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Electronic Unified Health System: opportunities for improvement

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ABSTRACT. This study aimed to develop and evaluate a prototype with opportunities for improvement for the e-SUS Primary Care module, integrated in the proprietary system used at the research site, with a view to improving the health information system. It is an applied research, with a qualitative approach, in the action-research modality. The population consisted of all (30) Community Health Agents assigned to six Family Health Centers in the city of Ribeirão Preto, State of São Paulo, Brazil and six computer experts, who agreed to participate in the research by signing the Informed Consent Form. The study was developed in three stages. Stage 1 - Knowledge brought by the Community Health Agent (CHA): observation, by the researcher, of the execution of professional activities in the Electronic Unified Health System of Primary Health Care and unstructured interview, between May and July 2016; Stage 2 - Construction of the prototype with opportunities for improvement for the e-SUS AB module. We used the AXURE RP Pro 7.0 software. Stage 3- Evaluation of the prototype by the CHA and computer experts. An evaluation instrument was developed considering the specifications described by ISO/IEC 25010, 9241 and 14598 with the parameters: poor, fair, good and excellent. The results show the importance of knowing the aspects related to the way of working, or behavior, that can influence the final quality of the data inserted in the Health Information Systems. In the same way, such systems aim to obtain inputs for the definition of the requirements and goals of usability, in order to meet the different user roles identified, and also reinforces the relevance of looking at own systems, acquired in the private market or developed in the municipality. The rapprochement between the researcher and the people involved in the investigated situation allowed for the detection of gaps between the indispensable components to carry out the actions that aim to consolidate computerization in health and, above all, to outline potential solutions to the problems identified.

Keywords: health Information system; community health agents; primary health care.

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Introduction

The important initiative of an Electronic Government (e-gov) is to set guidelines, coordinate and articulate the actions to implement the health information system (HIS) and aim at opportunities for the exchange and reuse of information, as well as, increasing quality and access to information for the purpose of establishing an adequate infrastructure for the implementation of the Electronic Health Record (HER) (Macedo, 2012; Conselho Nacional de Saúde [CONASS], 2013; Araujo, Pires, & Bandiera-Paiva, 2014; Martins, Garcia, Sodré, & Farah, 2018).

Furthermore, the World Health Organization reinforces the importance of building an efficient HIS, with Primary Care recognized as a facilitator for a convergence of health promotion, disease prevention, cure and care in general, subsidizing decision making aiming to direct public policies regarding the needs of primary care(Araujo et al., 2014; Organização Mundial da Saúde [OMS], 2008).

In this context, the strategy of the Electronic Unified Health System (e-SUS), articulates the restructuring of the forms of collection, processing and use of information, in addition to integrating health systems - by providing systems for different levels of care to health - aiming to contribute to the synergy between health management systems (Departamento de Informática do SUS [DATASUS], 2017).

Regarding the first level of care, the restructuring resulted in the e-SUS Primary Care Strategy (e-SUS AB) composed of the Health Information System for Primary Care (HISPC) and e-SUS AB, which became the

Current HIS for the purpose of financing and adhering to the National Primary Care Policy strategy programs.

The plurality of computerization and connectivity scenarios resulted in the availability of two software systems: Simplified Data Collection (SDC) and Electronic Citizen's Record (ECR), responsible for feeding HISPC, the system in force for financing purposes (CONASS, 2013; Ministério da Saúde [MS], 2014; 2017). It is a public software, offered free of charge for download to all health departments, municipal and state, interested in implementing it in Basic Health Units (MS, 2017; Vieira, 2015).

The Brazilian reality also coexists with the assortment of municipal initiatives with their own software systems, acquired from the private market or developed to support the information needs of the municipality's health services, entitled: proprietary software or even private software.

It is important to emphasize that the referred systems - SDC and ECR - in the public or private sphere, articulate the data collection in primary care and are responsible for feeding the HISPC, respecting the current technological availability of each basic unit, with all data organized in the centralizer module for later sending to the national HISPC base.

