Nursing Alert® mobile app to support nurses in identifying patient clinical deterioration

Aplicativo móvel Nursing Alert® para apoio ao enfermeiro na identificação da deterioração clínica do paciente

Aplicación móvil Nursing Alert® para apoyo al enfermero en la identificación del deterioro clínico del paciente

Lidiane Soares de Andrade[I] ; *Renata Flavia Abreu da Silva[I]* ; *Teresa Tonini[I]*

[I]*Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil.*

ABSTRACT

Objective: to describe the development of a hybrid, cross-platform, mobile application to assist nurses in systematizing their care in view of the risk of clinical deterioration of hospital patients. **Method:** descriptive study of the development of a hybrid, cross-platform, mobile application, through the conception, elaboration and construction phases of the Rational Unified Process of software engineering. **Results:** the name and logo of the Nursing Alert® application associate it with its function as an Android® and iOS® version mobile application registered with Brazil's National Industrial Property Institute. The target users, nurses, need to enter their professional registration number and patient vital signs information. Once downloaded, no Internet access is required. **Conclusion:** the Nursing Alert® mobile app can be an accurate, dynamic tool to assist nurses in their clinical judgment and priority setting for their patients.

Descriptors: Patient Admission; Clinical Deterioration; Mobile Applications; Nursing Informatics.

RESUMO

Objetivo: descrever o desenvolvimento de um aplicativo móvel híbrido multiplataforma para auxiliar o enfermeiro na sistematização de sua assistência diante do risco de deterioração clínica do paciente internado no espaço hospitalar. **Método:** estudo descritivo para elaboração de aplicativo móvel híbrido multiplataforma baseado no processo de engenharia de *software Rational Unified Process*, por meio das fases de concepção, elaboração e construção. **Resultados:** o nome e a logo do aplicativo *Nursing Alert* **®** associa-o à sua função como aplicativo móvel, versão para Android® e iOS® e registrado no Instituto Nacional de Propriedade Industrial. O enfermeiro, usuário-alvo, necessita inserir o seu registro profissional e as informações referentes ao paciente a ser analisado. Não necessita de rede *internet* após o seu *download*. **Conclusão:** o aplicativo móvel *Nursing Alert* pode ser uma ferramenta dinâmica e precisa para auxiliar o enfermeiro em seu julgamento clínico e definição de prioridades para seus pacientes.

Descritores: Admissão do Paciente; Deterioração Clínica**;** Aplicativos Móveis; Informática em Enfermagem.

RESUMEN

Objetivo: describir el desarrollo de una aplicación móvil híbrida multiplataforma para ayudar al enfermero en la sistematización de su asistencia frente al riesgo de deterioro clínico del paciente internado en el ámbito hospitalario. **Método:** estudio descriptivo para la elaboración de una aplicación móvil híbrida multiplataforma basada en el proceso de ingeniería de *software Rational Unified Process*, a través de las etapas de concepción, elaboración y construcción. **Resultados:** el nombre y el logo de la aplicación Nursing Alert® la asocia a su función como aplicación móvil, versión para Android® e iOS® y patentada en el Instituto Nacional de Propiedad Industrial. El enfermero, usuario objetivo, debe ingresar su matrícula profesional y las informaciones del paciente a ser analizado. No hace falta conexión de Internet una vez hecha la descarga. **Conclusión:** la aplicación móvil Nursing Alert® puede ser una herramienta dinámica y de precisión para ayudar al enfermero en su juicio clínico y en la definición de prioridades para sus pacientes.

Descriptores: Admisión del Paciente; Deterioro Clínico; Aplicaciones Móviles; Informática Aplicada a la Enfermería.

INTRODUCTION

Slightly more than ten years ago, with the advent of smartphones, development of software programs for mobile use in this type of electronic device has been ever increasing: they are the so-called applications or apps[1]. Various knowledge areas have benefited from this mobile technology; and the health area could not be the exception, with emphasis on Nursing care. Easy access to tools such as calculators for medication doses, guidance on the prevention of cardiovascular diseases and even ways of recording the Nursing Process are examples of how apps can be used in the nurses' professional routine[2,3].

Research Article
Artigo de Pesquisa
Artículo de Investigación

Andrade LS, Silva RFA, Tonini T
Nursing Alert® for nurses' support

DOI: http://dx.doi.org/10.12957/reuerj.2022.65600

Despite the difficulties associated with the use of these technologies, such as accessibility to the Internet network and usability of the software programs, apps have been developed for use with tablets and notebooks in health care environments. This tends to improve the records and, consequently, communication among health professionals, which is one of the Patient Safety goals[3].

Communication systems have been recommended in critical situations, such as in the face of clinical deterioration of a given patient. The literature defines clinical deterioration as "a complication described in health environments and that can develop at any moment during a patient's hospitalization"[4]. Attributes such as dynamic status, subjective and objective aspects and decompensation have been used to determine clinical deterioration. Dynamic status is identified through the variation in the physiological parameters, considering their negative evolution. The objective aspects, which point to clinical deterioration, are associated with the hemodynamic evaluation through vital signs, and the subjective aspects are seen as intuition and the feeling of "concern" in relation to the patients referred. In turn, decompensation, which is also considered a synonym to clinical deterioration, refers to inability of the body to "maintain the homeostatic function, either physiologically or psychologically"[4].

