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REPORT OF EXPERIENCE AND TECHNOLOGICAL INNOVATION

Development of software for the passage of nursing duty: report of experience and technological innovation

Desenvolvimento de software para passagem de plantão da enfermagem: relato de experiência e inovação tecnológica

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ABSTRACT

Objective: To describe the development, structuring, and testing of software intended for the passage of nursing duty with the mnemonic Situation-Background-Assessment-Recommendation. **Method:** Experience report referring to the process of technological innovation which detailed the development of software with the phases of communication, planning, modeling, and development. **Results:** The first versions are functional prospectuses to meet the basic requirements of the duty passage. The software in the beta version was developed according to the results of analysis from meetings and received positive interface analysis in the tests carried out, as well as changes necessary to optimize the product. In addition, it demonstrated functionality, usability, and scalability. **Conclusion:** The Digital Situation-Background-Assessment Recommendation suggests standardized communication and aims to assist in the quality of important information that must be shared robustly and understandably. However, it is understood that the adoption of the system requires planning so that the software meets the needs of the health environment.

Descriptors: Communication; Patient Safety; Nursing; Software; Information Technology.

RESUMO

Objetivo: descrever o desenvolvimento, estruturação e teste de um *software* destinado à passagem de plantão da enfermagem com o mnemônico *Situation-Background-Assessment-Recommendation*. **Método:** relato de experiência referente ao processo de inovação tecnológica o qual detalhou o desenvolvimento de *software* com as fases de comunicação, planejamento, modelagem e desenvolvimento. **Resultados:** as primeiras versões são prospectos funcionais para atender aos requisitos básicos da passagem de plantão. O *software* na versão beta foi desenvolvido conforme os resultados de análises oriundas de reuniões e recebeu análise de interface positiva nos testes realizados, assim como alterações necessárias para otimizar o produto. Além disso, demonstrou funcionalidade, usabilidade e escalabilidade. **Conclusão:** o *Situation-Background-Assessment Recommendation* digital sugere comunicação padronizada e visa auxiliar na qualidade das informações importantes que devem ser compartilhadas de forma robusta e compreensível. Contudo, entende-se que a adoção do sistema requer planejamento, a fim de que o *software* atenda às necessidades do ambiente de saúde.

Descritores: Comunicação; Segurança do Paciente; Enfermagem; Software; Tecnologia da Informação.

INTRODUÇÃO

Continuous care provision is one of the main responsibilities of the nursing team. In this context, the duty passage is a fundamental process that ensures continuity of assistance through systematization and effective transmission of information[1]. The main aspects to be highlighted during the duty passage are described as: general health conditions of the patient and/or his or her alterations, proposed conduct, and preparation or not for exams, presence of attachments such as se-

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ra, drains, and probes[2].

During duty passage, the participation of the nurse responsible for managing the unit becomes essential[3]. Based on the collection and selection of information, the nursing care develops a care plan that satisfies the individual needs of each patient. In addition, he or she plays the crucial role of distributing tasks within his or her team[4].

How the nursing staff can carry out the duty passage may vary depending on the organization and training of the team. The reports can be verbal, written, recorded, and computerized, which determines whether the team can meet or not[5]. It is worth noting that the effectiveness of the duty process is directly affected by the quality of communication, which may face problems such as delays, failures, lack of appreciation, and absence of direct interaction[2]. These adverse conditions lead to loss, scarcity, and omission of information, which can result in unproductive work and without need by professionals[6].

To minimize this adverse condition, some institutions choose to use standardized tools that assist in the duty passage process. The mnemonic Situation-Background-Assessment-Recommendation (SBAR) is a tool that allows individual-centered analysis, with verbal adequacy and reduction of written data[7].

The SBAR was originally developed in 2002 by military personnel in the State of Colorado and adopted in health services due to its easy application and safety. The tool aims to organize information logically, to facilitate case reporting[8]. Through it, the nurse develops critical thinking that culminates in the logical resolution of the problems[9].

The mnemonic structure includes four fundamental elements: Situation (S), which identifies the patient and the location, with details such as date of hospitalization and diagnosis; brief history (B), which explains the reason for hospitalization, allergies, comorbidities, and surgical history; evaluation (a), which covers clinical examination, vital signs and level of consciousness; and recommendation (R), which includes interconsultations, nursing interventions and guidelines to be followed[10].

