






DESIGN OF A COMPUTER TOOL TO ASSIST IN CARE COORDINATION BY THE PRIMARY CARE SERVICES

CONSTRUÇÃO DE FERRAMENTA COMPUTACIONAL PARA AUXILIAR A COORDENAÇÃO DO CUIDADO PELOS SERVIÇOS DE ATENÇÃO BÁSICA

CONSTRUCCIÓN DE HERRAMIENTA COMPUTACIONAL PARA AYUDAR A LA COORDINACIÓN DEL CUIDADO POR PARTE DE LOS SERVICIOS DE CUIDADO BÁSICO

 Bilgai Berbert Ferreira¹
 Daiane Medeiros da Silva¹
 Gabriel Rodrigues Neto¹
 Ana Cláudia Torres de Medeiros²
 Débora Raquel Soares Guedes Trigueiro¹

¹Faculdade de Enfermagem e Medicina Nova Esperança - FACENE, Mestrado Profissional em Saúde da Família. João Pessoa, PB - Brazil.

²Universidade Federal de Campina Grande - UFCG, Departamento de Enfermagem. Campina Grande, PB - Brazil.

Corresponding Author: Bilgai Berbert Ferreira
E-mail: berbertbil2@gmail.com

Authors' Contributions:

Conceptualization: Bilgai B. Ferreira, Daiane M. Silva, Gabriel Rodrigues Neto, Ana C. T. Medeiros, Débora R. S. G. Trigueiro; **Data Collect:** Bilgai B. Ferreira, Daiane M. Silva; **Investigation:** Bilgai B. Ferreira, Daiane M. Silva; **Methodology:** Bilgai B. Ferreira, Daiane M. Silva, Gabriel Rodrigues Neto, Ana C. T. Medeiros, Débora R. S. G. Trigueiro; **Project Management:** Bilgai B. Ferreira, Daiane M. Silva; **Software:** Bilgai B. Ferreira, Daiane M. Silva; **Statistical Analysis:** Bilgai B. Ferreira, Daiane M. Silva; **Visualization:** Bilgai B. Ferreira, Daiane M. Silva, Gabriel Rodrigues Neto, Ana C. T. Medeiros, Débora R. S. G. Trigueiro; **Writing - Original Draft Preparation:** Bilgai B. Ferreira, Daiane M. Silva; **Writing - Review and Editing:** Bilgai B. Ferreira, Daiane M. Silva, Gabriel Rodrigues Neto, Ana C. T. Medeiros, Débora R. S. G. Trigueiro.

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ABSTRACT

Objective: to design an electronic medical chart in the app format for the primary care services. **Method:** a methodological study that presented the process of designing a technological tool in the app format. The design of the app occurred in the three stages: a) elaboration of an integrative review on the theme; b) development of the variables and establishment of the response pattern using the findings of the integrative review, Resolution No. 1,638, of 2002, of the Federal Medical Council, and the Manual for using the system with the Citizen's electronic medical chart (*Prontuário Eletrônico do Cidadão*, PEC); and c) design of the electronic medical chart in the app format. The NetBeans program and Java language were used to design the app. **Results:** the electronic medical chart designed has the following basic principles: registration of the country, state, city, health district, primary health unit, neighborhood, street/avenue, uni- or multi-family residence and identification of the resident/family, in addition to enabling the notification of users' diseases and vaccines. **Conclusions:** the electronic medical chart model herein presented, in the app format, can be modified according to the needs of each community, as well as facilitate and make the health professional's work more effective, as it can generate appointment reports in different care points, speeding up assistance and the provision of longitudinal and individualized care.

Keywords: Health Records, Personal; Health Information Systems; Medical Informatics; Primary Health Care.

RESUMO

Objetivo: construir um prontuário eletrônico no formato de aplicativo para os serviços de atenção básica. **Método:** estudo metodológico que apresenta o processo de construção de uma ferramenta tecnológica no formato de aplicativo. A construção do aplicativo deu-se em três etapas: a) construção de uma revisão integrativa sobre o tema; b) desenvolvimento das variáveis e estabelecimento do padrão de respostas utilizando os achados da revisão integrativa, a Resolução do Conselho Federal de Medicina nº 1.638 de 2002 e o Manual de uso do sistema com prontuário eletrônico do cidadão (PEC); e c) construção propriamente dita do prontuário eletrônico no formato de aplicativo. Para a construção do aplicativo, foi usado o programa NetBeans e a linguagem Java. **Resultados:** o prontuário eletrônico construído conta com princípios básicos: cadastro do país, estado, cidade, distrito sanitário, unidade básica de saúde, bairro, rua/avenida, residência uni ou multifamiliar e identificação do morador/família, além de possibilitar a notificação de doenças e vacinas dos usuários. **Conclusões:** o modelo de prontuário eletrônico aqui apresentado, no formato de aplicativo, pode ser modificado de acordo com a necessidade de cada comunidade, bem como facilitar e tornar mais efetivo o trabalho do profissional de saúde, à medida que pode gerar relatórios de atendimentos nos diferentes pontos de atenção, agilizando o atendimento e a prestação de um cuidado longitudinal e individualizado.

