurement of the tracheal tube cuff	0	0	0	0	14	20.9	53	79.1
Intubation tube fixation technique	0	0	2	3.0	14	20.9	51	76.1
Questions	**Second evaluation**							
	Inadequate		Partially adequate		Adequate		Totaly adequate	
	n	%	n	%	n	%	n	%
Graphical presentation	0	0	0	0	23	34.3	44	65.7
Ease of reading	0	0	0	0	32	47.8	35	52.2
Algorithm sequence	0	0	0	0	21	31.3	46	68.7
Vocabulary	0	0	0	0	17	25.4	50	74.6
Interventions for patient safety	0	0	0	0	18	26.9	49	70.1
Open suction technique	0	0	0	0	19	28.4	48	71.6
Closed system suction technique	0	0	0	0	13	19.4	54	80.6
Aspiration equipment set up	0	0	0	0	18	26.9	49	73.1
Pressure measurement of the tracheal tube cuff	0	0	0	0	14	20.9	53	79.1
Intubation tube fixation technique	0	0	0	0	18	26.9	49	73.1

Table 2 shows the internal consistency of the questionnaire used by the judges to validate the content of the application. The average Cronbach's Alpha was 0.84 and the Cronbach's Alpha of the questions ranged from 0.84 to 0.86. These results characterize that the instrument used to validate the application showed good internal reliability.

Table 2. Internal consistency of the questionnaire used by the professionals to evaluate the application's content

Question	*Cronbach's Alpha*
Graphical presentation	*0.84
Ease of reading	*0.84
Algorithm sequence	*0.85
Vocabulary	*0.85
Interventions for patient safety	*0.86
Open suction technique	*0.86
Closed system suction technique	*0.85
Aspiration equipment set up	*0.85
Pressure measurement of the tracheal tube cuff	*0.84
Intubation tube fixation technique	*0.85
Mean of Cronbach's Alpha Coefficient	*0.86

*Good internal consistency α>0.80 to 0.90.

In table 3, it is observed that in the first evaluation of the application content the content validity index ranged between 0.76 and 0.93. The overall content validity index was 0.90. In the second evaluation of the application's content, the content validity index ranged from 0.96 to 1.0. The overall content validity index was 0.99; such a result characterizes that the content of the application is excellent.

Table 3. Content validity index of the application related to the first and second evaluation

Questions	**Content Validity Index**	
	First Evaluation	**Second Evaluation**
Graphical presentation	*0.93	0.97
Ease of reading	**0.86	1.00
Algorithm sequence	*0.96	1.00
Vocabulary	*0.90	1.00
Interventions for patient safety	*0.90	1.00
Open suction technique	**0.76	1.00
Closed system suction technique	*0.93	1.00
Aspiration equipment set up	*0.93	1.00
Pressure measurement of the tracheal tube cuff	*0.93	1.00
Intubation tube fixation technique	*0.93	1.00
General CVI	***0.90**	*0.99

Excellent (greater than or equal to *0.90). Good (less than or equal to **0.80)

Discussion

The application was developed based on information obtained from an integrative literature review with the goal of providing technical, clinical, and technological subsidies to provide information related to the endotracheal tube and upper airway suctioning technique. When this procedure is performed correctly, the professional provides assistance with the lowest possible risk, without damage and adverse events, in short, assistance with safety and quality.

The design of the application must rely heavily on literature and clinical evidence to provide technological, technical, clinical, administrative, and financial support, always with the goal of improving patient care and achieving the best outcomes for the institution.[12,15-18]

Health applications are technologies that guide clinical care decision making, add scientific rationality, and serve as guides for clinical diagnosis, self-care, prevention, and treatment of chronic and acute diseases.[10,16]

They provide information on the best prophylactic and therapeutic behavior to be applied in any clinical evaluation and procedures performed by health professionals, which confirms their suitability and acuity as a tool to guide care. The preparation and structuring of the application should consist of the evaluation of the application by a professional with knowledge in the field, the care measures, and the therapeutic proposal.[12,15,18]

A study conducted using an integrative literature review reported the great risk of aspiration failure and complications for the patient. When not performed using techniques based on scientific evidence, it is concluded that there is a need for improved training of professionals, development of care protocols, and practical mobile resources such as apps.[19]