Quick response teams were devised to intervene early in time, considering early identification of clinical deterioration and the risk related to cardiopulmonary arrest[5]. Scores resulting from predetermined values to the vital signs measured were also created with the objective of allowing the identification of clinical deterioration, such as the Early Warning Scores (EWS) and their modified version: MEWS (Modified Early Warning Score)[6,7]. BTF (acronym for Australian Between the Flags) is a single-track system and only needs a single change in the vital signs to trigger the care flow. Q-ADDS (acronym for Queensland Adult Deterioration Detection System) is a screening and triggering system that combines alert thresholds for the quick response teams and a score aggregated across several parameters. As diverse evidence indicates that systems with aggregated scores offer better predictive validity, this ends up having particular importance with regard to Patient Safety, as well as to the use of clinical resources[8]. NEWS (acronym for National Early Warning Score) is an aggregated system for standardizing the response process to clinical deterioration implemented in the United Kingdom and used in the screening of the patients' clinical conditions in order to trigger a clinical response. NEWS is based on six physiological parameters and on supplementary oxygen use, where each of them is assigned a score according to the variation found in the change of each parameter. Based on the aggregate score, there is guidance regarding the clinical responses and the demand for necessary care[9].

It is noticed that the score calculations are based on the vital signs routinely measured in the patients, based on the score obtained, which allows defining systematized actions, describing the patient's health status and directing care, grounded on validated protocols for assistance support, in addition to suggesting better allocation for these patients[6-9].

Scores have been used not only to predict clinical deterioration[8,10] in patients admitted to clinical units, but also to plan their discharge after hospitalization in Intensive Care Units (ICUs)[9] or to predict the need for their readmission[11]. Training of medical students in the recognition of clinical deterioration[12] and promotion of objective and systematic responses, in addition to its universal applicability and the potential for automation[10], have also been potentialities associated with the early warning scores.

Limitations have also been associated with the warning scores, such as: non-computerized use; non-continuous monitoring; inaccuracy in measurement of respiratory frequency - one of the frequent parameters in the scores; absence of a parameter related to the nurse's subjective assessment and questionable predictive value[10]. However, the fact stands out that there are no robust studies that contraindicate their use or that prove the absence of benefits in the prevention of adverse events, or even encourage their clinical application, as well as the scientific production associated with them.

Physiological changes compatible with progressive clinical deterioration are frequently found hours or even days before a severe critical event[8,10]. Data from the European Surgical Outcomes Study (EuSOS) showed that 73% of the deaths were in wards, with no previous transfers to any intensive care unit. The authors point out that, in wards, clinical supervision and monitoring are not continuous but intermittent and that, depending on the health system, there are fewer specialist physicians available[10]. This said, it is noted that delays in diagnosis and treatment can result in unforeseen ICU admissions, or even in severe complications leading to permanent disability or death.

When referring to the settings in which patients are sometimes in an acute or chronic state or even hemodynamically unstable, the urgent need for continuous and dynamic monitoring is pointed out. However, due to the fact that non-continuous and non-invasive clinical monitoring prevails in these care loci, such as wards, there is a major challenge in providing care with higher quality and safety levels, given the risk of clinical deterioration in the patient.

Research Article
Artigo de Pesquisa
Artículo de Investigación

Andrade LS, Silva RFA, Tonini T
Nursing Alert® for nurses' support

DOI: http://dx.doi.org/10.12957/reuerj.2022.65600

In this context, performance of the Nursing team stands out, which permeates all health care scenarios, dealing with individuals in different situations, such as in clinical or surgical hospitalization units, for example. The entire stress involving hospitalization is to be considered, mainly due to the surgical process and to all the prerogatives surrounding it[13].

Nursing care, uninterrupted during hospital care and focused on the patients' needs, tends to allow nurses to early identify clinical abnormalities[10]. Conjecturing this situation with the use of early warning scales, it is assumed that a dynamic, fast and accurate tool can help nurses sustain their critical thinking and develop skills to diagnose priorities in their patients. Regarding early identification of clinical deterioration, potentialities are noticed in a more proactive way, in order to meet this demand "at the bedside".

Thus, the objective of the current study is to describe the development of a multiplatform hybrid mobile app to assist nurses in systematization of the care they provide in the face of the risk of clinical deterioration in patients hospitalized in hospital spaces.

THEORETICAL FRAMEWORK

Identification of clinical deterioration was based on Wanda de Aguiar Horta's Theory of Basic Human Needs (BHNs), in order to evidence the determination of physiological/clinical priorities to be identified and defined as goals for the patients[14]. Florence Nightingale's Environmental Theory was used to define patients' allocation, according to their clinical condition, considering the concept of environment and its physical, social and psychological components as interrelated to and influencing the patients' clinical outcome[15].

As a suggestion to the stages related to the Nursing Process, a number of taxonomies were considered, such as the diagnoses from NANDA International, Inc. and from ICNP (International Classification for Nursing Practice), as well as the NIC (Nursing Interventions Classification) to standardize Nursing interventions and the NOC (Nursing Outcomes Classification) for the results[16]. Considering the common causes of clinical deterioration and evolution to cardiopulmonary arrest, the protocols published by the AHA (American Heart Association)[17] and the Latin American Institute for Sepsis (*Instituto Latino-Americano para a Sepse*, ILAS) were also used[18].

The multiplatform hybrid mobile app was designed using the Rational Unified Process (RUP), which consists in a software engineering process created to support the object-oriented, systematic development and unified modeling language created by the Rational Software Corporation[19].

