INFORMATION TECHNOLOGY FOR TRAUMA REGISTERS AND SERVICE MANAGEMENT

TECNOLOGIA DE INFORMAÇÃO PARA REGISTRO DE TRAUMA E GESTÃO DO SERVIÇO

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RESUMO

O objetivo deste estudo foi construir e validar um *software* para registro de trauma visando à identificação do perfil sociodemográfico e das escalas de gravidade com vistas à criação de um banco de dados substancial acerca do paciente vítima de trauma. A pesquisa metodológica foi desenvolvida em cinco etapas: diagnóstico situacional; revisão da literatura; elaboração de ilustrações, *layout, design* e textos; validação da exequibilidade do conteúdo do software; e teste piloto. O sistema de informação de registro de trauma SISAT foi elaborado contendo 13 telas de inserção intuitivas e dispondo sobre 37 variáveis sociodemográficas e clínicas para avaliações primária e secundária, escalas de gravidade em trauma, procedimentos, condutas, encaminhamento e alta. O sistema SISAT foi implantado em um centro de referência ao trauma. Os registros de trauma em países desenvolvidos demonstram segurança e qualidade na assistência prestada. A tecnologia gerada mostrou-se capaz de subsidiar ações como pesquisas, tomada de decisões e melhoria da qualidade do atendimento ao trauma.

Descritores: Tecnologia da informação; Registro de trauma; Enfermagem; Estudo de validação.

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ABSTRACT

This article describes the construction and validation process of a trauma register software aiming at the identification of sociodemographic profiles and severity scores with a view to the creation of a reliable trauma patients database. Our methodology was developed in five stages: situational diagnosis; literature review; production of illustrations, layout, design and texts; validation of software contents' feasibility; and piloting. The product of this process is the SISAT trauma information system, created with 13 user-friendly screens, including 37 sociodemographic and clinical variables for primary and secondary assessments, trauma severity scales, medical procedure, conducts, referral and discharge. The SISAT system was then implemented at a trauma referral center in Brasilia, Federal District, Brazil. Trauma registers in developed countries are characterized by safety and quality of care. The system resulting from this research has the potential to subsidize actions such as research, decision-making and trauma care quality improvements.

Descriptors: Information technology; Trauma registers; Nursing; Validation study.

INTRODUCTION

In the recent years, an increasing concern has been expressed in relation to the development of Health Information Systems (HIS) capable of strengthening the management of health services and promoting quality improvements in the provision of health care.[1] Counting on efficient electronic processes contributes to the continuity and customization of care, and for this reason health professionals and institutions, and the society at large must recognize the importance of Information Systems (IS) with their benefits and improvements in terms of access to health, communications and care provision.[2]

In the healthcare context, the field of urgent care, emergencies and traumas have been in contact with information systems aimed at improving care provision to severe clinical and trauma patients through medical priority systems, telemedicine, unified information systems, tablets and smartphones, among other resources.[1-2]

Brazilian Executive Ordinance 2048/2002 corroborates this trend by considering urgent and emergency care as an important component of health care and establishes the development of actions that improve care provision to urgent and emergency cases. It also establishes that referral hospitals in these modalities of assistance must count with adequate physical facilities and human and technological capabilities in order to meet the needs of their users.[3]

To implement new strategies on care provision to trauma victims, a partnership emerged in 2011 between Hospital de Base do Distrito Federal (HBDF) and the Mobile Urgent Care Services (SAMU in the Brazilian acronym) with the aim of continuing the provision of pre-hospital care to trauma patients. These efforts centered on restructuring care facilities and investing in material, technological and human resources to promote improved levels of organization, safety and support upon patient arrival, thus enabling better work conditions to health teams and decent quality reception to patients.[3-4]

On February 21, 2011, the Referral Unit for Trauma Victims – currently known as the HBDF Trauma Center (CT-HBDF) – came into existence including three physical sectors: the "red room" with the capacity to receive five severe trauma patients; the "yellow room", where assistance is provided to less severe trauma patients without fixed beds, due to the its high admittance levels, with enough space for seven stretchers; and the Advanced Trauma Assistance Unit (USAT), where stabilized patients wait for a vacancy at the Intensive Care Unit (UTI).[3-4]