Despite the ease of application of SBAR, its implementation faces resistance due to the lack of knowledge about standardized protocols among health professionals, as well as the lack of recognition of the importance of effective communication[11].

In response to these challenges, creating a software tool that integrates the four essential components of the SBAR mnemonic can reduce communication difficulties and improve the quality of annotations. Studies show that the use of health information technologies can improve patient safety, reduce communication errors, and improve clinical outcomes[12]. The integration of technologies, such as computerized systems of duty passage, is a growing strategy to improve communication and coordination of care. For example, research indicates that electronic medical records systems and digital communication platforms can reduce the incidence of failures in the transmission of critical information among nursing teams, promoting safer and more effective care[13].

During the COVID-19 pandemic, for example, technologies such as electronic medical records and telemedicine have been shown to be essential to minimize the impacts of the disease, contributing to the reduction of errors, improvement of the quality of care, and especially in patient safety. However, for these technologies to achieve their full potential, it is essential to ensure interoperability between the different health information systems, allowing the continuous flow of data and care coordination[14].

The implementation of SBAR in digital format offers nurses a tool that not only improves the accuracy of the transmitted information but also reduces the likelihood of human errors resulting from failures in verbal or written communication. In this context, the adoption of SBAR as software brings both managerial and care benefits, since the incorporation of information technologies in health has proved to be an effective strategy to improve the quality of care. In addition, the digitalization of the process offers greater convenience and efficiency, positively impacting various areas of assistance[15].

The objective of this article is to present the development, organization, and testing of a software tool based on the SBAR method, designed to optimize the duty passage in nursing.

Characterizing the problem

The absence of effective communication among health professionals represents one of the main contributing factors to the occurrence of errors and adverse events in the hospital environment[3]. The lack of standardization of the passage of duty with the failure to transmit critical

information about the patient's clinical status, ongoing treatments, and exam results can lead to erroneous diagnoses, duplication of examinations, administration of incorrect medications, and consequently, compromise patient safety[4]. These communication failures result in the reduction of patient safety, which depends on effective coordination among health professionals. Thus, effective communication in the hospital environment cannot be underestimated, because it is directly linked to patient safety and quality of care[5]. The Resolution of the Federal Nursing Council 564/2017, article 38, highlights the duty of the professional "[…] to provide written and/or verbal information, complete and reliable, necessary for the continuity of patient care and safety […]"[16].

Therefore, to carry out an appropriate duty passage, the communication must be clear and objective. Health professionals must use communication effectively as a key tool, indispensable for establishing bonds, understanding the needs of the patient and his family, and providing holistic and integrated care[1]. In this context, the application of health information technologies plans to strengthen communication among professionals in various areas of activity. The integration of these technologies into the care process has demonstrated effectiveness, with simplification of patient care, since the introduction of software in the health area facilitates the transmission of accurate information, decreases the chances of errors, and enables rapid response to emergencies[13].

Health information technologies and software with targeted programming allow health professionals to use these advantages in routine duty passage[17]. The use of SBAR software in health environments suggests optimizing the time of the nursing team, defining the care to be provided, eliminating the points of nonconformity, and allowing care assistance to be aligned.

Method

Type of Study

Experimental research of product innovation and technological development of software of the SBAR method. This was organized following four stages: communication, planning, modeling, and development[18].

Study scenario

The study was developed in the Undergraduate Course in Nursing of the Instituto Integrado de Saúde da Universidade Federal de Mato Grosso do Sul, in the context of Final Paper (TCC), with the use of meeting rooms and the Nursing Skills Laboratory, for software simulation, from October 2022 to July 2023.

The guiding principles for the software to be developed are cited below as**:** time optimization, standardization, and computerization of information related to assistance. The process model was incremental, which gradually generates a series of prototype versions, which are known as increments as functions are completed[18]. The first steps meet the requests of the users, being functional, since from the evaluation of these, other functionalities and versions are developed, as well as new features planned.

The usability test of the software was conducted in two face-to-face stages, with the objective of evaluating the functionality and ease of use of the system in a real scenario. To simulate the use of the software, participants were equipped with laptops and mobile phones connected to the Internet. Six distinct clinical cases were developed, which participants should insert into the system.