METHOD

A descriptive study in the technological production modality and carried out by means of data focused on the description of the element analyzed: the mobile app. Step-by-step description of the creation of an Information and Communication Technology (ICT) product, focused on clinical nurses' routine.

Topics

The idea of working on care systematization in identifying the risks of clinical deterioration in the hospital environment refers to the identification of physiological parameters translated into signs that indicate to the professionals the state of decline in the patients' clinical condition. In addition to that, it allows determining actions that positively interfere in a timely manner, translating the patients' health status, establishing care priorities, and using safe performance criteria and appropriate setting for the clinical condition identified.

Thus, Figure 1 presents the topics to be included in the app.

Early Warning Score - Warning scale, based on a system of assigning points (scores) to the vital parameters, with the main purpose of early identifying the risk of physiological deterioration in the patients[10].
Care flow - Actions that should be duly systematized to be implemented, according to the score resulting from the sum corresponding to the patients' vital signs.
Nursing diagnoses - A taxonomy that standardizes the description corresponding to the patients' health status, assisting in directing the care to be provided[16].
Nursing interventions - Direct or indirect care to be initiated, by means of the priority Nursing diagnosis established[16].
Suggested protocols - A set of pre-established and validated criteria to be met in the face of changes in certain physiological parameters.
Suggested location - Indication of the patients' allocation within the hospitalization unit, according to the surveillance degree necessary for their risk of clinical deterioration.

FIGURE 1: Topics to be included in the app. Rio de Janeiro, RJ, Brazil, 2019.

Development of the App

The methodology chosen to develop this multiplatform hybrid mobile app was based on the four phases described by Sommerville (2007)[20]; however, only the first three were considered in this study: design, elaboration and construction phases.

In the design phase, the main requirements for the system were established and the project scope was defined, as well as its target users and the context considered for its use. The chosen topics were selected, as well as the order in which they will appear and the interaction for them to be made available, the activities to be offered and the definition that it would be a mobile app targeted at nurses, whose scenario would be the hospital space.

In the elaboration phase, the architecture for developing the app was established, considering the use context, its main function, what is expected from its performance, the target users, the scope and how this content will be made available. In this phase, the screens that would comprise the app their layout order were defined, as well as its main function of assisting in detection of the risk of clinical deterioration, by nurses and in the hospitalization space.

In the construction phase, software components were developed or acquired, with a focus on developing components and other system resources, such as most of the coding. This part was in charge of a collaborator, based on the definitions included in the design and elaboration phases.

The last stage, called "transition", was not included in this study, as it covers delivery of the software to the target users and the testing phase, to enable its analysis and how it will be handled by the end users. The need for user training is highlighted, as well as testing the beta version of the system, in order to ensure an adequate quality level[20].

As this study does not involve human beings, research ethics appraisal was waived, according to Resolution No. 510/2016[21].

RESULTS

The app had its digital interface developed by a collaborator, in the multiplatform hybrid mobile app model, with a version for use on Android® and iOS®, based on a scope defined in the theoretical arsenal. It is based on topics and on a structure aimed at meeting the objective of systematizing Nursing care in the face of the risk of clinical deterioration in hospitalized patients through MEWS (Modified Early Warning Score). The layout was designed in order to offer ease of use and an interaction and information environment to ground nurses' clinical reasoning. Nurses will be allowed to use the app when they introduce their previous professional registration. All the information provided will be stored and consulted by means of the ID, respecting the patients' privacy and meeting the users' preferences. The app allows as many evaluations as necessary, with specific date and time and on screens with guidance, without loss of content, consulting the follow-up and any other information, according to the users' need. Only a mobile device will be required to use the app, be it a smartphone or a tablet, with no need for it to be connected to an Internet network after download.

The flow of the intended actions is determined by the following: calculation of the score based on the vital signs as an alert triggering all information contained in the app, leading to care to direct the Nursing actions, based on the priority Nursing diagnoses to identify the patients' status. Subsequently, the Nursing interventions to guide the care plan and the suggested location to organize care planning are presented, according to the specificities of the service.

Development of the app gave rise to 13 screens, the main ones being presented below:

Home screen

It offers a space for introducing the nurses' registration number in the COREN (Regional Council of Nursing) professional entity and their corresponding region, in compliance with Resolution No. 358/2009 of the Federal Council of Nursing (COFEN), on nurses' exclusive performance in the Systematization of Nursing Care[22].

The home screen also includes the icon that reinforces the identity of the mobile app, as well as a brief description and the logos of the funding agencies which made its development possible, in addition to the author-researchers' line of research[1].

The name chosen for the app was Nursing Alert®, as it is an instrument aimed at alerting nurses about the patients' clinical status. Its logo features a heart with an electrocardiogram tracing, reinforcing that it as an instrument which

Research Article
Artigo de Pesquisa
Artículo de Investigación

Andrade LS, Silva RFA, Tonini T
Nursing Alert® for nurses' support

DOI: http://dx.doi.org/10.12957/reuerj.2022.65600

enables guidance on priority interventions to minimize the risk of death. It is classified as a mobile app of the subtype comprising computer apps, multimedia and others of T1 stratification and was registered at the National Institute of Industrial Property (*Instituto Nacional de Propriedade Industrial*, INPI) as a computer program, under number BR512019002951-8[23].