Due to the intense demand for care and to the absence of scientific works on the work carried out at CT-HBDF, a group of nurses was mobilized in 2015 to analyze data on trauma victims, based on the hospitalization register, the electronic records of patients and the *trakcare®* information system as main sources. A databank emerged based on an Excel® spreadsheet with information on categories such as age, gender, diagnosis, injuries, means of transportation, trauma mechanism, responsible clinical professional or unit, referrals and care procedures. Thus, a statistical analysis found information on the profiles of patients assisted at CT-HBDF, where approximately 1900 care services are provided in the red room and 10 thousand procedures are provided in the yellow room on an annual basis.[4]

As a result of a high number of admissions and the absence of a databank system capable of providing quick access to patient data and accelerating the consolidation of important information for the decision-making process, a proposal emerged in 2016 of creating and implementing a software as a management tool, to record information and develop strategies that improve care provision.

It is a consensus that safe, accurate and reliable care is only possible based on an information model that allows the development of strategies based on the recorded data, independently of the unit where care is provided.[5-6] This study presents the construction of the Trauma Assistance System (SISAT) as a management tool that creates a trauma database to contribute to the improvement of care to trauma victims. Considering these aspects, it describes the process to construct and validate this trauma register software to create a databank.

METHOD

This study's methodology comprises five stages: situation diagnosis; literature review; production of illustrations; layout, design and system texts; validation of the feasibility of software contents; and piloting, that is, the construction and validation of the information technology software for trauma records.

The study is based on the red and yellow rooms of the Trauma Center at Hospital de Base do Distrito Federal (CT-HBDF), covering the period from June 2016 to March 2017, with a validation proposal during May and June 2017. Its research strategy is focused on the development, validation and assessment of research tools and methods.[9-10]

Study subjects include all trauma patients of both genders and all age groups who were admitted at the Trauma Center during the studied period.

In the Federal District (DF), trauma care is provided by the public and private networks. However, the CT-HBDF is the only type-1 hospital under the DF Secretariat of Health to offer many specialties demanded by this modality of care, in addition to being the only Trauma Center of the country managed by SAMU, in order to continue providing assistance to severe trauma patients admitted from pre-hospital care.

SISAT's contents were based on the healthcare and managerial needs identified by regular nurses and nursing residents working at the HBDF's emergency and trauma areas, who were approached via working group meetings starting in November 2015. After four years of manual records, the need for improving assistance was felt, starting from a pilot research with manual records at the yellow room, which is characterized by high patient admittance levels, with an average of 50 patients admitted per day.

At the meetings, this piloting tool raised some questions. How could a complete collection of data be enabled for patients involving several variables? Was there a need for in-service training to facilitate professional data collection? How could a common language be used in order to facilitate general understanding? Could the data collection timing be optimized?

The need for responses from the scientific literature for such questions became clear, and bibliographical surveys were carried out in the SciELO, BDENF, LILACs, MEDLINE, CINAHL and PubMed databases to find recent and updated publications on the theme, with an emphasis on information systems as tools to manage care provision and services in Brazil and other countries.

Since this system involved some technical skills from the field of information technology, a professional system programmer was hired to develop the task. The idea of creating and developing a database software came to life. Preliminary contents and illustrations were developed and submitted to the process of edition and layout, also known as the system's visual identity, following criteria linked to contents, structure / organization, language, layout and design, cultural sensibilities and adequacy to the target group.[11]

This software was developed by the *CLEAN – Smart solutions* consultancy company for information systems, along with nurse researchers

and nursing residents involved in the larger project entitled *Epidemiological profiles of trauma patients at HBDF*. This system includes internet access via user accounts with passwords, and it contains pages for the insertion of data that clearly allow assessing key care provision aspects.