In this way, HISPC will have the registration of the information of each citizen, unifying and integrating all systems in primary care, while e-SUS AB will be the mechanism used by professionals to insert and consult data on health users and actions taken with patients (Universidade Aberta do SUS [UNASUS], 2014).

Importantly, national basis of health information systems must follow national policy and aims to establish a Minimum Data Set for Health Care (MDS), with safe and shareable information for the creation, improvement and development of public health policies , as well as, reliable data for technical scientific studies that can assist in the improvement of the Brazilian health by including clinical, medical-administrative variables and administrative processes (Araujo et al, 2014; DATASUS, 2016).

Thus, the service network that makes up primary care, using a public or private system, will feed HISPC, which is part of the e-SUS strategy and intends to restructure, develop and guarantee the integration of health information systems, with a view to having an individualized register of citizens, based on the National Health Card (NHC), as well as building a standardized database, with reliable and comparable care information, through the MDS (DATASUS, 2016; 2017).

The great challenge is the greater participation of health professionals in the consolidation of SIS to provoke reflections not only on the importance of this tool for health management, but also on the relevance of the quality of the data collected to achieve the proposed objectives and goals , such as monitoring health policies, billing services and planning the health care network (|DATASUS, 2016; Sampaio, Moura & Évora, 2016).

In this context, meetings with partner municipalities, during the period of implementation of e-SUS, reinforced the need to bring e-SUS AB closer to the reality of the professionals who use it, not only to list strengths and weaknesses of implementation and use, but, mainly, to intensify the strengths, to know the opportunities for improvement, in addition to reinforcing the damage arising from an incomplete data collection and, thus, contributing to the establishment of a quality MDS (CONASS, 2013).

Furthermore, problems related to usability are alluded to as significant barriers to the adoption of health information systems that result in losses for decision making, time management and productivity of professionals and can induce professionals to enter wrong information (Dias, Pereira, & Freire, 2017; Khajouei, Esfahani, & Jahani, 2017).

Indicated as the main limitation in the development of an information system for the health sector, the low familiarity with the technology presented by most health professionals and the non-effective involvement of this relevant actor in the development results in software that is distant from the service routine (Sousa, Frade, & Mendonça, 2005).

It should be clarified that some authors reinforce the importance of training human resources to work in all stages of the health computerization process, as it aims to establish a minimum set of data capable of covering not only the management of health services, but, also, health evaluation of the population and administrative processes (DATASUS, 2016; Lopes & Heimann, 2016). In this context, the National Policy for Permanent Education in Health also emphasizes that for the establishment of a strengthened HIS, contemplating the qualification of health practices, the perspective centered on the work process is not limited to certain professional categories and reinforces the importance of approaching the whole team, at all levels of care (MS, 2009; Ministério da Educação e Cultura [MEC], 2010).

This study aimed to develop and evaluate a prototype with opportunities for improvement for the e-SUS Primary Care module, integrated into the proprietary system used at the research site, with a view to improving the health information system.

Methodology

This is a methodological, applied research with a qualitative approach, in the action-research modality.

This investigation started after authorization by the Research Ethics Committee of the Ribeirão Preto School of Nursing, University of São Paulo - under Opinion 1.504.932 (CAAE – 53756716.2.0000.5393).

The study site consisted of six Family Health Centers (FHC), belonging to the Western Health District of the city of Ribeirão Preto, State of São Paulo, Brazil. This space is destined to implement the Family Health Strategy, seeks to provide assistance in primary care and family health programs, for the community belonging to the district. Public health management in Ribeirão Preto is carried out by the Hygiaweb System, which is proprietary software, developed to support the information needs of health services in municipalities and states, distributed across the national scenario (Techne, 2019).

It is noteworthy that, according to the FHC regulations, each center houses a health team composed of at least one family physician, a nurse, two nursing assistants, five community health agents (CHA) and a general services assistant (Centro de Atenção Primária [CAP], 2010).

The population was made up of all 30 (thirty) community health agents, assigned to six FHC that integrated this research and by six computer experts, who agreed to participate in the research by signing the Informed Consent Form.

