

Development of a software for intraoperative nursing assistance

Desenvolvimento de um software para a assistência de enfermagem intraoperatória

Desarrollo de un software para auxiliar de enfermería intraoperatorio

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ABSTRACT

Objective: to develop a software that allows the nurse of the surgical center to plan intraoperative nursing care through electronic access to the work routines of his/her team. **Method:** the methodological course was carried out according to *systems development theory*, which guides five basic activities: *communication, planning, modeling, developing and delivery of the product*. **Results:** the activities and functions of the software were arranged in five modules, containing information regarding the inputs and the step-by-step involving the assembly, circulation and disassembly of the operating room to perform the various anesthetic and surgical procedures. **Final considerations:** The developed software will allow the surgical center's nursing team to access its intraoperative routines in a fast and systematic way, since this allowed to concentrate all the routines of assembly, circulation and disassembly of operating room in a safe space and accessible.

Descriptors: Surgicenters; Nursing Informatics; Software; Nursing; Intraoperative Period;

RESUMO

Objetivo: desenvolver um software que possibilite, ao enfermeiro do centro cirúrgico, planejar a assistência de enfermagem intraoperatória por meio do acesso eletrônico às rotinas de trabalho de sua equipe. **Método:** o percurso metodológico foi realizado de acordo com a *teoria de desenvolvimento de sistemas*, que orienta cinco atividades básicas: *comunicação, planejamento, modelagem, construção e entrega do produto*. **Resultados:** as atividades e funções do software foram dispostas em cinco módulos, contendo informações referentes aos insumos e o passo-a-passo envolvendo a montagem, circulação e desmontagem da sala operatória para realização dos diversos procedimentos anestésicos e cirúrgicos. **Considerações finais:** acredita-se que o software desenvolvido permitirá que a equipe de enfermagem do centro cirúrgico possa acessar suas rotinas intraoperatórias de forma rápida e sistemática, uma vez que este permitiu concentrar todas as rotinas de montagem, circulação e desmontagem de sala operatória em um espaço seguro e acessível.

Descritores: Centros Cirúrgicos; Informática em Enfermagem; Software; Enfermagem; Período Intraoperatório;

RESUMEN

Objetivo: desarrollar un software que posibilite al enfermero del centro quirúrgico planejar la atención de enfermería intraoperatoria mediante el acceso electrónico a las rutinas de trabajo de su equipo. **Método:** el recorrido metodológico se realizó según la teoría del desarrollo de sistemas, que orienta cinco actividades básicas: *comunicación, planeación, modelado, construcción y despliegue del producto*. **Resultados:** las actividades y funciones del software se dispusieron en cinco módulos con informaciones referentes a los insumos y al paso a paso del equipamiento, la circulación y el desmantelamiento del quirófano para la realización de los diversos procedimientos anestésicos y quirúrgicos. **Consideraciones finales:** se espera que este software, por su capacidad de concentrar todas las rutinas de equipamiento, circulación y desmantelamiento del quirófano en un espacio seguro y accesible, facilite el acceso al equipo de enfermería del centro quirúrgico a sus rutinas intraoperatorias de manera rápida y sistemática.

Descriptores: Centros Quirúrgicos; Informática Aplicada a la Enfermería; Programas Informáticos; Enfermería; Período Intraoperatorio.

INTRODUCTION

The use of computer resources represents major advances for health services, despite all the difficulties inherent in its implementation and use. The use of this technology improves the reliability and usability of nursing records when compared to the manual technique of this practice⁽¹⁾. However, the implementation of document management systems is still subject to some criticism, among them the persistence of bureaucratic paperwork, since, despite spending millions on digital infrastructure, paper documents persist in the health institutions⁽²⁾.

Health information technology is perfectly suited to the present reality of nursing in the search for the improvement of the quality of care provided⁽³⁾, since it can facilitate planning, decision making, management control and communication itself. Nursing information systems have been used with the purpose of assisting in the accomplishment of professional practice, allowing for improvements, either in data collection, processing, analysis or transmission of information essential to the planning of the implementation of nurses actions⁽⁴⁾.