The contents of the SISAT database were provided by a manual collection tool including variables with specific features and needs linked to the care services. It used the variables of socio-demographic data, means of transportation, trauma mechanisms, trauma circumstances, injury area, medication and test records and assessment scales, among others. Many meetings were held with the nurses, nursing residents and the system programmer in order to integrate the available information and consolidate the construction of the software.

The system validation proposal was scheduled to take place in June to August 2017 with the training of staff members and the provision of computers and other equipment to professionals form all work shifts. In-service training in order to make professionals more familiar with the system is expected to be carried out by nursing residents from the Federal District Secretariat of Health (SES/DF) working with urgent and trauma care participating in this research stage both at the red and yellow rooms.

SISAT is a powerful instrument in the treatment of trauma victims, since it will enable access to harmonized and integrated information to assist the decision-making process on effective care measures, thus serving the need for organized assistance that may reduce mortality via adequate funding, technology, research and training. On the other hand, the absence of adequate records leads to more precarious services and to an increase in preventable deaths.[7]

The Content Validity Index (CVI) will be used to assess the internal validity of data. The CVI consists in evaluating expert agreement regarding the representativeness of a measure in the context of a particular content under study. For external validity purposes, HBDF trauma records were compared with the records from other institutions with similar medical specialties. To tabulate the calculations of IVC measurements, the software *Statistical Package for the Social Sciences* (SPSS), v. 20.0 will be used, and its results will be presented by descriptive statistics. The internal SISAT validation is part of the second step of this research, which will be piloted for a period of three months with a one-month interval for assessing inconsistencies, making adjustments and then authorizing its use.

This research counts on the official approval of the Committee of Ethics of the Health Teaching and Research Foundation of the Federal District Secretariat of Health (FEPECS/SES/DF) under process 994.833. This project also meets the specifications of Resolution 466/12 of Brazil's National Health Council, which provides guidelines and regulations for researches involving human beings[9], in regard to physical databanks, manual patient records and health care service statistics.

RESULTS

SISAT comprises thirteen screens and a total of 37 variables. Each screen shows a number of options to be filled in according to the characteristics of each health care service. Its trauma records include socio-demographic and clinical information on injury mechanisms, trauma type, treatment and test records, clues and symptoms. One of its features is a standardized language to facilitate data review by using codes compatible with the national and international norms, such as trauma scales, pain and RASS.[7]

Its initial screen allows staff professionals to log in. It is followed by a patient admission form on the second and third screens, which includes full name, SES number, gender, date of birth, profession, injury information, pregnancy data, person responsible for filling in the register, date of occurrence, and date and time of admission (Figure 1).

Figure 1: Admission screen and form, SISAT Trauma Register System, Brasilia, 2017

The fourth screen is an admission data supplement with information on the type of care provided to patients, risk rating, reference physician, traces of legal and illegal drugs, existence or not of a companion, accident at work, place of accident, allergies, comorbidities and destination room.

The fifth screen covers secondary information on vital signs and symptoms, with a pain assessment scale and adult and pediatric trauma scales. For adults, it uses the Revised Trauma Score (RTS) to assess three parameters: a neurological assessment following the Glasgow Coma Scale (GCS), and hemodynamic assessments through systolic artery pressure (SAP) and respiratory rate (RR). And for pediatric procedures, it uses the Pediatric Trauma Score (PTS), which records children's weight, air passages, systolic artery pressure, level of consciousness, injuries and fractures (Figure 2).

Figure 2: Secondary information screen and form, SISAT Trauma Register System, Brasilia, 2017