The participants of the research were two undergraduate nursing students, two doctoral teachers in nursing, a master nurse, and the software engineer, responsible for the evaluation of the usability and functionality of the software. In the first stage of the test, some server incompatibility issues were identified, which were promptly fixed by the development team. In the second stage, after the resolution of technical issues, the software demonstrated satisfactory performance, allowing participants to complete the proposed tasks efficiently and intuitively.

The results of the tests indicate that the software meets the principles of usability since the participants were able to use the system autonomously and perform the proposed tasks successfully. The identification and correction of technical problems during the first stage of the test demonstrate the team's commitment to developing robust and easy-to-use software.

Specific tests have not yet been performed to evaluate the applicability of the software in different clinical contexts, nor the detailed evaluation of the layout and user interface. These tests are essential to ensure that the software is relevant and useful in a variety of scenarios by providing a satisfactory and intuitive user

experience.

Communication and planning

The purpose of this phase was to organize the demands of the system, as well as establish the functions and characters of the product. Thus, the methods and techniques to be employed to identify the expected requirements and purposes of the program were defined.

The team met with the software engineer to suggest parts of the system and plan actions during the subsequent months of development. From the meetings, results were obtained, and tests and new product analyses were performed.

In the first increment of the software, a form structured in digital format was developed, in which there were important clinical variables, in order to facilitate the documentation and transmission of essential information among health professionals.

In addition, a language for software has been carefully established to ensure that the interface is intuitive and reliable, and thus promotes acceptance and use by health professionals. This condition would result in a tool that can offer not only efficiency but also usability and practicality in the work environment. With the completion of the first version of the system, dates were established for the creation of hypothetical clinical cases, as well as for the subsequent simulation.

Modeling

The creation of abstract and visual representations of the system to be built is a fundamental procedure in the development of software applications. As shown in Figure 1, these can assist in understanding, planning, and communicating fundamental aspects, such as the organization of structure, behavior, connections, and information flows[18].

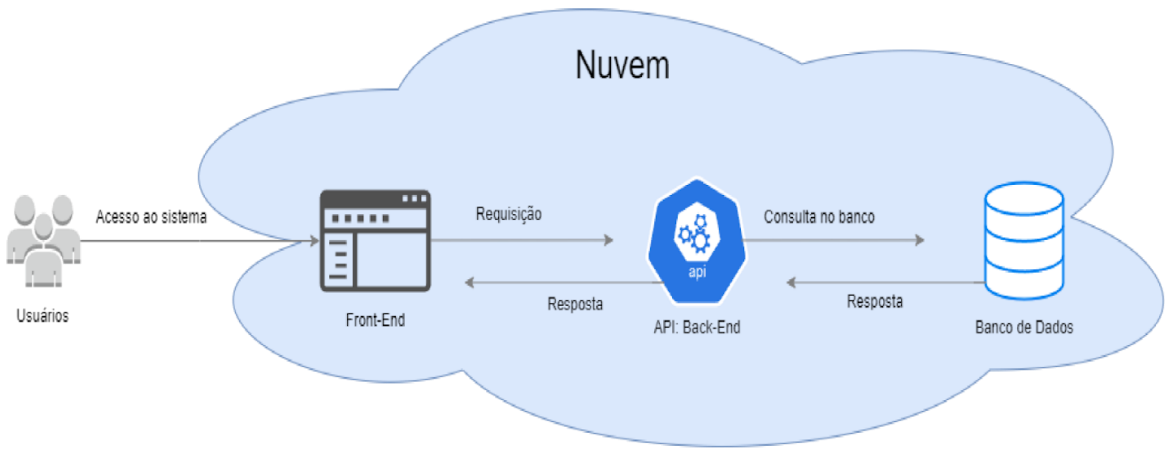

Figure 1 - Demonstration of the architecture chosen for software operation. Campo Grande, MS, Brasil, 2023

The system started with two parts known as the Front- end and the Back-end. The Front-end presents the visible part of the interface, is how the information is presented to the user, the Back- end is a part of the program that stores all data and functionality, but is not available in a visible way to users[19].