A similar study used structured observation to identify errors in care provided by the nursing team during endotracheal suctioning in intensive care units. The findings were that 63.2% of procedures did not disinfect hands before suctioning, 94.7% did not use goggles, 89.5% did not increase the oxygen fraction, 68.4% had suction times greater than 15 seconds, 78.9% did not use oral decontamination with antiseptic, and 76.3% were not recorded in medical records. It was concluded that guidelines were not always considered during aspiration procedures.[5]

The content of the application developed in this study was evaluated by a physiotherapist and a nurse with experience in the field using the Delph technique, and the evaluators agreed on the second evaluation. These results confirm those of other authors.[10,16,20]

Several studies that have validated the content of protocols, primers, applications, and algorithms using the Delphi technique have reported that corrections to the content should be made according to the suggestions of the evaluators on a scientific basis, as they contribute to better understanding, effectiveness, and implementation of the material in the institution and allow professionals to choose the best preventive and therapeutic measures, leading to safe care without harm and with the lowest possible risk and reducing treatment costs.[10,16,20]

Applications used by health professionals are considered important tools for solving various problems in the care and management of health services. Scientifically validated studies are based on technical, organizational, and policy guidelines. They also focus on standardization of clinical, surgical, and preventive procedures.[10,16,20]

The application developed in this study provides relevant information on the best suctioning technique for the endotracheal tube and upper airway, as well as on the preventive measures that should be taken to avoid respiratory infections, to guide healthcare professionals more confidently in their assessment and decision-making before an intubated patient or a patient with a tracheostomy who requires suctioning.

In this context, the use of this application for endotracheal suctioning and upper airway aspiration has the social impact of providing medical personnel with a theoretical and practical basis, as well as standardizing the evaluation, preparation, and technique of endotracheal and upper airway aspiration, resulting in improved patient care, individualized and systematized care with greater safety for the health professional and the patient.

Conclusion

The Asptraqueal- App was validated by a professional with experience in the area, showing agreement of the content between the judges in the second evaluation. And it may support health educational actions, contributing to the professional's ability to perform endotracheal tube and upper airway aspiration with the least possible risk. With safe, quality care.

Authors' contributions

Rosa GCM and Rosa JI contributed to the conception of the work, in the writing of the article, and in the final approval of the version to be published. Salomé GM contributed to the conception of the work, interpretation of the findings, and final approval of the version to be published.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, among others) have been declared in any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, and others).

References

1. Balbino CM, Braz MR, Medeiros JC, Rodrigues LMS, Silvino ZR. Evaluation of aspiration technique on the patient with mechanical ventilation performed by nursing. Rev Enferm UFPE Online [Internet]. 2016;10(Supl. 6):4797-803. Available from: https://periodicos.ufpe.br/revistas/revistaenfermagem/article/viewFile/11258/12880

2. Donoso MTV, Pertussati E, Simino GPR, Lima LKB, Mattos SS, Silva BVO. Conditions involved in the performance of tracheostomy in intensive care unit patients. Enferm Foco [Internet]. 2021;12(3):469-74. Available from: http://revista.cofen.gov.br/index.php/enfermagem/article/view/3737/1189

3. Beccaria LM, Doimo TMA, Polletti NAA, Barbosa TP, Silva DC, Werneck AL. Tracheal cuff pressure change before and after the performance of nursing care. Rev Bras Enferm. 2017;70(6):1145-50. https://doi.org/10.1590/0034-7167-2016-0486

4. Avelino MA, Maunsell R, Valera FCP, Lubianca Neto JF, Schweiger C, Miura CS, et al. First Clinical Consensus and National Recommendations on Tracheostomized Children of the Brazilian Academy of Pediatric Otorhinolaryngology (ABOPe) and Brazilian Society of Pediatrics (SBP). Braz J Otorhinolaryngol. 2017;83(5):498-506. https://doi.org/10.1016/j.bjorl.2017.06.002

5. Furtado ÉZL, Santos AMR, Moura MEB, Avelino FVSD. Endotracheal aspiration: healthcare team practices in care for critical patients. Rev Enferm UFPE Online [Internet]. 2013;7(esp):6998-7006. Available from: https://periodicos.ufpe.br/revistas/revistaenfermagem/article/viewFile/12369/15112