The study was developed in three stages:

Stage 1- The knowledge brought by the Community Health Agent (CHA) was the starting point for reflection and reconstruction of knowledge. In this context, in order to identify the difficulties presented by the users of the e-SUS system and the possible gaps between the necessary components for the effective use of the referred system, a direct observation of the user was made by the researcher, during the execution of the activities in the e-SUS AB system, in addition to unstructured interviews, which took place without a defined structure, while observing the use of the system, between May and July 2016.

The CHA population was chosen, both for acting as a fundamental character for the integration of health services with the community and for the insertion of these professionals in health information systems. The CHA uses four out of the seven forms, made available by the Department of Primary Care (DPC) for the registration of information and which served as a guide in the development of the Health Information System (HIS), made available in the e-SUS PC module, used in the municipality.

Obtaining information by observing the activities of the CHAs while using the e-SUS AB system, in their service routine, brought together the experiences and the user's point of view, allowed to know their reality, understand the actions that were not foreseen in the system and propose problem solving, in a collective construction to strengthen symbiosis in the action-reflection spiral.

This technique contributes to the approximation of complex events and contexts and also contributes to a comprehensive investigation when considering the influence of scenarios such as physical space and ergonomic conditions. It also adds the possibility of inserting questions brought by the interlocutor that were not previously provided.

This action aimed to emphasize the relevance foreseen in the prototype (such as the importance of obligatory fields in health information systems), as well as the relevant points mentioned by the participants (such as the insertion of new fields in the HIS), bringing up new information.

Factors such as vacations and absences enabled at least one meeting with each of the CHA participating in the research, with an average of one hour and 30 minutes spent on each meeting. However, the commitment of some participants to collaborate with the research resulted in three or even four meetings per CHA and were essential in deepening knowledge and discussions.

In this way, the researcher accompanied the CHA while using the e-SUS AB module in the Hygiaweb System (within the service routine) in order to identify the doubts presented, the strengths and opportunities for improvement of the e-SUS AB module in the Hygiaweb System, operating in the municipality.

Stage 2 - Construction of the prototype with opportunities for improvement for the e-SUS AB module.

The initial step of this stage consisted of elaborating the theoretical background, in search of what is

recommended by the bodies responsible for the primary care HIS (such as the Ministry of Health and the Department of Health Care) as well as becoming aware of international precepts - such as interoperability and usability - in addition to defining the actors involved in this research.

In this sense, the implementation policies outline the fundamental actions for each context, through laws, ordinances and decrees, contemplating the HIS and the level of care to which it is intended (primary, secondary, tertiary).

Added to this, the information from direct observation and unstructured interviews with the CHAs (stage 1), which contributed to extract/list both direct and non-verbal information, identify difficulties while using the system and possible gaps between components necessary for the effective and efficient use of the system.

The expectation of the prototype is to signal gaps and list the opportunities for improvements for the e-SUS AB module in the Hygiaweb System in order to corroborate basic principles of software engineering and cooperate both in the understanding of the participants and in the optimization and qualification of their practices. It also considers the interoperability standards that stipulate standards that aim at accessing, retrieving and exchanging information effectively, that is, allowing the sharing of information on different systems.

Thus, interpretation of what is seen on the screen and identifying its functionalities contribute for the effective use of the computer and directly influence the way of interacting with activities developed on it, pointing the interface as the means of accessing options, information and other characteristics that allow using the computer (Guedes, 2013). However, if it is difficult to understand the information on the screen and the need to search for all its functionalities, interaction with the computer will not be so easy and beneficial. If people are unable to use the system, they tend to devalue its full potential (Guedes, 2013).

In this perspective, usability is directly related to the elements of user interaction, associating characteristics of software quality, outlined by standards such as ISO 9241, ISO/IEC 9126, ISO/IEC 14598 and ISO/IEC 25010, presented in Table 1. Consenting to be used together, the standards can be subdivided, according to their characteristics.

