



DESENVOLVIMENTO DE UMA APLICAÇÃO WEB PARA CONTROLE DE MUDANÇA DE DECÚBITO EM PACIENTES HOSPITALIZADOS

Development of a web application to control decubitus change in hospitalized patients

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Resumo

Objetivos: apresentar um protótipo virtual de uma aplicação web (AW), para auxiliar a equipe médica no controle da mudança de decúbito de pacientes com mobilidade reduzida. Método: a técnica de projeto e prototipagem virtual foi utilizada para projetar este AW que será apresentado, através das etapas do ciclo de vida clássico de desenvolvimento de software. Portanto, a pesquisa será classificada como de “natureza” aplicada, do tipo normativo, pois o interesse está no desenvolvimento de tecnologias, estratégias e ações para mitigar os efeitos das lesões por pressão em pacientes hospitalizados. Resultados: pode-se citar que o AW apresentado é um protótipo que preenche uma lacuna no atendimento de pacientes com mobilidade reduzida, pois auxilia no monitoramento da mudança de decúbito e representa, portanto, uma tecnologia inovadora e de fácil utilização, conforme indicado no relatório de teste do usuário final. Conclusão: espera-se uma diminuição das lesões por pressão e uma melhora significativa no conforto e segurança do paciente, uma vez que este protótipo seja implementado em um contexto real de assistência à saúde.

Palavras-chave: lesão por pressão; cuidados de enfermagem; segurança do paciente

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Abstract

Objectives: to present a virtual prototype of a web application (WA), to assist the medical care team in controlling the change in position of patients with reduced mobility. **Method:** the technique of design and virtual prototyping was used to design this WA that will be presented, through the steps from the classic life cycle of software development. Therefore, the research will be classified as “nature” applied, of the normative type, as the interest is in the development of technologies, strategies and actions to mitigate the effects of pressure injuries in hospitalized patients. **Results:** it can be mentioned that the presented WA is a prototype that fills a gap in the care of patients with reduced mobility, as it helps in monitoring the change in decubitus and represents, therefore, an innovative and easy-to-use technology, as indicated in the end user test report. **Conclusion:** a decrease in pressure injuries and a significant improvement in patient comfort and safety is expected once this prototype is implemented in a real health care context.

Keywords: pressure injury; nursing care; patient safety

1.Introduction

Pressure injury (PI) is an area of tissue damage and loss that normally occurs above a bone structure or in another fragile tissue area: it is caused by intense pressure and/or shear in tissue areas; represents a complication typically associated with partial or total lack of mobility. The lesion may or may not break the skin (open or closed wound) and may or may not be associated with the sensation of pain in the affected area (Bandeira et al., 2021; Moraes et al., 2016). The costs associated with the acquisition of material for the treatment of PI and its complications are high for the Health System as a whole. Patients who need longer hospital stays and who, consequently, need more time dedicated to their care, are the ones who most demand this resource (Lima et al., 2021; Moro et al., 2007).

In a holistic approach, according to data from the National Pressure Ulcer Advisory Panel (NPUAP), the prevalence of PI in hospitals is 15% and the incidence is 7% (Gefen et al., 2020). On the other hand, in Brazil, although there are few studies on the incidence and prevalence of PI, studies carried out may show figures of up to 39.8% (Meireles et al., 2020; Macedo et al., 2021; Barbosa et al., 2019). The numbers, in the literature, present variations that are due to the characteristics of the patients and the level of care provided.

In this context, thus, the objective of this work is to present a virtual prototype of a Web Application (WA), to assist the medical assistance team in controlling the change in position of patients with reduced mobility, using the technique of design and virtual prototyping, through the stages of the cycle life for software development. As a result, it is expected a decrease in pressure injuries and a significant improvement in patient comfort and safety, when this prototype is implemented in a real case.



2. Material

The consequences of PI are frequent in hospitalized patients, as they are susceptible to colonization by bacteria and a potential sepsis clinical condition (Ribeiro et al., 2018). Thus, chronic wounds such as pressure wounds often have necrotic tissue, which predisposes them to infection and this, unlike colonization, causes an increase in recovery and healing time (Thomé et al., 2018; Araujo et al., 2019).