The sixth screen delimits bodily injuries by identifying anteroposterior parts of the human body represented by a mannequin-figure on which injury areas and their respective types of injuries can be selected (Figure 3).
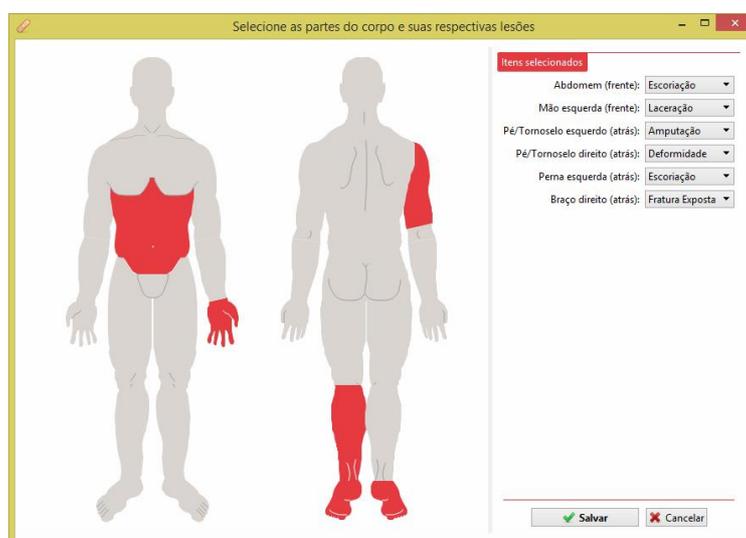

Figure 3: Bodily Injuries screen and form, SISAT Trauma Register System, Brasilia, 2017

The seventh screen contains a list of past interventions and additional space for describing new interventions. The eighth screen describes medication uses, posology and form of administration, medication schedule, radiological and laboratory tests, and the procedures carried out (Figure 4). The ninth screen corresponds to a combination of the second and third screens. It displays a preliminary health care service report with a review of the interventions that took place. And the final screens complete the database by showing the full record of the individual patient, or of all selected patients.

This system can gather information on a total of 37 variables and includes four scales – two of them linked to trauma (RTS and PTS), one aimed at pain assessment, and, finally, a Ramsey Sedation Scale. The integration of scales carried out by SISAT provide significant decision-making resources, since they enable to measure severity levels, thus directing the provision of care to conducts compatible with the severity of each case, while contributing to an improved diagnosis and improved survival chances. It also allows assessing the quality of provided care.[8,9,10]

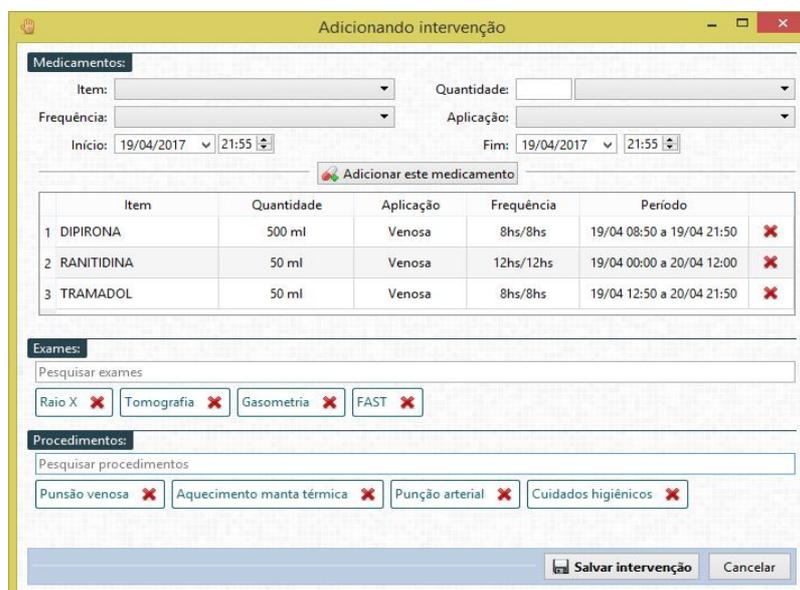

Figure 4: "New Intervention" screen and form, SISAT Trauma Register System, Brasilia, 2017.

This system was developed with the C++ programming language and runs both in Windows and Linux operating systems. It can produce consolidated data on levels of prevalence and incidence, and socio-demographic profiles. It can also cross variables. With the use of filters, it can generate customized reports on the provided services.

The information is stored in a physical server database at the HBDF. It will also count with daily data backups, which will be safely copied to another server, to ensure the preservation of all information involved in the system's use, even in case of main server malfunction.