Identification screen

It is intended for monitoring the evaluations carried out and the place where the diverse information referring to the patient being evaluated by the nurse will be exposed, with date, time and score assigned. The term "identification" was chosen to allow using numbers or initials, according to the users' preference (Figure 2).

Users can include a patient to be evaluated, as well as exclude those whose clinical outcome was hospital discharge or death.

Monitoring screen

It allows monitoring the evaluations; it will appear when the bed is selected. It contains all the information previously collected, including parameters, date, time and score assigned, according to MEWS (Figure 2).

Vital Signs screen

It is intended to include the vital signs, which will be the base parameters for calculating the score: respiratory frequency (RF), axillary temperature (T_{ax}), systolic blood pressure (Sist BP), heart rate (HR) and simplified level of consciousness, through the AVSU acronym (Alert; reaction to Verbal stimulus; reaction to Sensorial stimulus and Unresponsive) (Figure 2).
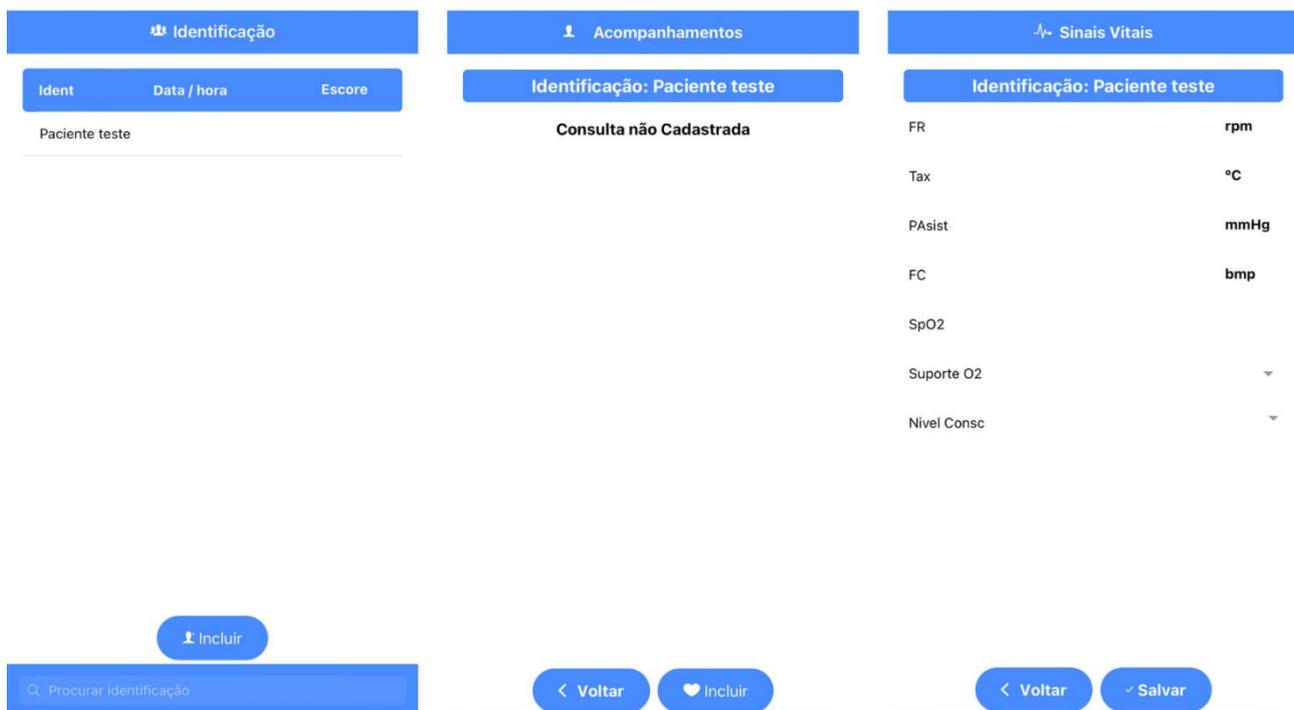
FIGURE 2: Image of the Identification, Monitoring and Vital Signs screens. Rio de Janeiro, RJ, Brazil, 2019.

Score screen

It displays the score assigned by the sum of the predetermined parameters based on MEWS. The red, yellow, green and white colors were used to help express the patients' severity along with the physiological parameters, as in the Manchester Protocol, which resorts to colors to express the classification of priorities. Red indicates emergency, yellow indicates urgency, green indicates patients with no risk of death, and white indicates stable patients[24] (Figure 3).

Actions Score screen

It shows the actions proposed to direct the care flow by the nurses, as well as the indication of the time in which the patients should be reevaluated, according to the MEWS identified (Figure 3).