Palavras-chave: Registros de Saúde Pessoal; Sistema de Informação em Saúde; Informática Médica; Atenção Primária à Saúde.

RESUMEN

Objetivo: construir una historia clínica electrónica en formato de aplicación para los servicios de atención primaria. **Método:** estudio metodológico que presenta el proceso de construcción de una herramienta tecnológica en el formato de aplicación. La construcción de la aplicación se realizó en tres etapas: a) construcción de una revisión integradora sobre el tema; b) desarrollo de las variables y establecimiento del estándar de respuestas utilizando los hallazgos de la revisión integradora, la Resolución del Consejo Federal de Medicina No. 1.638 de 2002 y el Manual de uso del sistema con la historia clínica electrónica del ciudadano; y c) la construcción real de la historia clínica electrónica en el formato de aplicación. Para la construcción de la aplicación se utilizó el programa NetBeans y el lenguaje Java. **Resultados:** la historia clínica electrónica construída tiene principios básicos: registro del país, estado, ciudad, distrito de salud, unidad básica de salud, barrio, calle / avenida, residencia unifamiliar o multifamiliar e identificación del residente / familia, además de permitir la notificación de las enfermedades y vacunas de los usuarios. **Conclusiones:** el modelo de historia clínica electrónica que aquí se presenta, en forma de aplicación, puede ser modificado según las necesidades de cada comunidad, además de facilitar y hacer más efectivo el trabajo del profesional de la salud, ya que puede generar informes en los diferentes puntos de atención, agilizando el servicio y brindando atención longitudinal e individualizada.

Palabras clave: Registros de Salud Personal; Sistemas de Información en Salud; Informática Médica; Atención Primaria de Salud.

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INTRODUCTION

Information and communication technologies in health, precisely through the Health Information Systems (*Sistemas de Informação em Saúde - SIS*), have largely contributed to the improvement of the citizens' health conditions, enhancing the decision-making processes and allowing the sharing of information across the different care points in a fast and accurate way.¹

When considering Brazil, the SIS has become a great ally of management and of the health professionals in the organization of flows and counterflows, as well as proactivity in the workplace. This is so because one of the greatest difficulties to improve the users' access to the Brazilian public health services is linked to the disorganization of the information flow and of the work process, due to the often high demand of the professionals' bureaucratic work and to the excess of guides to be filled in, which can lead to misinterpreted and incomplete information, causing delays in assistance, dissatisfaction, and disbelief in these services by the population.²

A Brazilian study on the quality of the records in information systems reinforces the previous assertion, showing a high percentage of lack of information in relation to schooling, occupation and clinical conditions or relevant morbidities for the management, evolution and treatment of the disease. These failures in the records make it difficult to adequately characterize the population and identify predictive factors for the abandonment of the recommended therapy, in addition to interfering with planning and decision-making.¹

However, the SIS cannot be considered a solution for all problems since, for this system to be effective, it is important that it presents information both for the health professional and for the patient, providing shared care. The implementation of an information system that meets these particularities in integrated health care systems enables the availability of innovative technologies that will assist the practice and improve health care by introducing reliable information in an easy, fast and safe manner, leading to organization of the records and to a reduction of misleading information.³

Added to this is the fact that the adequate use of these systems can reduce dependence on paper, enhance the practice, improve the work process and generate cost reductions for the management, especially when there is the possibility of resorting to technological tools capable of converting the information obtained to the electronic format, as in the case of the electronic medical chart.⁴

However, managers face challenges to implement the electronic medical chart, such as specialized technical support, indeterminately, or adequate structure, which can generate high costs for the public coffers to meet the updates and the safety needs, in addition to requiring integration of the actions and services that will operate actively, following the changes that occur in the practice.⁵