DISCUSSION

Statistical data from the Federal District have shown that between the years 2000 and 2015, external causes ranked third among causes of death and second among causes of hospital admission. One of the actions to tackle such situation, according to the Plan of Strategic Actions to Tackle Chronic and Non-Communicable Diseases in the Federal District 2017-2022, is to provide support to researches using the available databases.[12]

The improvement of health care quality has increasingly become an aspiration of health care institutions, as a result of increased demands by their users, of far-reaching technological advancements, of an increase in the complexity of care, and of high costs. The provision of quality services demands from managers the ability to face a number of challenges in order to overcome difficulties by enhancing their managerial skills.[13]

Amidst a complex scenario involving health systems with a diversity of needs in terms of services and of adequate skills to meet specific demands, it is increasingly indispensable to count on combined strategies involving managers and professionals as a pathway towards overcoming the current difficulties.[14]

The computer sciences are an ally in this improvement-process, since they allow for management strategies capable of leading to better responses and to autonomy in the development of services, by adjusting the available routines to local realities, thus favoring mechanisms in support of decision-making processes, control and assessment of actions, while centralizing information and organization, filing and data-processing tasks.[15]

The 13 screens and 37 variables included in the SISAT system comprise specific information sets on trauma patients and allow following up on their healthcare services. Its records on age groups, gender, trauma mechanisms and injuries provide important data for assessing trauma situations and policies. As is known, the most frequent types of trauma among elders are linked to falls and car-pedestrian collisions, leading to higher fracture and cranioencephalic trauma (CET) rates. This is the fifth cause of death among the elderly population, and it is affected by the existence of typical comorbidities of its age groups, leading to increased morbidity and mortality rates.[16-18] Among young adults, in turn, a predominant trend of males involved in car crashes stands out. Such trend includes by higher admission levels on weekends and is primarily characterized by less severe injuries on body extremities. CET is the main cause of death among its victims.[19]

Trauma is the number one cause of non-obstetric death during pregnancy. This is a finding that evinces the need for a specific approach to cope with the situation.[21] As a trauma referral hospital, the HBDF must be prepared for this specific demand. And for this reason, the SISAT system includes fields related to pregnant patients.

The use of the RTS scale at the moment of admission significantly contributes to the decision-making process, since it allows evaluating the

likelihood of survival, while enabling to assess trauma severity and the physiological situation of patients at different moments during the provision of care services, considering elements such as the level of consciousness, artery pressure and respiratory rate.[10, 20]

Physiological measurements such as wrist/heartbeat, artery pressure, respiratory rate and the use of the Glasgow Coma Scale are essential for grasping trauma responses, assessing patients' prognosis, and identifying complications and avoidable deaths.[22]

The pediatric population demands distinct register features, due to the specific characteristics of the anatomy and physiology of children. The Pediatric Trauma Scale (PTS) considers physiological and anatomical variables that include a child's weight, air passages, level of consciousness, artery systolic pressure (which is estimated via central and peripheral pulse) and the existence of fractures and skin injuries. A value ranging from -1 to +2 is ascribed to each item, and the sum of all items provides an overall score ranging from -6 to +12, in which 8 is considered as a severity threshold. Thus, patients with a score below 8 must be dealt with at specialized centers, on account of their increased death risk.[7, 9]

The use of legal and illegal drugs can lead to an underestimation of a patient's clinical condition, since his or her consciousness level can vary in the course of time.[16] Personal trauma mechanism and injury areas are also severity factors. The assessment of vital signs is a source of information on a patient's hemodynamic stability and his or her response to interventions. And allergies and pain records determine the selected medication.[23]

Identifying the place where a trauma has occurred can help policy-makers devise specific measures in terms of preventive and educational approaches.[21] Imaging and lab tests, in turn, guide the provision of health services, since they can indicate a diagnosis of possible changes. And comorbidities are significant for a patient's prognosis.[23]

Pain is considered the fifth vital sign, and the challenge regarding it lies in the difficulty of measuring it, as a result of its subjective element. For this reason, a visual analog scale serves as an instrument to guide the appropriate therapeutic measures.[23]