In PI with a consolidated inflammatory process, bacterial proliferation is observed in the devitalized tissue, wound surface and invasion of viable tissue with an inflammatory response. The delay in the healing process is a consequence of competition between host and bacterial cells for oxygen and nutrients. Thus, there is production of inflammatory cytokines and proteases in response to microorganisms and their associated toxins, which culminates in longer hospitalizations and, consequently, requires more time dedicated to their care (Dos Santos et al., 2022).

The practical solutions found, currently, to reduce the high incidence of PI in patients with reduced mobility, are focused on the materials and forms of mattresses to be used by these patients (Galletto et al., 2021). Mattresses known as eggshells and others inflated by air, occupy a prominent place among the most found on the market. In addition, the work and commitment of health professionals, most notably nurses and nursing technicians, are highly requested to act directly on patients, periodically changing their position in hospital beds (Mendonça et al., 2018; Otto et al., 2019; Rodrigues et al., 2020).

Brazil is a member country of the World Alliance for Patient Safety, proposed by the World Health Organization (WHO), whose main objective is to seek compliance with measures that increase the safety and quality of health services. The prevention of PI is the sixth among the International Goals for Patient Safety, combined with the reduction of the risk of falls.

Even with scientific and technological advances, it is clear that PI remains a challenge to increase patient safety (Bezerra et al., 2021). In Brazil, there are no accurate records regarding the occurrences of PI, a factor that makes managing this condition difficult (Souza et al., 2020). Thus, it becomes relevant to manage risks and implement strategies with the aim of mitigating tissue damage (da Silva et al., 2021; Fontenele et al., 2021). The adoption and diffusion of technological innovations are motivated by increased efficiency and organizational performance, also known as the strategic choice perspective (Rogers et al., 2003). Furthermore, technology emerges as a valuable tool for solving PI problems due to the improvement of products and processes for the prevention and treatment of PI (Queiroz et al., 2012).

The care offered to patients with PI undergoes innovations every day. Thus, it is indisputable that the introduction of technology and the invention of more robust devices, with internet access,



have brought many benefits, including the speed in choosing coverage for the prevention and treatment of wounds by the professionals involved. In addition, there was an improvement in knowledge, allowing these professionals to have access to a vast amount of information, both on the patient, through their health record, and on the best clinical practices. (Ferreira et al, 2020; Delmore et al, 2019). The web application is designed to perform a group of specific functions, which aim to benefit the user in their activities. They are important devices, since most people and, consequently, health workers have mobile devices that are almost always available. (Sprigle et al, 2020; Lopes et al, 2020). The use of a web application as a tool for therapeutic and preventive measures is quite innovative and presents itself as a method capable of generating interest and motivation for learning, considering that the devices that host these applications are used by health professionals in a proportion of 45% to 85%, being more consulted than conventional platforms. (Sprigle et al, 2020; Vêscovi et al, 2017)

Thus, it is clear that technological tools are linked to health management, and the Health Informatics Agenda provides for actions to be implemented to promote the development of all aspects of Information Technology applied to health (Bakken et al, 2008). Thus, the reorganization of health care was oriented towards the search for new technologies and the development of safe software that anchor theories to data visualization and analysis (Cherman et al, 2018). Software, applications and automated equipment can assist in making more accurate decisions, which could provide standardization of routines, improving patient safety and comfort during hospitalization. In addition, it would reduce the operational cost and optimize the time spent by the professionals involved (Campos et al, 2020; Alturkistani et al, 2018; Ali et al, 2020). In this sense, software, applications and automated equipment can help in more accurate decision-making, which could provide standardization of routines, improving patient safety and comfort during hospitalization. In addition, it would reduce the operational cost and optimize the time spent by the professionals involved (Campos et al., 2020; Alturkistani et al., 2018; Ali et al., 2020).

The guiding question for this research was “How can we mitigate the effects of pressure injuries in hospitalized patients?” (Kampa et al., 2020). And the answer is, in fact, the objective of the present study: to present a virtual prototype of a WA, to assist the multidisciplinary care team in controlling the change in position of patients with reduced mobility. Therefore, this technology will have the important function of monitoring and recording, in real time, the evolution of the change in decubitus of hospitalized patients.