6. Gonçalves RL, Tsuzuki LM, Carvalho MG. Endotracheal suctioning in intubated newborns: an integrative literature review. Rev Bras Ter Intensiva [Internet]. 2015;27(3):284-92. Available from: https://www.scielo.br/j/rbti/a/7dzrjPVMWPhpzmBmww3XTYz/?format=pdf&lang=pt

7. Carmo AFS, Korinfsky JP, Xavier CC, Mendes RNC, Nunes GFO, Silva RM. Nursing in ventilatory assistance: analysis of endotracheal aspiration in the intensive care unit. Rev Enferm UFPE Online [Intetnet]. 2013;7(12):6800-7. Available from: https://periodicos.ufpe.br/revistas/revistaenfermagem/article/downloadSuppFile/12341/9168

8. González-Samartino M, Delgado-Hito P, Adamuz-Tomás J, Viso Cano MF, Castellà Creus M, Juvé-Udina ME. Accuracy and completeness of records of adverse events through interface terminology. Rev Esc Enferm USP. 2018;52:e03306. https://doi.org/10.1590/S1980-220X2017011203306

9. Salomé GM, Ferreira LM. Developing a Mobile App for Prevention and Treatment of Pressure Injuries. Advances in Skin & Wound Care. 2018;31(2):1-6. https://doi.org/10.1097/01.asw.0000529693.60680.5e

10. Cunha JB, Dutra RAA, Salomé GM, Ferreira LM. Computational system applied to mobile technology for evaluation and treatment of wounds. J Nurs UFPE Online. 2018;12(5):1263-72. https://doi.org/10.5205/1981-8963-v12i5a230677p1263-1272-2018

11. Carvalho MRF, Salomé GM, Ferreira LM. Construction and validation of algorithm for treatment of pressure injury. J Nurs UFPE Online. 2017;11(Suppl. 10):4171-83. Doi: 10.5205/reuol.10712-95194-3-SM.1110sup201722

12. Salome GM, Rosa GCM. Mobile application to support endotracheal tube and upper airway aspiration. Saúde (Santa Maria). 2020;46(2):e41729. https://doi.org/10.5902/2236583441729.

13. Salomé GM, Mendonça ARA, Almeida MVT, Miranda FD. A Mobile Application to Guide Healthcare Professionals in the Correct Technique for Personal Protective Equipment Use During the COVID-19 Pandemic. Journal of Coloproctology. 2021; 41(04):383-92. Doi.org/10.1055/s-0041-1739372

14. Salomé GM, Rocha CA. Mobile application for evaluation, prevention and treatment of dermatitis associated with incontinence. Rev Enferm Contemp. 2020;10(1):1-9. https://doi.org/10.17267/2317-3378rec.v10i1.2963

15. Cardoso IA, Salomé GM, Miranda FD, Alves JR, Leão JPP, Leão AS, et al. A new APP for prevention and treatment of complications of intestinal peristomal skin. J. Coloproctol. 2020;40(2):120-8. https://doi.org/10.1016/j.jcol.2019.10.011

16. Pasquali L. Principles of elaboration of psychological scales. Rev Psiq Clin [Internet]. 1998;25(5):206-13. Available from http://www.hcnet.usp.br/ipq/revista/vol25/n5/conc255a.html

17. Pereira FGF, Rocha DJL, Mel GAA, Jaques RMPL, Formiga LMF. Building and validating a digital application for the teaching of surgical instrumentation. Cogitare Enferm. 2019;24(11):1-11. http://dx.doi.org/10.5380/ce.v24i0.58334

18. Lopes VJ, Muller F, Souza MAR, Silva IA. Endotracheal suction in patients hospitalized in icu with artificial airway in invasive mechanic ventilation. Rev. enferm. Cent.-Oeste Min. 2018;8:e1973. https://doi.org/10.19175/recom.v8i0.1973

19. Salomé GM, Cunha AL, Pereira AP, Miranda FD, Alves JR. Educational handbook for healthcare professionals: Preventing complications and treating peristomal skin. J. Coloproctol. 2019; 39(4):332-8. https://doi.org/10.1055/s-0041-1735460

20. Salomé GM, Mendonça ARA, Almeida MVT, Miranda FD. A Mobile Application to Guide Healthcare Professionals in the Correct Technique for Personal Protective Equipment Use During the COVID-19 Pandemic. J Coloproctol 2021;41(4):383–92. https://doi.org/ 10.1055/s-0041-1739372