Some authors point out that the software developed in nursing, in addition to documenting care actions, can support decision making, contributing to the quality of care⁽⁵⁾. However, regardless of their field of activity, the nurse still uses much of his time with bureaucratic activities. In this context, the time spent during the retrieval and consultation of information from manual registers greatly compromises the decision-making process of the nurse⁽⁶⁾.

Making significant organizational change in information management requires a systematic knowledge of both the available technological resources and the workflows involved in the processes and subprocesses of the production of nursing care itself. Thus, it is indispensable that the nurse integrates the computer science team to actively participate in the construction of new technologies aiming at the continuous improvement of the process of implementation of the care⁽⁴⁾. The mapping of these processes can be used to better understand how tasks are performed and how they can influence the final design of each product⁽⁷⁻⁸⁾.

Process mapping is an analytical management tool for communication, which enables the identification of delays and problems in the execution of workflows, which assists managers in the decision-making process based on evidence⁽⁹⁾. It is a visual identification technique, in the form of graphical drawings of the main steps and decisions of the workflow through flowcharts and Standard Operating Procedures (SOPs)⁽⁹⁾.

In general, the various process mapping models are applied generically in the description of work routines of the hospital institutions, however, it is possible to identify knowledge gaps in the literature on the use of mapping techniques for work processes directed to areas more specific of nursing, such as perioperative nursing, which includes nursing actions performed in the perioperative period, which in turn is divided into pre, intra and postoperative periods⁽¹⁰⁾.

In this context, all the activities performed by the nursing team during the intraoperative period comprise the planning and actions involved in assembly, circulation and disassembly of the operating room (OR) in each anesthetic-surgical procedure⁽¹⁰⁾.

Nursing plays a fundamental role in the care of patients during the intraoperative period. For this, it is up to the nurses to

develop care activities that contemplate physical, psychological, social, cultural or spiritual aspects⁽¹¹⁾, to ensure patient safety. However, the promotion of patient safety should involve not only a follow-up of the assistance, but also the entire multiprofessional team and senior management of the institutions, either in the implementation of actions directly related to the assistance or in the support of projects for this purpose⁽¹²⁾.

OBJECTIVE

To develop a software that enables the nurse of the Surgical Center (SC) to plan intraoperative nursing care in a computerized and accurate way, regarding the access to the routines of work of its staff in the day to day.

METHODS

Ethical aspects

The research project was previously approved by the Research Ethics Committee (REC) of the city of the study institution, EERP-USP, and by the zip code of the participating city, Hospital de Clínicas de Uberlândia (HCU).

Design, setting and period

This is an exploratory descriptive study of methodological development of an information technology tool, in the form of a software called the Intraoperative Nursing Care Program (INCP), based on the theory of the life cycle of the systems development of Pressman and Maxim⁽¹³⁾. The research was carried out in the period of March to May of 2017, in SC of HCU.

Study protocol

The methodological course of the present study was carried out in agreement with the theory of Pressman and Maxim⁽¹³⁾, which encompasses five stages of development: *communication between the developer and client, planning of the techniques and resources to be used, modeling of the technology to be developed, development of the software and delivery of the product.*

Communication between the developer and the client: after identifying the need to develop a tool to improve nursing consultations, nursing assistants and technician's intraoperative assistance SOPs. A meeting was held between a nurse researcher at the SC and the management team of Information Technology of the hospital institution, for the planning of the technical development of the software.

Planning of the techniques and resources to be used: the INCP software was based on a prototype of the system, developed using the Microsoft Excel version 2010, containing all the anesthetic-surgical procedures related to the assembly, circulation and disassembly of OR, as well as information on the inputs and work routines inherent in each of these procedures. The language of choice for the development of INCP software was Java and the

database was IBM DB2 of International Business Machines (IBM), with more than 100 GB of data and a storage with 35 terabytes of virtualized and (hot-swap allows changes in an operating system without the need to interrupt its operation), ensuring enough storage space for the system to grow its database without concern for space. In the system development architecture, the Java Frameworks used were PrimeFaces.

Modeling of the technology to be developed: in this stage software models were built that would meet the scope of the orientations, functions and activities to be performed by the system in accordance with its requirements.