The created structure offers several benefits, such as the effectiveness, flexibility, and full use of the operating system. The Front- end allows interaction and accessibility between the user and the application, which separates the responsibility of the system and facilitates the improvement of the developers in different technological areas. The Back-end keeps information organized in the system through storage techniques such as databases, memories, and storage systems[19].

The entire developed system is hosted in a cloud, i.e. it is not on a local physical server; instead, it is on affordable remote servers with large storage. This condition allows the dimensioning of the necessary infrastructure according to the demand to be used in the health institution, with quality of program performance.

Development

Software development comprises the organization and subdivision of work to create an application in several stages, ranging from analysis to conservation and progressive updates[18]. There are several methodologies used for de-

velopment teams, but it is observed that there are common and fundamental elements in all software projects. Among the steps are the requirements analysis, design, coding, and testing, known as the fundamentals of the software creation process, also called the life cycle[20].

In the software architecture, the Front-end layer is designed with React. JS and NEXT.JS structuring, which allows user interactivity. It is worth noting that this connects to the Back-end by the Application Programming Interface (API) developed in Node.js, which manages the necessary access, standards, and validities. To improve the quality relative to system agility, the MongoDB database was used to store the data.

It is essential to emphasize that, in the development of this software, strict measures were adopted to ensure compliance with the General Data Protection Law (LGPD). The privacy of user data is a priority, and all stages of development, from collection to storage, are designed to protect patients' personal information. The use of modern technologies and the adoption of robust security practices ensure that data is treated ethically and transparently, in accordance with current legislation[21].

Thus, with the use of the aforementioned technologies and approaches, the product tends to be more robust, with greater safety and quality, in meeting the expectations and needs of nursing when using the software.

RESULTS

The beta version of the SBAR software complied with the specifications agreed upon during team meetings. This version was made available for tests in the nursing laboratory, and during the tests the software obtained a positive opinion from the interface with the users in terms of structure and functions, requiring some initial adjustments.

The initialization layout and colors have been set to make SBAR components easier for the dynamics of use. Figure 2 presents the beginning of the screen for registration and registration of initial data such as: name, date of hospitalization, medical records, and bed. Soon after, it is possible to visualize the elements of the mnemonic, which must be filled.

The layout configuration tends to facilitate visualization by the nurse, regarding the clinical picture of the patients and recommendations inserted by the nursing team in the previous shift. In Figure 3, you are demonstrating how data can be filled in the system fields. It is valid to note that all information was derived from laboratory simulation and elaborated to evaluate the prototype and its usability.

After the analysis of the beta, it was found that it would be necessary to perform new tests to correct and improve. Some of the suggestive features for implementation were: personal login for each user, ensuring individualized identification and access control. This system will allow each health professional to have unique credentials and restricted access only to information relevant to their area of activity, such as patients in the unit in which they work. This functionality will meet security and data protection requirements, ensuring that sensitive information is accessed only by authorized users.

In addition, a nurse identification icon will be incorporated, which will allow you to verify who made the records and changes in the system. This feature facilitates the traceability of actions and provides greater transparency during the use of the platform. Another important point is the creation of a research field, which will allow quick location of patients registered in the system, optimizing the time of professionals during the duty passage and improving efficiency in the consultation of data. Also, the data export functionality will be implemented in formats such as CSV, TXT, or DOC, allowing professionals to share or analyze the information outside the system, practically and flexibly.

Although the current prototype has not yet implemented granular data filtering, it is planned to create an access control system per hospitalization unit. With this, professionals will have access only to patient data related to their specific unit, ensuring greater security and compliance with good data protection practices, such as LGPD.

These improvements have been identified based on the tests performed and are already being considered in the development plan for the next version of the software. It is worth noting that the software is still in a prototype phase, and new tests will be carried out to evaluate the effectiveness of these improvements and ensure that the system efficiently meets the requirements of security, usability, and data protection. It is important to note that the implementation requires planning to meet the real needs of professionals in hospital environments, to be adopted as relevant subsidies for them and not just as another product.