Table 1. Standards used to measure the software quality.

Standard	Year of publication	Content
ISO 9241	1998	It addresses the definition of usability and collaborates with relevant guidelines regarding measures of performance and user satisfaction. Usability is defined as the capability that an interactive system offers its user, in a given context of operation, to perform tasks effectively, efficiently and pleasantly.
ISO/ IEC 9126	1999	It describes a software quality model contributing with guidelines for extracting quality assessment measures. It defines usability as the ease with which a user can learn to operate, prepare inputs and interpret the outputs of a system or component.
ISO/ IEC 14598	1999	It defines a process for evaluating software products about parameters such as functionality, reliability, usability, efficiency, maintainability and portability.
ISO/ IEC 25010	2011	Replaces ISO/IEC 9126. It defines software quality characteristics essential to all software. It adds important parameters like compatibility and security.

Source: ISO 9241, 1998; ISO/IEC 9126, 1999; ISO/IEC 14598, 1999. Prepared by the author (2017).

In this sense, it is important that the software prioritize user-friendly interfaces, employing techniques that meet the development standards - defined by software engineering with the support of the responsible bodies - using the established technical specifications.

In this way, the development of the prototype was guided by the enumerated precepts and built using the AXURE RP Pro 7.0 software, since it offers support for the development using components - such as fields and buttons - contributing to the goal of enhancing the user experience when generating interactive prototypes using codes, such as HTML (Hyper Text Markup Language) and CSS (Cascading Style Sheets).

Stage 3 - Evaluation of the prototype by CHA and computer experts

The importance of evaluating this study - by health and computer professionals - meets the need to appreciate and reinforce both the aspects mentioned by primary care professionals, who use HIS, and the concepts highlighted in the literature and recommended by health agencies with the expectation of providing progress/improvements to these health professionals and contributing, consequently, to health management.

Thus, the third stage consisted of evaluating the prototype by health and computer experts, in order to check whether the final product met the technical aspects. To this end, the evaluators received a brief presentation on the e-SUS AB system with the web address of the prototype made available for this purpose

and the evaluation instrument considering the specifications described by ISO/IEC 25010, 9241 and 14598 (ISO 9241, 1997; ISO/IEC 9126, 1999; ISO/IEC 14598, 1999).

These standards explain the relevant definitions and methods that provide guidelines and requirements for evaluating software products as well as give directions to meet the requirements for software quality and usability. At the end of stage 3, the items were assessed within the following parameters: poor, fair, good and excellent, in addition to having a field for suggestions or other notes.

Results and discussion

In order to characterize the relationship between Community Health Agents (CHA) and the system, aiming at appropriate solutions for the type of use expected for the product, we sought to identify the different user profiles to know aspects relevant to the way of working and, also, contribute to the verification of requirements and usability goals, as highlighted in Table 2.

In this context, the development of a prototype aimed to provide a view of the health system in force in the municipality, experimenting with suggestions and increasing requirements, with the intention of minimizing risks (such as errors and omissions) and maximizing the benefits of the SIS. The proprietary system called the Hygiaweb System was used as the basis for the development of the prototype e-SUS AB module, as well as the forms that govern the Simplified Data Collection of the e-SUS AB System.

The e-SUS AB has the option of informing whether the new registrant is responsible for the family or not, however, during data collection it was noticed that the system in use in the municipality does not provide the bond of other residents of the same household as an obligatory field. If the Community Agent does not inform at the time whether the new registrant user is responsible for the family, he/she is not obliged to mention who is the family responsible for the household, resulting in incomplete information and which is not in accordance with the recommendations of the Ministry of Health.

It is worth emphasizing that the complementation of the requirements survey, carried out by monitoring the record filling in the e-SUS AB system, during the work routine of CHAs, allowed to approximate the experiences of these professionals, ascertaining perceptions of requirements, in addition to identifying strengths and opportunities for software improvement (Table 3), resulting in the prototype e-SUS AB module, of the Hygiaweb System.