3.Method

A research project only starts if there is a question to which an answer is desired, that is, it is to seek or look for a solution to some problem in the world. The question for the present research was: “How



can we mitigate the effects of pressure injuries in hospitalized patients?” In fact, what drives scientific research can be intellectual reasons such as the desire and satisfaction to know, or practical reasons such as the desire to do something that can impact the real world (Gil et al., 2007). It is important to emphasize that research is defined as a rational and systematic procedure that aims to provide answers to the problems that are proposed; moreover, applied research is characterized by its practical interest, that is, in solving problems that occur in reality (Sommerville et al., 2015). The present research is, therefore, classified as applied “nature”, as it is characterized by its practical interest. As for the “objectives”, the research is classified as normative, as the interest is in the development of technologies, strategies and actions to improve the results available in the existing literature. Finally, regarding the research method, the technique of design and virtual prototyping was used to design this WA, through the stages of the classic software development life cycle, as shown in Figure 1.

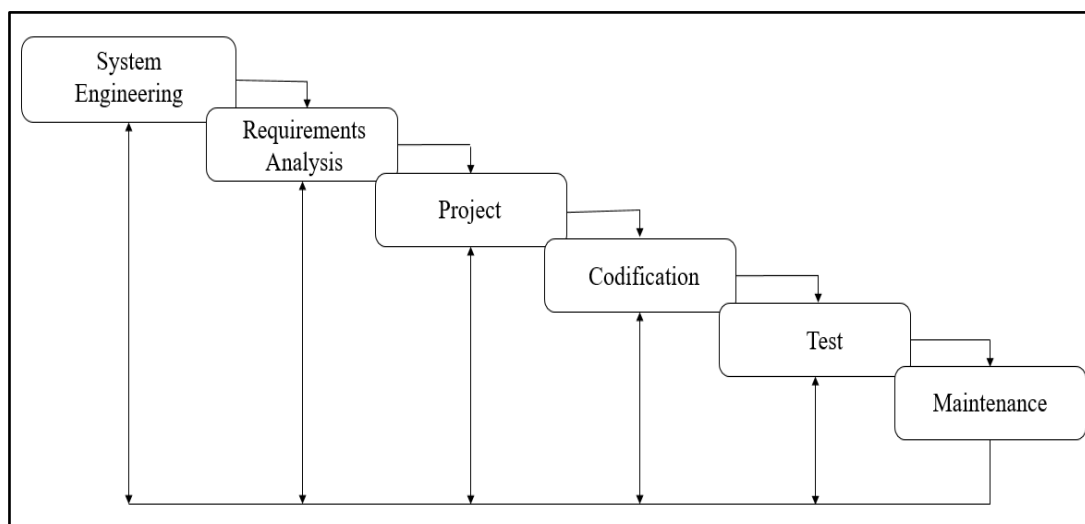


Figure 1. Software development life cycle (Pressman and Maxim, 2014)

In the first stage, called “Systems Engineering”, the objectives, functionalities and scope of what will be developed are defined. Then, the “Requirements Analysis” step serves as a variable that will launch the boundary conditions, that is, everything that the application or software must contain according to the needs of the end customer. In the present case, this step referred to the requirements that summarize what must be done in the software development process. Therefore, the best technical solutions were studied and defined, both in relation to the model and layout, as well as the programming language and database management system of the present application.

Next, the “Design” step defines how the previous steps are related and important considerations of execution time, quality and costs are inserted. In the “Coding” stage, the programming languages are applied, and the development of codes is carried out for the purpose



indicated in the first stage. The “Test” stage was applied to the application, and conducted by the development team and medical students, who performed tests on usage, response, interface and speed. Furthermore, the test consists of generating a corresponding set of results and interventions provided by professionals and is based on the idea of carrying out the initial testing for successive refinement until reaching the final product (Pressman et al., 2016; Gao et al., 2021). The last step refers to “Maintenance” and was not considered, as the application was not implemented. Therefore, in the construction of the WA, the developers used the basic premises of software engineering based on the steps of the classic software development life cycle proposed by Pressman and Maxim (Marconi et al., 2002). Finally, it is worth noting that MongoDB® was used and its structure oriented to documents, each document being a json file, which may contain, in addition to its values, an array or even another json object. About the application programming interface (API), it can be said that its application structure was separated between controllers, models and routes.