Nevertheless, the adoption of this tool by the managers can facilitate coping with major challenges in the daily practice, especially in Primary Care (PC) services, since it will provide the team with simultaneous access to the user's information, making actions more productive and reducing task duplication, such as repeated requests of examinations and unnecessary referrals.⁶

To such an end, permanent training and commitment of the health professionals become indispensable so that this information is reported in an appropriate manner, contemplating the peculiarities and complexities presented by each user in their medical history. Therefore, it enables establishing continuous and efficient communication between the team responsible for the care provided and the other care points to which the user may need to be referred, making the treatment follow-up proposed safer, more resolute, and effective.⁶

Even in the face of barriers regarding costs, lack of experience in the professionals, deficient infrastructure, and lack of technical support, it is noticed that the inclusion of the electronic medical chart to support clinical decisions is a global trend⁷, relevant to plan and guarantee comprehensive and continuous care in the different care points, especially in Primary Care, which must design and use electronic medical charts not only as a way to generate future indicators but also as a decision support tool. They must also enhance the production of high-quality and individualized care and facilitate the planning of actions and the exchange of information between users, professionals and managers, through timely reminders, when necessary, also improving care coordination by the primary care services.⁸

It is highlighted that the municipality of *João Pessoa*-PB, where the research was developed, has been showing interest in qualifying its SIS, with the implementation of *e-SUS Atenção Básica* (e-SUS AB) in the services since 2013, representing an advancement in the qualification and use of the information registered during the health actions developed in PC.⁴

However, due to the lack of a computerized system in all units of the municipality, only the Simplified Data

Collection (*Coleta de Dados Simplificada* - CDS) version was adopted, which enables integrated and simplified registration, consisting in registration forms of street addresses and of users, individual assistance, dental assistance, collective activities, procedures, and home visits. The CDS is used by the Family Health Units (FHUs) that do not have a computerized system, until it is properly structured to have the PEC installed in all the FHUs. Despite this advancement in the SIS, the municipality still presents an incipient, non-computerized information system limited to the local team. It is emphasized that, even considering the importance of this tool, there are still few studies addressing this theme, especially in the national scope.

In the face of such information, this study is justified by the scientific knowledge gap regarding the electronic medical chart as an efficient tool for the production of comprehensive and continuous care, fundamental for the implementation of care coordination by PC; both for generating relevant information about this technology for health managers and professionals and for contributing to the organization of the diverse information generated in the entire care network of the municipality.

In this sense, this research intends to answer the following guiding question: "Can the design of an electronic medical chart in the app format assist primary care in care coordination in the entire health care network?" Therefore, the objective is to design an electronic medical chart in the app format for the primary care services.

METHODOLOGY

This is a methodological research study, which involves investigating methods to obtain and organize data and to conduct rigorous research. This type of research addresses the development, validation and assessment of research tools and methods.⁹ For this study, the first stage of the methodological research was carried out, the development (design) of an electronic medical chart in the app format for the PC services.

The design of the app occurred in the three stages: a) elaboration of an integrative review on the theme; b) development of the variables and establishment of the response pattern; and c) design of the electronic medical chart in the app format.

To conduct the 1st stage, the following guiding question was considered: What is the scientific evidence about the effectiveness of the electronic medical chart for the performance of care coordination by PCH? In order to answer this research question, articles were searched for

between October and November 2017 in the Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE) and Latin American and Caribbean Literature in Health Sciences (*Literatura Latino-Americana e do Caribe em Ciências da Saúde*, LILACS), through the Virtual Health Library (*Biblioteca Virtual em Saúde* - BVS).

The Descriptors in Health Sciences (*Descritores em Ciências da Saúde* - DeCS) used for data collection, "Electronic Health Records", "Health Information System" and "Medical Informatics", mutually combined by means of the Boolean connector "OR", were combined with the descriptor "Primary Health Care" using the Boolean connector "AND".

To ensure the legitimacy of the content under analysis, the *corpus* was elaborated independently by two authors. The initial universe consisted of 147 articles that met the following inclusion criteria: being an article, being available in full and free of charge, and published in the last 10 years (2007-2017) in English, Portuguese or Spanish, in national and international journals indexed in the aforementioned databases. The articles excluded were those that did not refer to the study object and those that were duplicates.

Of the studies identified in the databases, 84 were excluded after reading their titles, as they did not describe aspects related to the electronic medical chart, 63 articles remaining for analyzing their abstracts. Of these, 18 were duplicates. After assessing the 45 remaining abstracts, it was verified that 11 did not make their texts available in full and free of charge; 13 dealt with health insurance and 03 with research in databases; 02 were theses; 01 was a dissertation; and 02 were letters to the editor. A total of 13 articles remained for analysis.