The validation of requirements checking the disclosure of errors or omissions, among other items, took place through the intervention of the evaluation by computer experts.

In this sense, in addition to the initial screen of the e-SUS module in the Hygiaweb System - the proprietary system in force in the municipality - screens were developed for the four forms that the CHA uses, until the present moment of the research. In addition, screens were developed referring to the same four forms, but containing suggestions of opportunities for improvement, guided by notes from the participants of this study and based on the literature.

The suggestions of opportunities for improvement were highlighted in the dialog box, placed on the right side of each screen presented, highlighting the actions that will articulate in search of contributing to achieve the goals proposed by this important proprietary system, focused on public health management, as well as contributing to user expectations.

Table 2. Prominence of considerations from CHAs. Ribeirão Preto, State of São Paulo, 2017.

A) Identify the profile of the different types of users who use the health information system.	Prominence of considerations from CHAs: Expand the possibilities of locating a patient, (address, responsible family member, among others).
B) Know the aspects related to the way of working or behavior that can influence the final quality of the data entered in the system.	Prominence of considerations from CHAs: Allow the use of special characters in fields such as name and CPF. Clarify doubts about the required information quickly and directly.
C) Obtain inputs for the definition of usability requirements and goals, based on the observation of the actors' activities, in order to meet the different user roles identified	Prominence of considerations from CHAs: Include the essential information meeting the recommendations of the Ministry of Health. Make it possible for the data entered to be in accordance with the reality presented at the data collection site.

Source: Prepared by the author (2017).

Table 3. Opportunities for improvement and the proposed actions. Ribeirão Preto, State of São Paulo, 2017.

Opportunities for improvement	Action
Color	GREEN to indicate the items already filled-in by the system; BLUE indicating the obligatory fields; RED exclusively to highlight errors (e.g. failure to fill-in obligatory fields).
Unification of colors	Highlight some blocks, inside the form. Example: term of refusal for household and individual registration, as well as the exit of the citizen, were highlighted for easy and quick access.
Availability of access to the button	Disable buttons (or icons) that do not allow use at that time, using colors in gray tones.
Button text	Explicit indicative text, making the action clear, that is, the purpose of the button or icon.
Item arrangement	Establish a standard visual language of the data, it is not recommended to present the same data in a different order, on the different screens.
Item identification	Arrangement of fields with standard margins, aiming to define a more organized structure.
Item presentation	Standard in the order of presentation of the graphical interface elements (check list and radio box).

Source: Prepared by the author (2017).

Among the suggestions of opportunities for improvement, illustrated in Figure 1, we highlight the insertion of new fields (such as including landline phone number), the provision of an information board to clarify information about the required item, through an icon of quick access characterized by a question mark; and yet, the importance of establishing a visual identity, both in the arrangement and indation of the items (items separated by a standard margin space defining a more organized structure), as well as in the benefits of using color aiming to contribute to the quality of information presentation.