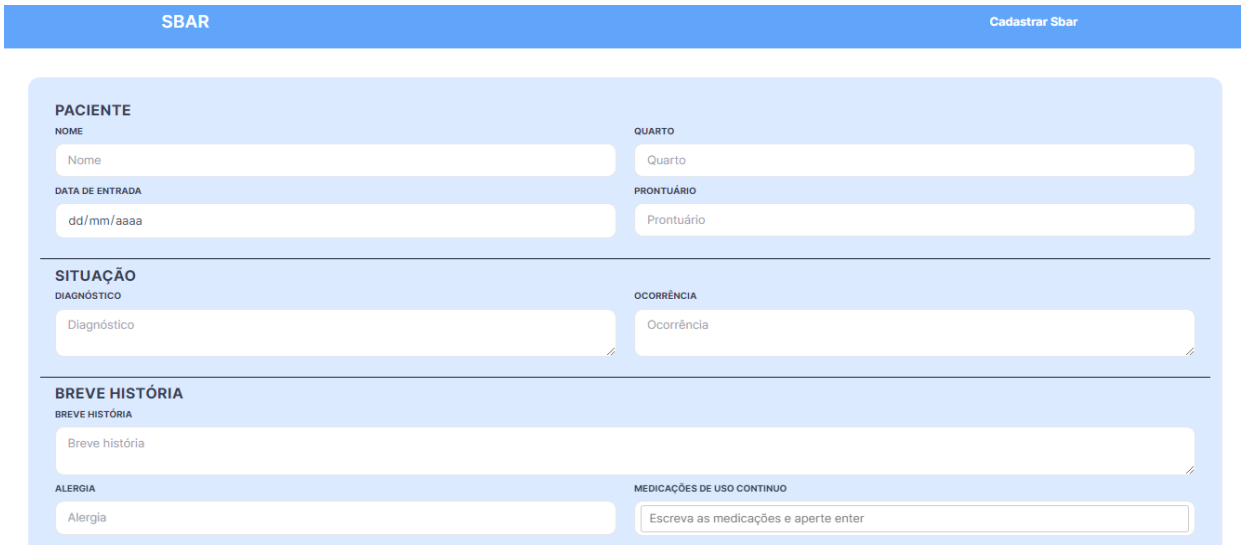

Figure 2 – SBAR software with initial registration screen and components. Campo Grande, MS, Brasil, 2023

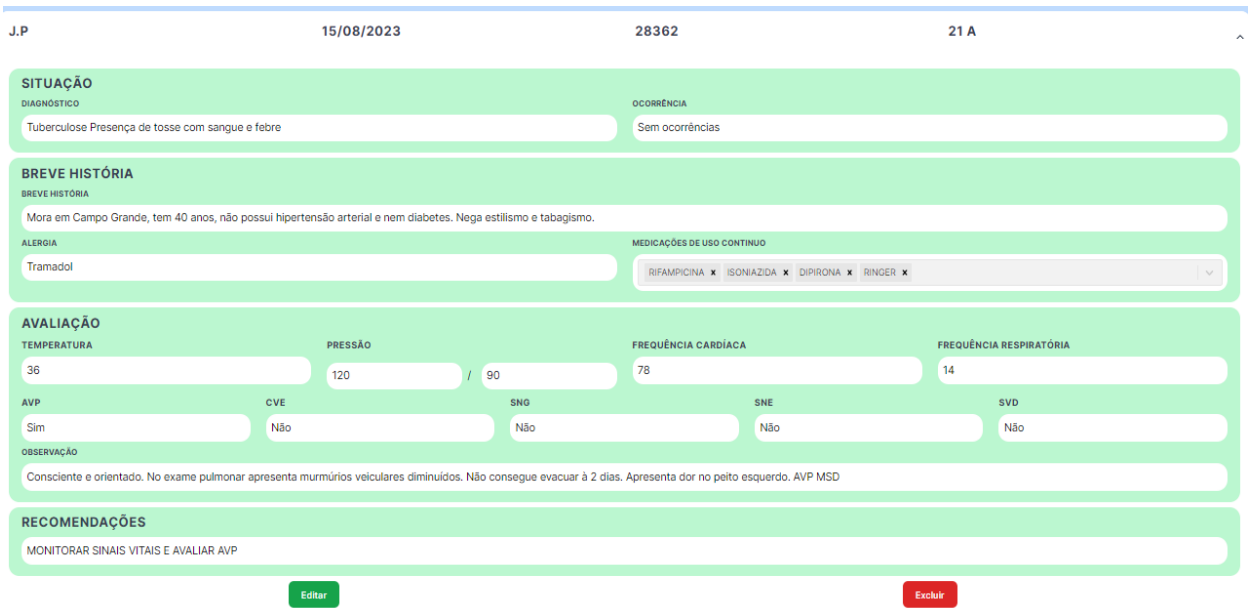

Figure 3 – SBAR software with data summary screen during a service shift. Campo Grande, MS, Brasil, 2023