Software construction: an analyst and system programmer of the institution and two research nurses participated in the construction of the software, being a member of the nursing team of the SC and the other one linked to the Ribeirão Preto School of Nursing of the University of São Paulo (EERP- USP), SP. One of the nurses was registered as a system administrator because he/she was part of the nursing team of the SC where the software was developed.

In the development of the software, a data validation system (BeanValidation) was introduced, capable of informing the system administrator of the invalid data entry. In addition, the technology used in software development has assistive tools that facilitate digital inclusion for some visual and motor deficiencies, for example.

The software was developed as a multiuser and multitasking system, that is, able to perform its functions normally when other systems are in use, sharing the same network.

For text output and user access reports (output), the system provides a module developed with JasperReports® technology (TIBCO JasperSoft® Studio) version 6.0.

Finally, an audit log control was introduced to the software, which guarantees the irremovability of authentications made. These authentications can also be by means of passwords.

After the technological development of the software, it was sent to the nurse administrator of the system to insert the texts referring to the intraoperative nursing routines (assembly, circulation and disassembly of OR).

To do this, data collection regarding nursing routines was performed by the system's nurse administrator during a periodic review of the SC's SOPs, using the process mapping technique through interviews with key informants based on the snowball technique (snowball). This method uses reference chains, in which the initial informants, after being interviewed, indicate new participants until the "saturation point of information" is reached, which is when the new interviewees begin to repeat the contents already obtained, without adding information relevant to data collection⁽¹⁴⁾.

Software delivery: after the software development and training of nurses, technicians and nursing assistants for their use, the system was installed in the SC for evaluation and feedback to developers.

RESULTS

The INCP software was developed in accordance with the following requirements: to make available all the information

inherent to the OR assembly, circulation and disassembly routines; be able to recover data in case of failures; have a user help module; allow free text input; allow the issuance of texts and access reports; allow its use by persons with disabilities; be able to report invalid data entry; have satisfactory screen quality; have a satisfactory response time; have an adequate execution time; exchange information with other systems; be able to perform its functions normally when other systems are in use, sharing the same network; security of access through passwords; enable user management; generate alert when the storage space for records reaches an occupancy threshold; be able to identify the author, as well as date and time of access; use an authentication method in order to ensure the unretractability of the authentication performed; and, finally, provide an open space for the user to record suggestions for changes or considerations.

Scope of INCP software

According to the software requirements, its scope has been translated into five modules designed to provide the user with a systematic access to the intraoperative nursing routines of assembly, circulation and disassembly of the OR.

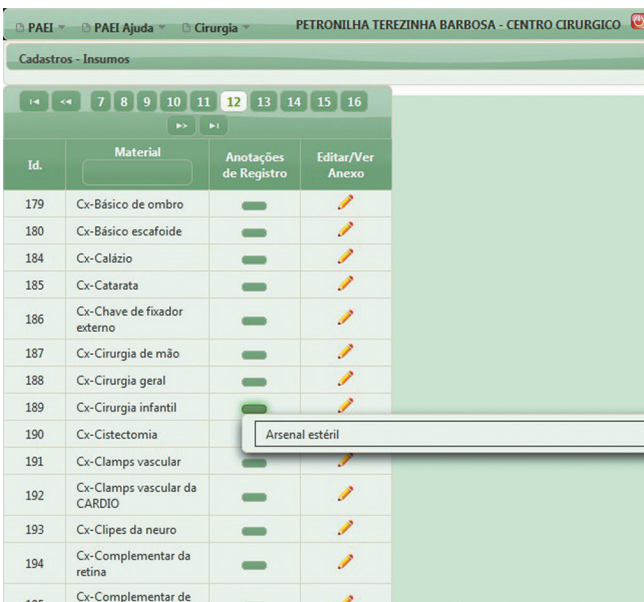
The INCP software provides on its screens the following access modules:

- "Registration of Procedures" module: this module allows the user to view the various anesthetic-surgical procedures, so that by clicking on the icons in the "Record Notes" column, the user will have step-by-step access to the assembly, circulation and disassembly of OR for each anesthetic-surgical procedure (Figure 1);
- "Registration of inputs" Module: in this module the user visualizes the inputs used in the various procedures. The user can click on the "Notes" column to locate the inputs and, if necessary, access the icons in the "Edit/View Attachment" column to see the input data searched (Figure 2);
- "Sheet of Procedures by Inputs" Module: in this worksheet the user will have access to the visualization of the inputs (in column) required for each anesthetic-surgical procedure (in line) divided by specialties (Figure 3).
- "Registration of Observations" module: this open space allows the user to record their suggestions or considerations about the texts and/or the software itself (Figure 4);
- "INCP Help" module: In this module the user will have access to the navigation step-by-step of all other modules of the system (Figure 5).

The system also provides a module, restricted to the nurse administrator of the system, for the registration of procedures and inputs by specialty. Using the "Registration of Procedures" modules (Fig. 1) and "Registration of Input" (Fig. 2), the system administrator nurse can also include inputs and procedures in these modules.



Note: Id. - Procedure Number
Figure 1 – “Registration of Procedures” Module



Note: Id. - Procedure Number; †Cx - Surgical instrument box
Figure 2 – “Registration of inputs” Module

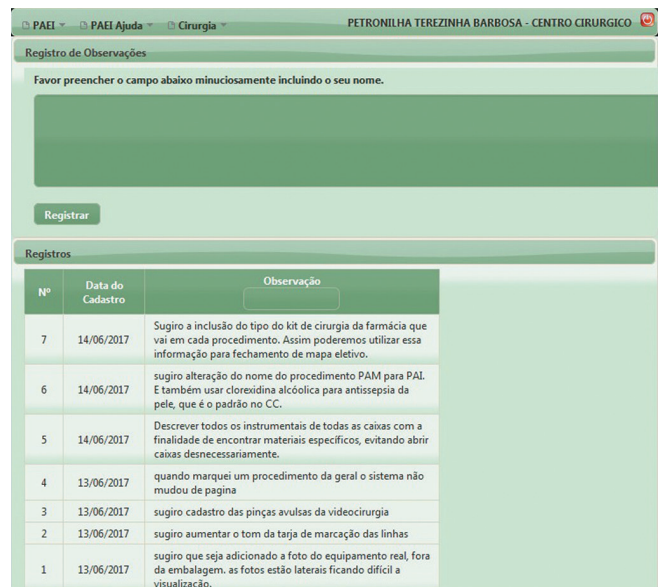
Registration, alteration and exclusion of users: the action of inclusion, change or exclusion of users is allowed only to the IT Support sector of the participating institution, in response to requests, via e-mails, issued by the system administrator nurse.

Issuance of access reports: INCP software has a module with a password-restricted view of system administrators that allows the issuance of texts and access reports of users, allowing the identification of the author, as well as the date, time of access and the machine where there was access.

Other information about the software: After inserting, changing or deleting data in a module, the software will inform the system administrator, respectively, one of the messages: “data successfully registered”; “Data successfully changed” or “Data



Note: Sn - If necessary
Figure 3 – “Sheet of Procedures x Inputs” Module



Note: Nº - Occurrence number
Figure 4 – “Registration of Observations” module



Figure 5 – “INCP Help” Module

deleted successfully”. Any alteration of data referring to the OR assembly, circulation and disassembly routines in the software is only allowed to the system administrator nurse.

In case of data loss and/or failure, the system administrator can retrieve the content using a high availability feature that provides fault tolerance through data validation (BeanValidation).

When the storage space for records reaches an occupancy threshold, the INCP software will issue alerts to enable operators to take preventive measures.

To make INCP software available for access to registered users (nurses, technicians and nursing assistants), it was necessary to register the system in the domain www.hc.ufu.br. With this, it was possible to make available through the web browser, access by any computer terminal in the SC sector of the participating institution, provided that the user and password are previously registered and authorized. One week after the installation of the software in the computers terminals of the SC, a 30-minute training for each user was administered by the research nurse through the "user help module" containing all the necessary steps to use INCP software. With this, the entire nursing team of the SC was given access to the system to plan their day-to-day work activities.