Suggested Protocols screen

Considering that institutions have care protocols specific to their reality, it was decided to offer nurses the possibility of consulting more generalized information, based on the specificity of the physiological parameters indicating risk of sepsis, using the ILAS[18] guidelines for this purpose and, for cardiopulmonary arrest, in this case, the Guidelines set forth by the AHA[17] (Figure 3).
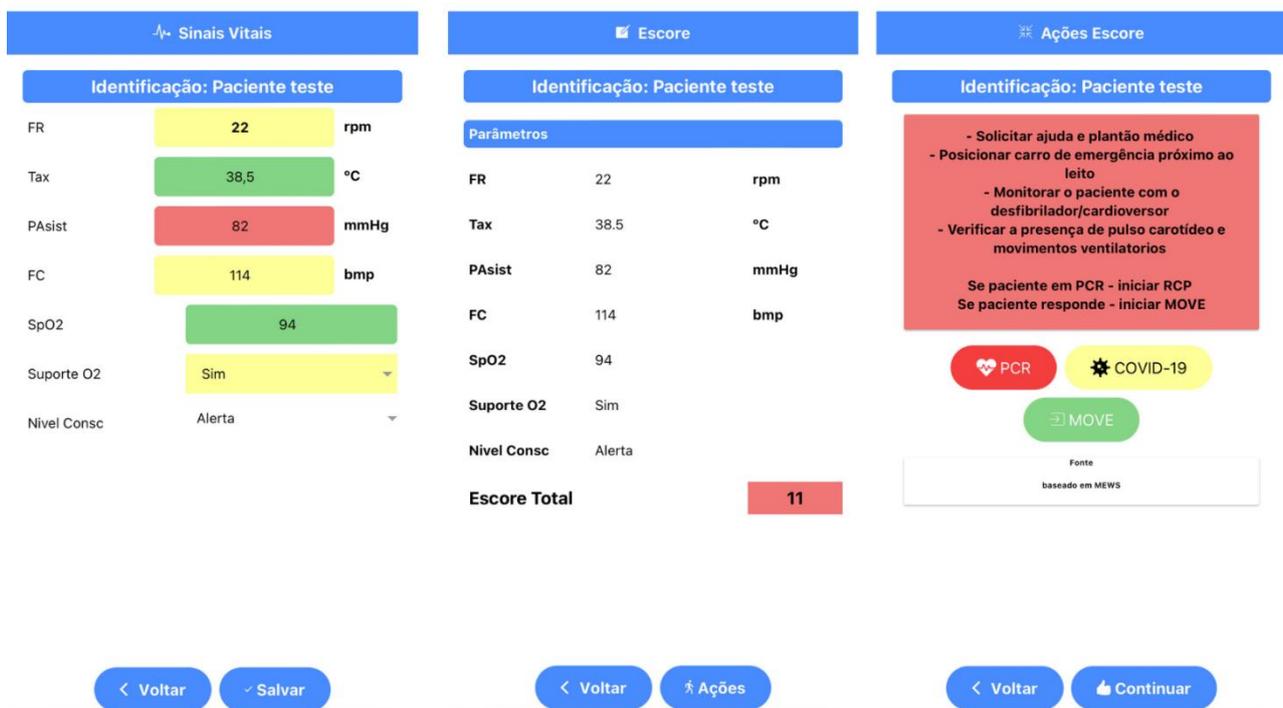
FIGURE 3: Image of the Score, Actions Score and Suggested Protocols screens. Rio de Janeiro, RJ, Brazil, 2019.

Priority Nursing Diagnoses screen

The possible Nursing Diagnoses are displayed, considering their priority, for each altered physiological parameter found, based on the NANDA-I diagnoses, for being a taxonomy (Figure 4).

Nursing Interventions screen

According to the established priority Nursing diagnoses, Nursing interventions based on the NIC (Nursing Interventions Classification) taxonomy are indicated (Figure 4).

Suggested Surveillance screen

It indicates to the nurses the necessary surveillance of the patients' clinical status, as well as the suggestion of transfer to a unit for the treatment of critically-ill patients, assisting in care planning (Figure 4).
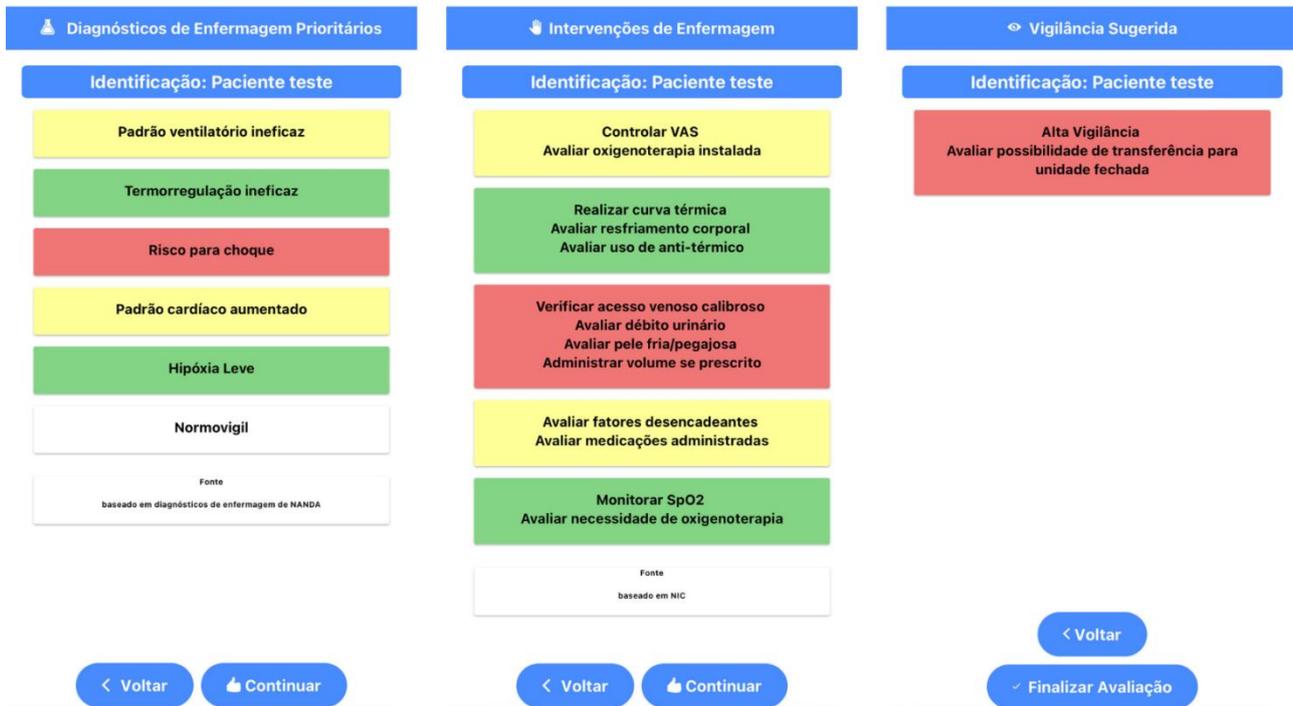
FIGURE 4: Image of the Diagnoses, Interventions and Surveillance screens. Rio de Janeiro, RJ, Brazil, 2019.