Information systems have proved to be useful, since they can enable positive changes in health care protocols and guidelines. Even though they are more frequently found in developed countries, adjustments to new technologies are now increasingly necessary in developing countries, considering that trauma is a public health problem, and bearing in mind the current high levels of mortality and disability.[10, 25-26]

The first known electronic trauma record was made in Chicago in 1969. Since then, efforts have been made in the USA to consolidate a nationwide register. Other countries developed register systems customized to the needs of their regions, and the biggest difficulties are found in less developed countries, as a result of their scarce resources.[26]

It is crucial to create these registers at the emergency rooms of countries such as Brazil, where trauma is an important cause of morbidity and mortality, considering the broader aim of constructing integrated trauma systems at the state and national levels, to identify epidemiological profiles by analyzing variables such as frequent occurrences and its places, types of injuries, and associations between trauma mechanisms and injuries, among others.[10, 25]

The use of technology has been helpful in the provision of emergency care both in the pre-hospital and in-hospital stages, in the design and activities of contingency plans, and also for the integration of policies, data storage needs, process management, research development and quality control. Indeed, technology has been a key ally of decision-making processes.[26]

Despite the conspicuous importance of trauma registers for choosing priorities and developing management plans,[27-28] registers must be adequately devised. Some studies point at a number of limitations regarding the use of information systems, such as the quality of the collected data, the lack of training activities for the professionals who must record a register's data, the precariousness of registers, systems unsuited to local realities, the lack of control over data-production processes, and the unavailability of adequate equipment and well-trained human resources. Such factors can lead to uncertainties regarding information reliability and controversies as to the contribution of registers to research and to the organization and assessment of care services. Therefore, successful strategies are necessary in order to tackle these challenges.[26]

Additional difficulties can be seen in the field of emergency care regarding the use of technologies and the lack of awareness about the real benefits of computerized systems, about the importance of developing and maintaining such systems, about the lack of trained professionals to meet the demands, low internet quality, and the lack of the necessary investments.[26]

Some mistakes have been reported at places that use trauma registers, such as the duplicity of information, wrong codes, the lack of adequate chronological accounts, or the scarcity of clinical evolution details.[28] Such problems are probably consequences of the high level of stress experienced at emergency units, which are characterized by an intense demand, continuous stress, excessive activities, work overload and staff deficit, leading to lower performance levels among health professionals.[28-33]

Brazil is characterized by a diverse landscape in regard to the use of information systems, and it is necessary to disseminate computer-based processes so that they may become a familiar reality in emergency care services around the country.[27]

FINAL REMARKS

This study allowed us to present important findings on the creation of SISAT as a management tool, with the purpose of enabling a resource capable of recording key information and data on health care assistance to trauma patients with a view to the construction of a reference databank. SISAT was developed after studying the needs of the institution where it will be implemented, with its 13 screens, 37 variables and four assessment scales. With this system, it will be possible to learn about the profiles of patients assisted at Hospital de Base's Trauma Center, and new actions are also expected to help the decision-making process in connection with trauma patient management. It is believed that a databank will enable researches, improvements in the synergies between material and human resources, the obtainment of reports and the creation of protocols that seek to optimize services, with the development of health care strategies. SISAT's feasibility will be assessed by validating its current version and by an effective adherence by health professionals, so it will not be seen by them as an element of stress but, instead, as a tool with the potential to improve their services.

As limitations of this study, it can be pointed out that all processes of change demand a measure of adaptation, since the incorporation of new technologies requires both the availability and reasonability of all involved actors. Additional limitations of this study included a small number of available computers, current internet quality and the challenge of a standardized language. New demands that have not yet been considered might arise after SISAT's validation process, leading to the moment when they can be incorporated to the system without disadvantages.

The creation of the SISAT trauma register software will enable nursing gains, since it will serve as a framework for professionals, residents and students, allowing for quality surveys on patients' needs leading to the provision of health care, as well as for a rationalization of nursing services, bearing in mind that it will reduce the necessary register time while expanding the available data for the provision of quality care.

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