In order to systematize the data assessed in the articles, a collection instrument was used that categorized them considering the following aspects: title, objective, research locus, journal, and year of publication. The interpretation of the results was based on the full-reading of the articles selected, which were grouped by similarity of content, summarized, and compared to each other. This stage was fundamental for the contextualization and problematization of the study object, in addition to evidencing the main challenges and benefits faced by the health services to use and implement the electronic medical chart.

For the 2nd stage of the study, the following was taken into account: Resolution No. 1,638 of 2002, of the Federal Medical Council (*Conselho Federal de Medicina* - CFM)¹⁰, which, in article 5, item I, indicates the items

that should obligatorily be included in the medical chart, whether in electronic format or in paper; and the Manual for using the system with the Citizen's Electronic Medical Chart (*Prontuário Eletrônico do Cidadão - PEC*), of the Brazilian Ministry of Health.¹¹

With this information, the 3rd stage of the study was initiated: the design of the electronic medical chart in the app format, with the elaboration of the layout and graphic organization of the variables. To design the app, the *NetBeans* program and the *Java* programming language were used, the latter being a complete programming language, adequate for the development of apps based on the Internet network, closed network, or even stand-alone programs, that is, which do not require any ancillary software, such as an interpreter, for their execution.¹²

The *Netbeans* program, available free of charge and open-coded, enables the development of Web apps for the Internet and intranet using the *Java* language, but any other programming language is acceptable.¹²

The main administrator will have the control to provide information with a vocabulary standard. This vocabulary is called "interpreted languages". Interpreted languages are programming languages which use source codes that will be executed by a software program to be run by the operating system.¹³

In order to reduce the difficulty inherent to executing and handling the app, some characteristics were prioritized in its design, as follows: remote and simultaneous access so that various actors can access the same medical chart simultaneously, without changing the information posted previously by another professional, since each one will have their own login; availability of the electronic medical chart for the health professionals; users' levels, each user will have a pre-defined password and access (access can be by various types of users: administrators, physicians, nurses, community health agents, etc.).

Each of these users will access the program using a login and password combination. Each function (type of user) has access to the program components related to their work; vocabulary standards; to register information in the program, the user must follow certain standards that will be provided by the program, for example: all text fields must be in uppercase; data safety, in addition to having login and a log document, logging all the activities that a user performs in the program. For access safety, the program will run on a server configured using the safety standards of online apps, in addition to generating monitoring, by means of a log, of access traffic and information.

In addition to that, the medical chart also has data confidentiality based on the users' levels, being easily monitored by the periodic audits that can be conducted to identify non-authorized access; and warning about information ambiguity, since the program was designed to avoid duplicity of information, as the entire registration has the CPF number as key to avoid such duplicity. If a CPF that is already registered tries to access the program, registration will not be executed and, in a corner of the screen, an information box will appear with following phrase: patient already registered.

Assistance will also be made available for the research, as all the data are in accordance to the SUS structure and codes, facilitating epidemiological studies. Free-text data can be added together with the pre-configured items; generation of printed or on-screen reports; and data updated automatically, with date and user that entered them.

The design process of the app proposed took place with the assistance of an IT specialist from March 2017 to January 2018.

RESULTS

The electronic medical chart designed has the following basic principles: registration of the country, state, city, health district, primary health unit, neighborhood, street/avenue, uni- or multi-family residence and identification of the resident/family. After these data are entered into the app, the patient's CPF will be used as identifying key and all the information recommended by the SUS will be linked to this key. These reports are of fundamental relevance for the location and identification of all SUS users so that, based on them, it is possible to obtain data that allow advancing in diagnoses and maintaining a more precise follow-up of the patient.

The screens for viewing the electronic medical chart are shown below:

Figure 1 shows the login and administrator menu screens. The program has to be managed as a pyramid, that is, in users' levels, according to the attributions. A login and password combination is required to access the system. This combination will be generated by the administrator. Each login has a hierarchical structure to be followed so that it is not changed by unauthorized individuals.

Figure 2 shows the screens for registration of the state, city, health district, health unit, neighborhood, street, residences, and residents. For each screen filled in, a summary of the information entered in the app will appear.



Figure 1 - Login (initial) and administrator menu screens. João Pessoa, 2019
Source: Primary data, 2019.