4.Discussion

A virtual prototype of WA to help control the change in position of the hospitalized patient was developed mainly using HTML5, CSS, Bootstrap and Java Script technologies and was made available only locally, as it is a virtual prototype. A front-end interface has been assertively designed to make it easier for healthcare and nursing teams to manipulate the system when the application is launched. It is worth mentioning that all patient data is directed to the MongoDB database and all data security protocols and assumptions were contemplated within the context of the General Data Protection Law (GDPL). Below, some “screens” of the Application in question will be briefly presented. In Figure 2, it is possible to follow the “fictitious” registration process of new patients, which consists of fields to be filled in: name; current decubitus (left and right sides, Prone or supine); patient bed and notes – field where individualized details must be added to be considered by professionals when managing the patient.



Mudança de Decúbito Início Painel de Pacientes Histórico de Pacientes Indicador de eficiência da mudança de decúbito **Cadastro de Paciente** Sair

Nome do paciente:

Decúbito Atual do Paciente: Leito:

Observação:

Gravar **Voltar**

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Figure 2. Patient registration (Authors, 2022).

In Figure 3, there is the control screen of all active patients: they will remain in control until they are discharged. Therefore, they are presented in such a way that patients with delayed decubitus are displayed first on the panel, in addition to being highlighted with a red background color; following, patients will be arranged, in a decreasing way, according to the time to carry out the change of decubitus.

Mudança de Decúbito Início Painel de Pacientes Histórico de Pacientes Indicador de eficiência da mudança de decúbito **Cadastro de Paciente** Sair

Pacientes do Painel

Paciente	Leito	Status	Próximo Decúbito	Tempo	Opções
B	2	Alterar Decúbito	Decúbito Lateral Esquerdo	02:36	Registrar Ocorrência
C	3	Decúbito Ok	Decúbito Dorsal	00:48	Registrar Ocorrência
A	1	Decúbito Ok	Decúbito Lateral Esquerdo	02:00	Registrar Ocorrência

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Figure 3. Control Panel (Authors, 2022)



It is worth emphasizing, that the records of occurrences are individualized for each patient: it guarantees the possibility of discharge, in addition to recording the options for changing the position. Also, it is allowed to change the patient's position according to the individualized possibilities and restrictions of each individual. Thus, it is possible to quantify and monitor the time and position of each patient registered on the platform; whether the position is correct or incorrect, or even more time has passed than it should for the change to be effected – making it an important quality control tool.

5. Conclusion

The presented WA is a prototype for monitoring the change in position and, therefore, represents an innovative technology that is easy to apply. Although there is a need for data entry, when compared to the established form, which uses paper and pen or conventional computer spreadsheets, it has the advantage of making the process of changing the position more dynamic, complete, controlled and individualized.

The intended objective of this present research was successfully achieved, with the advantage that this technology is an idea to be developed until the evolution to the mobile version, which will allow it to be used in the main current platform: mobile telephony; and be deployed in computer network structures already in operation.

Finally, the advantages of this WA consist of being able to be used as an autonomous tool or complementary to its computational environment, because its convergence allows to implement it at low cost, being able to add to the other systems operating in the local hospital network, without major changes. in the structure, with safety and good performance. Furthermore, the software is a dynamic and open system, able to incorporate innovations and updates at any time, whenever necessary and requested by users.

References

- Ali, Y. C. M. M., Souza, T. M. P., Garcia, P. C., & Nogueira, P. C. (2020). Incidência de lesão por pressão e tempo de assistência de enfermagem em terapia intensiva. *Estima (Online)*, e1120-e1120.
- Alturkistani, A., Majeed, A., Car, J., Brindley, D., Wells, G., & Meinert, E. (2018). Health information technology uses for primary prevention in preventive medicine: a scoping review protocol. *BMJ open*, 8(9), e023428.