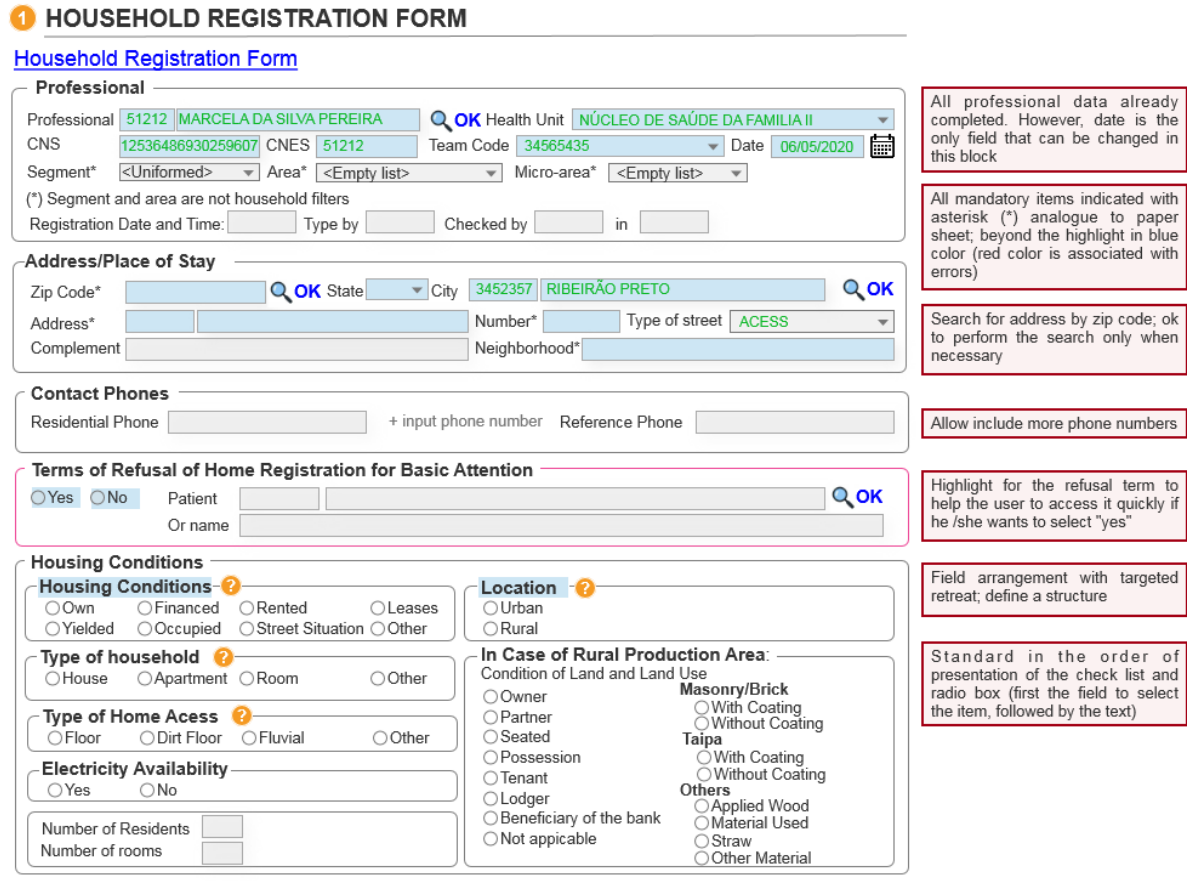

Figure 1. Household Registration Form, household data entry screen. Ribeirão Preto, State of São Paulo, Brazil, 2017.

Source: Prototype developed by the author.

The screens of the prototype were developed based on the literature and also guided by remarks from the participants of this study, including the evaluation through a questionnaire by computer experts. Items related to: accessibility and navigability; and the quality of the interface (design of screen, letters, colors and figures) were considered by most evaluators to be excellent and good and no item was rated as poor.

Authors show the importance of benefiting from information about the user, while developing information systems, aiming at achieving a family environment focused on their preferences, needs and behaviors and allows to understand the reason for their actions (Camargo & Vidotti, 2011).

The prototype, shown in Figure 1, exposes the clarity and simplicity necessary for the user to start and complete a task, highlighting the influence of usability and the importance of adapting to the context of using the product; it offers the user the ability to perform his/her tasks in a way pleasant, within effective and efficient parameters (Nielsen & Loranger, 2007; Pádua, 2012). The approach with the user prevents his/her fatigue and confusion that could later result in his/her performance (example: loss of time, rework to insert information, insertion of incomplete information) or, still, in the rejection of the information system (Dias et al., 2017; Khajouei et al., 2017).

In this way, it contributes to characterize the relationship between a class of users and the system, aiming at appropriate solutions for the type of use expected for the product, providing the identification of different user profiles, knowing aspects relevant to the way of working and, still, contributing to the verification of the requirements and usability goals.