It is important to highlight that all these items already have an initial registration (answer option) to avoid registration and information duplicity. Based on the previous registrations, the individualized ones will be performed, with all the users' information. These are data that generate a map, offering the possibility of identifying micro-regions with their own endemic characteristics.

In order to guarantee anonymity and that there is no duplicity in the residents' registration (images 18 and 19), the CPF is used as a standard. The subsequent data are for the identification of parameters for the study or, in case there is an emergency with a patient, the data will be at the disposal of the care unit in real time, all in accordance to CFM Resolution No. 1,638/2002.¹⁰

Figure 2 shows the registration of the health professionals: nurse, physician, dentist and community health agent (CHA), with diverse information relevant to the assistance and to care continuity. As well as in the data of the previous images, all the professions are previously registered so there is no duplicity.

Figure 4 shows the registration of the users' information in the medical chart. The forms offer blank spaces so that the professionals registered in the app complete them, filling them in with the user's data. All data will be in accordance with the SUS; therefore, there is a part with vocabulary already defined by the SUS - codes and names together with the history (assisting in a search for procedures and/or problems) - and a free part, enabling the health professional to write freely, since the inten-

tion of this medical chart is to confer more speed and fluidity to the local information.

Figure 2 shows the data for the compulsory notification of diseases, according to the Ministry of Health, as well as of the cases that are being monitored by the health team, with information updates at each assistance service performed, whether in the health unit or at the patient's home, as well as registration of the vaccines taken by the users, with previous scheduling of other doses, if necessary. With this pre-scheduling in the medical chart, notifications are created so that the CHA and the FHU team can monitor the user's vaccination.

DISCUSSION

Management in health in a country of gigantic proportions, such as Brazil, has a high complexity level. This challenge can only be overcome with the appropriate use of information technologies to maintain control of routine operations of the health management system and, at the same time, provide support for decision-making and for tactical and strategic thinking.¹⁶ For this reason, this study aimed at designing this electronic medical chart in the app format for the PC services.

In this regard, the electronic medical chart is a source of clinical and administrative information for decision-making and a communication means shared among all the professionals, in addition to being a legal record of the actions performed by the health pro-

The image shows a registration form for residents, divided into two columns. The left column contains fields for 'Nome', 'Estado', 'Cidade', 'Bairro', and 'Rua', each with a dropdown menu. Below these are two buttons: 'Cadastrar' (green) and 'Cancelar' (red). The right column contains fields for 'Titular', 'Tipo de Residência', 'Condições da Residencia', 'Quantidade de Moradores', 'Estado', 'Cidade', 'Bairro', 'Rua', and 'Agente Comunitário', each with a dropdown menu. Below these is a green bar.

Figure 2 - Registration of the state, city, health district, health unit, neighborhood, street, residences, and residents. *João Pessoa*, 2019
Source: Primary data, 2019.

The image shows a registration form for health professionals, consisting of a single column of fields. The fields are: 'Nome', 'Usuario', 'Senha', 'Confirmar Senha', 'Tipo de Profissional', 'Especialidade', and 'Unidade de Saude' (with a dropdown menu). Below these are two buttons: 'Cadastrar' (green) and 'Cancelar' (red).

Figure 3 - Registration of the health professionals: nurse, physician, dentist and community health agent
Source: Primary data, 2019.

professionals, being a source for research studies (clinical, epidemiological, and quality assessment studies) and promoting teaching and management of the services, providing data to support organizational aspects and cost management, characteristics that strengthen care coordination by PC.¹⁶

Added to this, this tool can also contribute positively for care coordination to occur effectively and efficiently by PC since, in addition to integrating the

different points in the care network, it facilitates intercommunication across the services. Moreover, it enables care continuity and reduces misuse of equipment and services, avoiding the unnecessary repetition of exams and procedures, since it constitutes the information basis for interconsultation and referral. In addition to that, it allows for systematic and longitudinal monitoring by all those involved in the health/disease process.¹⁷

Paciente
- Selecione -

Unidade de Saúde
- Selecione -

Agente Comunitário
- Selecione -

Profissional de Saude
- Selecione -

Data de Entrada
[]

Data de Finalização
[]

Natureza da Consulta
[]

Status do tratamento
- Selecione -

Notificação
[]

Observação
[]

Gravidez
[]

Figure 4 - Registration of the users' information. *João Pessoa*, 2019
Source: Primary data, 2019.