- Araujo, M. T., Castanheira, L. S., Salomão, M. C., Guimarães, S., & de Windsor Silva, Y. O. (2019). Análise de custo da prevenção e do tratamento de lesão por pressão: revisão sistemática. *Revista Enfermagem Atual In Derme*, 89(27).
- Bakken, S., Stone, P. W., & Larson, E. L. (2008). A nursing informatics research agenda for 2008–18: Contextual influences and key components. *Nursing Outlook*, 56(5), 206-214.
- Bandeira, L. D. L. M., de Carvalho, S. M. O., Calaça, L. R. R., dos Santos Rabelo, G. M., Barbosa, W. C. F., da Silva Machado, B. A., & Silva, J. S. (2021). Estratégias de prevenção de lesão por pressão facial ocasionadas pelo uso da posição prona. *Brazilian Journal of Enterostomal Therapy*.
- Barbosa, A. S., Oliveira, E. S., Leite, M. G., Feitosa, D. S. L. L., Studart, R. M. B., Cavalcante, T. D. M. C., & de Oliveira, P. M. P. (2019). Perfil clínico dos pacientes acometidos por lesão por pressão. *Revista Enfermagem Atual In Derme*, 88(26).
- Barbosa, W. C. F., da Silva Machado, B. A., & Silva, J. S. (2021). Estratégias de prevenção de lesão por pressão facial ocasionadas pelo uso da posição prona. *Brazilian Journal of Enterostomal Therapy*.
- Bezerra Borges, D., Meyer Soares, P., & Santana Silva, M. (2021). Programs and Instruments for Promoting Innovation with Technology-Based Companies in Brazil. *Journal of technology management & innovation*, 16(2), 28-40.
- Campos, R. S., Blanes, L., Nicodemo, D., & Ferreira, L. M. (2020). “Sem Pressão”: aplicativo com orientações para identificação, estadiamento e prevenção de lesões por pressão. *Brazilian Journal of Enterostomal Therapy*, 18.
- Cherman, C. M. T. Tecnologia computacional para gerenciar o cuidado e indicadores relacionados à lesão por pressão (Doctoral dissertation, Universidade de São Paulo).
- Da Silva, B. R., de Moraes, M. R., da Silva Soares, R. C., Caldeira, A. G., & de Andrade Aoyama, E. (2021). atuação da enfermagem na prevenção de lesão por pressão em unidade de terapia intensiva. *Revista Brasileira Interdisciplinar de Saúde*.
- Delmore, B., Ayello, E. A., Smith, D., Rolnitzky, L., & Chu, A. S. (2019). Refining heel pressure injury risk factors in the hospitalized patient. *Advances in Skin & Wound Care*, 32(11), 512-519.
- Dos Santos, D. J., Limeira, F. N. O., & de Oliveira Alves, V. B. (2022). Percepção do cuidador diante da lesão por pressão de pacientes atendidos na atenção domiciliar. *Revista Enfermagem Atual In Derme*, 96(37).



- Ferreira, D. S., Ramos, F. R. S., & Teixeira, E. (2020). Mobile application for the educational praxis of nurses in the Family Health Strategy: ideation and prototyping. *Escola Anna Nery*, 25.
- Fontenele, N. Â. O., Ximenes, M. A. M., Brandão, M. G. S. A., Fernandes, C. D. S., Galindo Neto, N. M., Carvalho, R. E. F. L. D., & Barros, L. M. (2021). Construção e validação de álbum seriado para prevenção de Lesão por Pressão: estudo metodológico. *Revista Brasileira de Enfermagem*, 74.
- Galetto, S. G. D. S., Nascimento, E. R. P. D., Hermida, P. M. V., Busanello, J., Malfussi, L. B. H. D., & Lazzari, D. D. (2021). Prevenção de lesões por pressão relacionadas a dispositivos médicos em pacientes críticos: cuidados de enfermagem. *Revista Brasileira de Enfermagem*, 74.
- Gao, Z., & Hands, D. (2021). The Strategic Role of Design in Driving Digital Innovation: A Theoretical Foundation. *Journal of technology management & innovation*, 16(1), 58-66.
- Gefen, A., Alves, P., Ciprandi, G., Coyer, F., Milne, C. T., Ousey, K., ... & Worsley, P. (2020). Device-related pressure ulcers: SECURE prevention. *Journal of wound care*, 29(Sup2a), S1-S52.
- Gil, Antônio Carlos. Como elaborar projetos de pesquisa. 4.ed. Atlas: São Paulo, 2007.
- Kampa, J. R., Cziulik, C., & Beltrão, P. A. D. C. (2020). New Product Opportunity Identification: A Perspective from Inside the Intuitive Phenomenon. *Journal of technology management & innovation*, 15(1), 40-54.
- Lima, A. R., Palmer, C. R., & Nogueira, P. C. (2021). Fatores de risco e intervenções preventivas para lesão por pressão em pacientes oncológicos. *Estima (Online)*, e1021-e1021.
- Lopes, T. S., dos Santos Videira, L. M. M., Saraiva, D. M. R. F., Agostinho, E. S., & Bandarra, A. J. F. (2020). Multicentre study of pressure ulcer point prevalence in a Portuguese region. *Journal of Tissue Viability*, 29(1), 12-18.
- Macedo, A. B. T., Mello, D. B., Graciotto, A., Cortelini, C. L. S., Souza, E., & Picetti, N. (2021). Lesões por pressão em adultos portadores de germes multirresistentes: um estudo de coorte. *Saúde Coletiva (Barueri)*, 11(69), 8347-8358.
- Marconi, Maria de Andrade *et al.* Técnicas de Pesquisa. 5.ed. Atlas: São Paulo, 2002.
- Meireles, V. C., & Baldissera, V. D. A. (2019). Qualidade da atenção aos idosos: risco de lesão por pressão como condição marcadora.