DISCUSSION

The Nursing Alert® mobile app aims at offering quick and assertive activities related to its purpose, considering the need for timely actions in the face of clinical deterioration in the patients. It allows MEWS calculation, after introducing the vital signs measured, triggering actions for the care flow, based on the priority Nursing diagnoses and associated Nursing interventions, focusing on protocols and allocation of the patients evaluated by the nurses.

Measurement of the vital signs in hospitalized patients, a routine incorporated into the practical Nursing routine, sometimes does not awaken in nurses the need for an oxyhemodynamic evaluation, associated with the reason for hospitalization. The ability to identify clinical deterioration in the patients seems to be associated with the time of professional experience, considering that more experienced nurses will have developed more skills to recognize, prioritize and respond to the demands of patients undergoing clinical deterioration[25,26].

Given that critically-ill patients at risk of death require exclusive assistance from nurses, it is observed that early identification of clinical deterioration is fundamental[27]. However, developing knowledge and skills to provide care to patients who present clinical deterioration is a major challenge in professional training and improvement[12]. Deepening recognition of clinical deterioration, as well as skills in its management and development of teamwork, for example, are pointed out as topics to be developed with nurses[28].

Definition of the Priority Nursing Diagnosis[29] is understood as a crucial aspect in the face of clinical deterioration, as it tends to generate interventions that meet the patients' actual needs. Therefore, it is noted that the *Nursing Alert*® mobile app is not only based on this prerogative but also on suggestions regarding interventions and results related to the NDs. Generalist protocols were chosen because they are widely used in the clinical practice, namely cardiopulmonary resuscitation of AHA[17] and sepsis of ILAS[18], for understanding the existence of different structures of work environments that imply conduction of the care processes.

Installing the mobile app on a device that allows visualizing the health professionals, in order to enhance the identification of the need for nurses to reevaluate the patients, is a resource available in the app. That said, due to the fact that some barriers, such as difficulty maintaining patients' monitoring due to the accumulation of tasks and the difficulty communicating/collaborating with the teams responsible for the care to be provided to patients at risk of clinical deterioration, were pointed out by a group of nurses[30]. Technical and non-technical skills and collaboration between the team of health professionals are factors that influence the response to abnormal vital signs, maintaining

Andrade LS, Silva RFA, Tonini T
Nursing Alert® for nurses' support

Research Article
Artigo de Pesquisa
Artículo de Investigación

DOI: http://dx.doi.org/10.12957/reuerj.2022.65600

the persistence of "sub-optimal care" in clinical units, such as wards, leading to the development of potentially preventable severe adverse events[31].

In their various areas of professional performance, nurses begin to acquire expertise in serving the target population; however, in some health care spaces, they may encounter unexpected situations that require rapid critical reasoning and decision-making. For assigning value to the vital signs measured routinely by the Nursing team, the early warning scores can collaborate in terms of the imminent risk of clinical deterioration. However, it is warned that, for functionality of the technology, it is necessary to invest in human and material resources and in the improvement of communication in transitional care, but also in holistic evaluations by nurses, in order to detect deterioration as early as possible and ensure that patient safety is not compromised[32].

Although identification of clinical deterioration in patients through a mobile app is made available, it is noted that use of an exclusive device in the work environment is not encouraged. It is believed that the use of apps can and should be encouraged considering some prerogatives, such as the following: peer review, validation, and updated evidence as a basis. Reduction in adverse events and hospitalization times seem to be benefits arising from the use of mobile apps; however, the limited information regarding their effectiveness and extrapolation possibility must be emphasized, in addition to safety in their use[33]. Finally, it is pointed out that, even in the face of suggestive evidence of a positive impact on the use of mobile apps in the health area, these technologies should be employed to support clinical decision-making, not replacing it.

CONCLUSION

Considering the idea of technological innovation that permeates Nursing care, it is assumed that a dynamic, fast and accurate tool can help nurses sustain their critical thinking and develop skills to diagnose priorities in their patients.

Based on the vital signs measured in the patients, a routine intervention in hospital institutions, calculation of the score obtained by the *Nursing Alert*® mobile app allows the following: defining systematized actions; describing the patients' health status; directing care, based on validated protocols to support the assistance provided; and suggesting better allocations for these patients.