DISCUSSION

It is clear that information systems, whether for records or data queries, have their space consolidated in modern nursing. However, many healthcare institutions still find it difficult to plan computerized systems⁽¹⁵⁾. Despite the many advantages obtained through its use, the application of technological resources in health and nursing still encounters obstacles, often due to lack of effective actions, since many managers do not understand the dynamic relationship of the elements that make up this type of tool. It is necessary to consider some factors such as the great need for investment in infrastructure, high implementation costs, technological maintenance and systematic training needs. The more resources available, the greater the facility to plan and deploy new work methodologies⁽¹⁵⁾. Some authors emphasize that, before the insertion of new technologies in the services, changes are necessary in the structural policy of the institutions⁽¹⁶⁾.

When used correctly, the technology provides several advantages for the implementation of quality nursing care, among them, it can be mentioned, the optimization of the time and improvement in the proficiency of the team⁽¹⁷⁾. In this context, the development of software related to the documentation of nursing care actions should seek the creation of systems that, besides being tools for documentation of nursing actions, serve as support for the qualification of the work team.

Among the different environments of a hospital unit, SC is one of the most complex sectors of the health organization, requiring a complicated logistic distribution with numerous equipment and professionals⁽¹⁸⁾, which demands a high investment in technological support when considering that in this environment, several processes and subprocesses of work are linked directly or indirectly to the surgical process.

However, despite technological advances involving modern medicine, flaws in surgical procedures in particular can cause considerable damage to the health of its users. In the context of surgical patient care, a worldwide estimate indicates that half of these postoperative complications could be avoided. This led the World Health Organization (WHO) to launch in 2009 the Safe

Surgeries Saves Lives Program, which is part of the second global challenge for patient safety⁽¹⁹⁾. Data such as these alerted the world to the fact that the system was not really foolproof, thus beginning a global investment initiative geared towards higher quality security assistance⁽²⁰⁻²¹⁾. Given this context, it becomes necessary for the nurse of the surgical unit to follow the new trends and participate in the construction of alternatives that respond to the challenges of improving the supply of the quality not only of the technology required in all procedures, but also of the services provided by its work team.

Regardless of the increase in the demand for health combined with the lack of resources, the search for excellence, efficiency and effectiveness is necessary in view of the complexity of the processes and technologies existing in hospital institutions⁽²²⁾, especially when considering patient safety as one of the top priorities of health care.

Regarding advances in scientific knowledge, the great application that the INCP software has in the process of access to the intra-operative nursing routines, as well as its potential for future researches involving resource management, work process and others.

Study limitations

This study presents as a limitation the absence of an evaluation of the quality of the Software, however, it should be noted that the evaluation of the quality of the system is in the process of being finalized.

Contributions to the area of nursing, health or public policy

This study should contribute to fill gaps and produce knowledge in the area addressed since this allowed to concentrate much of the information inherent to intraoperative nursing in a technology tool accessible to the entire work team.

CONCLUSION

The purpose of this study was to develop a system that would enable nurses in the surgical center to improve and optimize intraoperative nursing care through electronic and systematic access to their team's work routines.

The INCP software is still in the test condition, however, its inclusion in the daily practice of the nursing team of the SC of the institution under study, allowed the researchers to observe improvements in the process of access to work routines. The specific knowledge of each function of the nursing team, previously restricted to some collaborators, was inserted in a device accessible to all nursing in the sector. Another advantage observed was the optimization of the time that the nursing professional spends in accessing his work routines. These observations reflect a positive feedback from SC nursing in relation to the developed software.

In accordance with the theoretical framework adopted for software development, the technology used allowed the elaboration of screens designed to facilitate the user's access to all the data necessary to perform their activities related to intraoperative

nursing care. Other aspects such as the software language chosen, as well as the database in which the system was developed, allowed the construction of a software product with several modules of easy access and good navigation.

In this perspective, it is considered that the objective of this research was reached, because the software developed allowed the concentration of all the nursing routines related to the assembly, circulation of disassembly of OR, in a safe and accessible space. However, it is necessary to carry out research aimed at evaluating the quality of INCP software, in order to contemplate

the last stage of the systems development life cycle according to the assumptions of Software Engineering.

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