Mendonça, P. K., Loureiro, M. D. R., Frota, O. P., & Souza, A. S. D. (2018). Prevenção de lesão por pressão: ações prescritas por enfermeiros de centros de terapia intensiva. *Texto & Contexto-Enfermagem*, 27.

Moraes, J. T., Borges, E. L., Lisboa, C. R., Cordeiro, D. C. O., Rosa, E. G., & Rocha, N. A. (2016). Conceito e classificação de lesão por pressão: atualização do National Pressure Ulcer Advisory Panel. *Revista de Enfermagem do Centro-Oeste Mineiro*, 6(2).

Moro, A., Maurici, A., Valle, J. B. D., Zacliffevis, V. R., & Kleinubing Junior, H. (2007). Avaliação dos pacientes portadores de lesão por pressão internados em hospital geral. *Revista da Associação Médica Brasileira*, 53, 300-304.

Otto, C., Schumacher, B., de Lemos Wiese, L. P., Ferro, C., & Rodrigues, R. A. (2019). Fatores de risco para o desenvolvimento de lesão por pressão em pacientes críticos. *Enfermagem em Foco*, 10(1).

Pressman, Roger; Maxim, Bruce. Engenharia de Software-8ª Edição. McGraw Hill Brasil, 2016.

Queiroz, F. M., Aroldi, J. B. D. C., Oliveira, G. D. S. D., Peres, H. H. C., & Santos, V. L. C. D. G. (2012). Venous ulcer and compression therapy for nurses: development of online course. *Acta Paulista de Enfermagem*, 25, 435-440.

Ribeiro, J. B., dos Santos, J. J., Santana, N. A., Fraga, I. M. N., & Nery, F. S. (2018). Principais fatores de risco para o desenvolvimento de lesão por pressão em unidades de terapia intensiva. *Caderno de Graduação-Ciências Biológicas e da Saúde-UNIT-SERGIPE*, 5(1), 91-91.

Rodrigues, C. B. O., Prado, T. N. D., Nascimento, L. D. C. N., Laignier, M. R., Canicali Primo, C., & Bringuente, M. E. D. O. (2020). Ferramentas gerenciais no cuidado de enfermagem a criança com lesão por pressão. *Revista Brasileira de Enfermagem*, 73.

Rofers, E. M. (1995). Diffusion of innovation.

Sommerville I. Software engineering. 10th ed, New York: Pearson; 2015.

Souza, M. D. C., Loureiro, M. D. R., & Batiston, A. P. (2020). Organizational culture: prevention, treatment, and risk management of pressure injury. *Revista Brasileira de Enfermagem*, 73.

Sprigle S, McNair D, Sonenblum S. Pressure ulcer risk factors in persons with mobility-related disabilities. *Adv Skin Wound Care*. 2020;33(3):146-54.



Thomé, A. M. C., Francisco, N. L. D. S. G., do Val Amaral, J. P. B., Soares, L. C., & Trajano, E. T. L. (2018). Isolamento de bactérias de úlceras por pressão de pacientes internados em hospital universitário. *Revista Pró-univerSUS*, 9(1), 46-50.

Trajano, E. T. L. (2018). Isolamento de bactérias de úlceras por pressão de pacientes internados em hospital universitário. *Revista Pró-univerSUS*, 9(1), 46-50.

Vêscovi, S. D. J. B., Primo, C. C., Sant'Anna, H. C., Bringuete, M. E. D. O., Rohr, R. V., Prado, T. N. D., & Bicudo, S. D. S. (2017). Mobile application for evaluation of feet in people with diabetes mellitus. *Acta Paulista de Enfermagem*, 30, 607-613.