The app will be made available for use by nurses who provide care at the bedside, after validation and usability studies, allowing for the performance of impact assessment studies, improvements in the beta version of the system, and evaluating its contribution to minimize the risk of clinical deterioration in hospitalized patients.

REFERENCES

1. Banos O, Villalonga C, Garcia R, Saez A, Damas M, holgado-Terriza JA, et al. Design, implementation and validation of a novel open framework for agile development of mobile health applications. BioMed Eng OnLine [Internet]. 2015 Aug 13 [cited 2020 Dec 14]; 14(Suppl 2):S6 DOI: https://doi.org/10.1186/1475-925X-14-S2-S6
2. Barra DCC, Paim SMS, Sasso GTMD, Colla GW. Methods for developing mobile apps in health: an integrative review of the literature. Texto contexto - enferm [Internet]. 2017 [cited 2020 Dec 14]; 26(4):e2260017. DOI: https://doi.org/10.1590/0104-07072017002260017
3. Araujo JL, Sant'Anna HC, Lima EFA, Fioresi M, Nascimento LCN, Primo CC. Mobile app for nursing process in a neonatal intensive care unit. Texto contexto - enferm. [Internet]. 2019 [cited 2020 Dec 14]; 28:e20180210. DOI: https://doi.org/10.1590/1980-265x-tce-2018-0210
4. Padilla RM, Mayo AM. Clinical deterioration: A concept analysis. J Clin Nurs [Internet]. 2018 [cited 2022 Jun 23]; 27(7-8):1360-8. DOI: https://doi.org/10.1111/jocn.14238
5. Elliott R, Martyn L, Woodbridge S, Fry M, Foot C, Hickson L. Development and pragmatic evaluation of a rapid response team. Critical care nursing quarterly [Internet]. 2019 [cited 2020 Dec 14]; 42(3):227–34. DOI: https://doi.org/10.1097/CNQ.0000000000000263
6. Subbe CP, Kruger M, Rutherford P, Gemmel L. Validation of a modified early warning score in medical admissions. An Int. Journal of Med. [Internet]. 2001 [cited 2020 Dec 14]; 94(10):521–6. DOI: https://doi.org/10.1093/qjmed/94.10.521
7. Montenegro SMSL. Avaliação do desempenho do escore de alerta precoce modificado em hospital público brasileiro. Dissertação (Mestrado em Gestão de Organizações de Saúde) - Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto [Internet]. 2017 [cited 2020 Dec 14]; DOI: 10.11606/D.17.2018.tde-26042018-113302
8. Campbell V, Conway R, Carey K, Tran K, Visser A, Gifford S, et al. Predicting clinical deterioration with Q-ADDS compared to NEWS, Between the Flags, and eCART track and trigger tools. Resuscitation [Internet]. 2020 [cited 2022 Jun 22]; 153:28-34. DOI: 10.1016/j.resuscitation.2020.05.027
9. Zaidi H, Bader-El-Den M, McNicholas J. Using the National Early Warning Score (NEWS/NEWS 2) in different Intensive Care Units (ICUs) to predict the discharge location of patients. BMC Public Health [Internet]. 2019 [cited 2022 Jun 22]; 19(1):1231. DOI: https://doi.org/10.1186/s12889-019-7541-3

Research Article
Artigo de Pesquisa
Artículo de Investigación

Andrade LS, Silva RFA, Tonini T
Nursing Alert® for nurses' support

DOI: http://dx.doi.org/10.12957/reuerj.2022.65600

10. García-Del-Valle S, Arnal-Velasco D, Molina-Mendoza R, Gómez-Arnau JI. Update on early warning scores. Best Pract Res Clin Anaesthesiol [Internet]. 2021 [cited 2022 Jun 22]; 35(1):105-13. DOI: https://doi.org/10.1016/j.bpa.2020.12.013

11. Kupeli I, Subasi F. If early warning systems are used, would it be possible to estimate early clinical deterioration risk and prevent readmission to intensive care? Niger J Clin Pract [Internet]. 2021. [cited 2022 Jun 22]; 24(12):1773-8. DOI: https://doi.org/10.4103/njcp.njcp_682_19

12. Messerer DAC, Fauler M, Horneffer A, Schneider A, Keis O, Mauder LM, Radermacher P. Do medical students recognise the deteriorating patient by analysing their vital signs? A monocentric observational study based on the National Early Warning Score 2. BMJ Open [Internet]. 2021 [cited 2022 Jun 22]; 11(2):e044354. DOI: https://doi.org/10.1136/bmjopen-2020-044354

13. Albuquerque NMQ, Branco ALC, Pimentel MRAR, Silva FVC, Assad LG, Santos MA. Process of hospitalization in surgical-clinic unit at a public university hospital. Rev. Enferm. UERJ [Internet]. 2020 [cited 2022 Jun 22]; 28:e48849. DOI: https://doi.org/10.12957/reuerj.2020.48849

14. Horta WA. Enfermagem: teoria, conceitos, princípios e processo. Rev. esc. enferm. USP [Internet]. 1974 [cited 2020 Dec 15]; 8(1):7-17. DOI: http://dx.doi.org/10.1590/0080-6234197400800100007.

15. Nightingale F. Notas sobre enfermagem: o que é e o que não é. Tradução de Amália Correa de Carvalho. São Paulo: Cortez; 1989.