The research has some limitations that should be considered. Such as the absence of comparable products in the market, especially specific software for the passage of duty in nursing with the SBAR model, which hinders a more robust comparative evaluation. The scarcity of studies and articles on the application of similar technologies in nursing also represents a challenge, since there is a lack of data on best practices, benefits, and challenges of using tools like this in hospital environments. In addition, the testing phase was performed in a controlled nursing laboratory environment, which may not fully reflect the actual working conditions, such as the pressure of time and the intense rhythm of the plantings. This implies that the initial results may not fully represent usability in a daily-use scenario.

Despite the limitations mentioned, the development and implementation of the SBAR software bring innovative contributions to the nursing area, especially regarding the improvement of communication between health teams. The software not only digitizes the SBAR model, making it more accessible and efficient but also integrates technological resources such as evaluation and recommendations, aspects that promote customization, traceability, and practicality. The use of agile technologies such as React. JS for the front-end and MongoDB for

storage enables the creation of a robust and scalable platform that can evolve according to the needs of the hospital environment.

In addition, the integration of SBAR with existing hospital systems, such as electronic medical records, also represents an innovation, since it facilitates the exchange of information among health professionals, without the need to return with data, which improves the efficiency of patient care. This is an important step toward digital transformation in nursing because the tool not only reduces the risk of communication errors but also improves the response time of the nursing team during the duty passage.

CONCLUSION

The development of SBAR software offers a standardized communication structure among nursing professionals, ensuring that critical information is shared consistently and comprehensively, contributing to the quality of care and patient safety.

The tests performed with the beta version of the software, conducted in a controlled environment, demonstrated that it meets the proposed functional requirements. The SBAR performed the functions specified correctly and responded positively to the needs of users, especially in terms of interface usability. However, the evaluation also pointed out areas for improvement, such as the need for interface adjustments and the implementation of new features, such as the creation of personal logins to ensure the traceability of information.

Based on the results obtained so far, we can conclude that the SBAR software represents an important innovation in the nursing area, offering a practical and efficient tool for the passage of duty and the exchange of essential information among the members of the health team. However, to validate the effectiveness of the tool in real clinical scenarios, it is necessary to perform new field tests, with the active participation of nursing professionals during the plantings, so that we can evaluate the user experience in everyday situations and make the necessary adjustments to improve the system.

Regarding the applicability in the clinical practice of nurses, we emphasize that although the digital SBAR presents great potential to improve communication and reduce errors, its implementation depends on an adaptation to the reality of the hospital environment, considering the work routine of nursing professionals. The acceptance of the tool in the real context of work will be a crucial factor for its success, and the next studies will focus on this aspect, evaluating the integration of the software into daily routines and the effectiveness of the tool in the clinical decision-making process and the improvement of patient safety.

In addition, in relation to the limitation of the scarcity of comparable studies on software prototypes for communication in nursing, it is important to highlight that, although there are some studies on digital tools, the literature on specific software prototypes, such as SBAR, is still limited. The lack of similar studies on the implementation of such technologies in clinical practice highlights the need for more research to validate and expand the use of digital solutions in the health context, something that will be addressed in future phases of our study.

In short, the digital SBAR has the potential to transform the way nursing teams communicate, reducing errors and improving the continuity of patient care. The next stages of development and testing, which will include implementation in real hospital environments, will be essential to confirm its effectiveness and expand its use in different clinical contexts.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

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Data analysis and interpretation: Doege REM, Oliveira MDM, Melo TA
Writing and/or critical review of the intellectual content: Doege REM, Cardoso AIQ, Higa CML, Oliveira MDM, Melo TA, Sarat CNF
Final approval of the version to be published: Doege REM, Cardoso AIQ, Higa CML, Oliveira MDM, Melo TA, Sarat CNF
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