What is seen on the computer screen directly influences the way of interacting with it, indicating the interface as the means of accessing options, information and other characteristics that allow using the computer. A good interface is the non-interface, that is, having an interface so simple and easy to use that people naturally interact with it, without worrying about understanding all the complexity of the functionalities and what they would have to do after doing something in the system, since the interface itself would take people to the next step (Nielsen, 2000; Rocha & Baranauskas, 2003; Norman, 2006; Guedes, 2013).

An important concept, usability must understand the factors that determine how people operate and make use of computers effectively, in order to translate this understanding into tools and techniques to achieve efficiency, effectiveness and security in interaction (Fernandes, Ferreira, Cunha & Morgado, 2010). Such action may contain the execution of mistakes due to difficulty in the user's interaction with the information system. Thus, the literature points out that some questions are so specific that they are not addressed in reports and instigate the need to conduct tests with the users themselves (Nielsen & Loranger, 2007).

Professionals in the area relate usability with the acceptance of the system, since a good interface makes interaction easier to learn and use, and can influence user productivity (Lucena & Liesenberg, 1994; Fernandes et al., 2010), collaborate with restructuring health and information systems, as well as contributing to the consolidation of computerization in health, recommended by the Ministry of Health.

The prototype was developed with the expectation of minimizing the influence of three factors directly related to the severity of a problem for users: the frequency with which users will encounter the problem; the impact for the user, which can vary from irritation almost imperceptible to loss of working hours; and, persistence of the problem for the user, that is, if after identifying the problem, the user can overcome it in the future or if the interface is so confusing that people are repeatedly disoriented (Pádua, 2012).

Thus, understanding what is seen on the screen and identifying its functionalities contribute to an efficient use of the computer. However, if it is difficult to understand the information on the screen and the need to search for all its functionalities, interaction with the computer will not be so easy and beneficial. If people are unable to use the system, they tend to devalue its full potential (Guedes, 2013).

Usability problems must be identified and addressed both during the development of the system and during and after implementation, with a prominent role in improving patient care and the quality of information (Dias et al, 2017).

Experts in the area relate usability to the acceptance of the system, since a good interface makes interaction easier to learn and use, and can influence user productivity (Lucena & Liesenberg, 1994; Fernandes et al., 2010), collaborate with restructuring health and information systems, as well as contribute to the consolidation of computerization in health, recommended by the Ministry of Health.

In this context, the present study aimed at transformations to cooperate with the reliability and veracity of the available information, to collaborate in restructuring and consolidating SIS, to add quality to the population's service by reinforcing the guidelines established in the national health plan, in addition to

contributing to the user experience of the e-SUS AB system to be pleasurable, even collaborating with productivity by highlighting the importance of usability in the development of health information systems.

It is important to emphasize the importance of investigating the public-private relationship, identifying whether the proprietary software in use in the municipality corresponds to the expectations not only of the Ministry of Health and the Municipal Health Secretariat, but also, the expectations of health professionals who use the SIS.

In this sense, the information collected in the studied municipality can provide subsidies to other municipalities that operate this public-private relationship and make use of private software. In addition, the approach to users of the primary care health system helps to identify failures in training and difficulties to resolve doubts that may meet the experiences of other users, of municipalities that use the native system, provided by the Ministry of Health, or make use of a private system.

It is important to consider that due to the mandatory use of the e-SUS AB System (by the Ministry of Health) it is essential to contribute so that the use of the system - by health professionals and managers - is effective and efficient, in line with the guidelines established in the national health plan, thus contributing to the evolution and support of primary health care actions.

As a limitation of the study, it can be said that the insertion of the professional nurse in the research population, as well as a greater number of specialists in the area of information technology, could expand the contributions in the study universe.

Conclusion

The outcome highlights the importance of considering the context of use of the e-SUS system and the profile of the user (health professional). Simple modifications that strengthen the exchange and reuse of information, contribute to increase the quality of the information collected and also cooperate in the construction of an adequate infrastructure for the implementation of the Electronic Health Record.

The rapprochement between the researcher and the people involved in the investigated situation allowed for the detection of gaps between the indispensable components to carry out the actions that aim to consolidate computerization in health and, above all, to outline potential solutions to the problems pointed out.

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