16. Johnson M, et.al. Ligações Nanda-NOC-NIC. Condições clínicas suporte ao raciocínio e assistência de qualidade. Editora Elsevier. Tradução da 3ª ed. 2013

17. American Heart Association, compiler. Destaques das diretrizes de RCP e ACE de 2020 da American Heart Association [Internet]. JN-1088; 2020 [cited 2020 Dec 14]. Available from: https://cpr.heart.org/-/media/cpr-files/cpr-guidelines-files/highlights/hghlghts_2020eccguidelines_portuguese.pdf

18. Instituto Latino Americano de Sepse. Implementação de protocolo gerenciado de sepse - protocolo clínico atendimento ao paciente adulto com sepse / choque séptico. ILAS [Internet]. 2018 [cited 2020 Dec 14. Available from: https://www.ilas.org.br/assets/arquivos/ferramentas/protocolo-de-tratamento.pdf

19. Pereira DJ. Comparação entre Metodologias de Desenvolvimento de Software baseadas nos métodos RUP e XP. Rev. de tec. aplicada (RTA) [Internet]. 2016 [cited 2020 Dec 14]; 5(3):46-52. Available from: http://www.cc.faccamp.br/ojs-2.4.8-2/index.php/RTA/article/download/1006/497

20. Sommerville I. Engenharia de Software / Ian Sommerville ; tradução Bosnic I e Gonçalves KGO; revisão técnica Kechi Hirama. — 9. ed. — São Paulo: Pearson. Prentice Hall, 2011. Título original: Software engineering.

21. Brasil, MS/CNS. Resolução 510/2016. Diário oficial da união, ed. 98, seção 1, p. 44. 2016. Available from: https://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/22917581

22. Conselho Federal de Enfermagem (BR). Resolução No. 358/2009. Dispõe sobre a Sistematização da Assistência de Enfermagem e a implementação do Processo de Enfermagem em ambientes, públicos ou privados, em que ocorre o cuidado profissional de Enfermagem, e dá outras providências. [cited 2013 Jan 10]. 2009. Available from: http://www.cofen.gov.br/resoluo-cofen-3582009_4384.html

23. Soares LA, Silva RFA. Nursing alert. Depositante: Universidade Federal do Estado do Rio de Janeiro. Procurador: Renata Flavia Abreu da Silva. BR nº BR512019002951-8. Depósito: 10 de novembro de 2019. Concessão: 24 de Dezembro de 2019.

24. Mackway-Jones K, Marsden J, Windle J. Sistema Manchester de Classificação de Risco. Versão Brasileira de Welfane Cordeiro Júnior e Maria do Carmo Paixão Rausch. 2ª ed. Belo Horizonte: Folium, 2018.

25. Orique SB, Despins L, Wakefield BJ, Erdelez S, Vogelsmeier A. Perception of clinical deterioration cues among medical-surgical nurses. J Adv Nurs [Internet]. 2019 [cited 2020 Dec 14]; 75(11):2627-37. DOI: https://doi.org/10.1111/jan.14038

26. Leonard-Roberts V, Currey J, Considine J. Senior emergency nurses' responses to escalations of care for clinical deterioration. Australasian emergency care [Internet]. 2018 [cited 2020 Dec 14]; 21(2):69–74. DOI: https://doi.org/10.1016/j.auec.2018.05.003

27. Conselho Federal de Enfermagem (BR). Lei nº 7498/86. 25 Jun 1986. Available from: http://www.cofen.gov.br/lei-n-749886-de-25-de-junho-de-1986_4161.html

28. Currey J, Massey D, Allen J, Jones D. What nurses involved in a Medical Emergency Teams consider the most vital areas of knowledge and skill when delivering care to the deteriorating ward patient. A nurse-oriented curriculum development project. Nurse education today [Internet]. 2018 [cited 2020 Dec 14]; 67:77–82. DOI: 10.1016/j.dt.2018.05.009

29. Herdman TH, Kamitsuru S, Lopes CT eds. Diagnósticos de enfermagem da NANDA-I: definições e classificação 2021-2023. 12a ed. Porto Alegre: Artmed; 2021.

30. Petersen JA, Rasmussen LS, Rydahl-Hansen S. Barriers and facilitating factors related to use of early warning score among acute care nurses: a qualitative study. BMC emergency medicine [Internet]. 2017 [cited 2020 Dec 14]; 17(1):36. DOI: https://doi.org/10.1186/s12873-017-0147-0

31. Smith D, Francis JJ, Aitken LM. Developing a complex intervention for deteriorating patients using theoretical modelling (DECIDE study): study protocol. J Adv Nurs [Internet]. 2019 [cited 2022 Jun 25]; 75(9):2024-35. DOI: https://doi.org/10.1111/jan.14076

32. Wood C, Chaboyer W, Carr P. How do nurses use early warning scoring systems to detect and act on patient deterioration to ensure patient safety? a scoping review. Int J Nurs Stud [Internet]. 2019 [cited 2022 Jun 25]; 94:166-78. DOI: https://doi.org/10.1016/j.ijnurstu.2019.03.012

33. Morgan VA, Jhant J, Ellison J, Varela A, Carpenter W. Practical guidelines for the use of electronic applications by advanced practice nurses in the emergency department. J Emerg Nurs [Internet]. 2016 [cited 2020 Dec 14]; 42(6):544–5. DOI: https://doi.org/10.1016/j.jen.2016.09.010