Código	Nome	Editar	Remover
37	Variola	E	R
38	Dengue	E	R
40	Triplíce Viral	E	R

Voltar

Código	Nome	Editar	Remover
1	Acidente de trabalho com exposição a material biológico	E	R
2	Acidente de trabalho em crianças e adolescentes	E	R
3	Acidente de trabalho fatal	E	R
4	Acidente de trabalho grave	E	R

Figure 5 - Compulsory notification of case monitoring and vaccine registration. *João Pessoa*, 2019
Source: Primary data, 2019.

However, despite these findings, a research study carried out in the West region of *Minas Gerais*, south-eastern Brazil, verified that only 5.6% of the municipalities have electronic medical chart systems, in 14% of the total of FHUs; but 20.4% of the municipalities did not have computerized FHUs, only registration forms.¹⁸

This reality was also found in a research study carried out in *Mato Grosso*, which, despite having started the implementation of *e-SUS AB* in 2013, by 2015 it had not yet implemented the electronic medical chart in any of its municipalities.¹⁹

A study carried out with 17,053 family health teams found that such challenges in implementing this tool in the PC services are mostly due to weaknesses related to the technological infrastructure, funding, professional qualification, and the organiza-

tion of processes in the SUS context. This is linked to the reality of using these electronic records in PC which, when they exist, are limited to computerized reports, without adequate data systematization, thus underusing the technology.²⁰

This is because the fact that the health service is using an information system does not necessarily mean that the quality of the service provided has improved or that care coordination is efficient. Quality registration alone is often not enough, since the output of this data is just as important as the information input. Reports that allow assessing and qualifying the efficiency of the treatment proposed are essential because they ensure a better assessment of the care plans offered by the professionals responsible for these patients and, consequently, monitoring becomes more efficient.³

A research study carried out in the United States asserts that, in addition to the need for investments in training the professionals for the correct use of electronic medical charts, it also becomes mandatory to acquire hardware and software that facilitate timely processing and updating of the data. Such investments become relevant for facilitating the collection of mandatory data, reducing and even eliminating the possibility of the system being inoperative for hours or days, making the information unavailable, in addition to contributing to the quality and safety of the information recorded.⁵

Another study also carried out in the same country asserts that continuous monitoring and assessment by the management are necessary in order to identify gaps, adapt to the health scenarios and constantly update the implemented systems.⁶ Constant improvement after the deployment of a computerized system is indispensable, with continuous specialized technical support, permanent assessment by the managers, adaptation to the different health contexts so that the electronic medical chart is permanently feasible and reliable, and that it significantly contributes to planning in health and to care continuity.

In this technological advance, users cannot be forgotten, since they are the main actors in health care, who should also have tools that facilitate the monitoring of their therapy, such as apps that assist in disease control and actively integrate them into the care plan proposed by the health team. These devices go beyond registration, enabling co-accountability for care between users, family members and health professionals, facilitating adherence to the care plan and, consequently, control of their comorbidities.²¹

The electronic medical chart is an essential system in the development of the health sector, influencing the entire team in their daily tasks, whether in the clinical, outpatient, diagnostic center, hospital or academic environment, when properly used. This tool will allow the PC health professionals and management to have essential information for the good progress of the population's health in a given region and for decision-making. Thus, the chances of assertiveness and time and resource optimization are increased, making the health services more efficient and effective.

It is known that the use of electronic medical charts will never replace the user-professional relationship, but it will certainly facilitate care coordination by PC, communication and sharing of information in the different care points, ensuring care continuity and improvement in the quality of the services provided.

CONCLUSION

The design of this app showed that there is feasibility regarding this technology, so that the discussion of its implementation seems to be worthy of deepening. The involvement of dentists, physicians, nurses, Nursing technicians and professionals who will be able to use the electronic medical chart will make them aware, from an individual and at the same time collective perspective, of the usefulness of this technology.

The electronic medical chart model, herein presented in the app format, can be modified according to the needs of each community, in order to offer answers according to each demand in question. It will be able to facilitate the health professionals' work, with information about the patients they care for, monitor vaccination coverage and the notification of diseases and health problems, as well as generate reports of assistance services at different care points, speeding up assistance and providing longitudinal and individualized care.

In order to achieve a better response regarding the applicability and efficiency of this app, it is recommended to later validate this tool, so that it can be adapted to the health context of each location. The time taken for its design and the reduced number of studies addressing the theme, especially in the Brazilian context, constituted limitations for carrying out this research, although without failing to offer great contributions to the health care network of the municipality and showing that it can assist in the coordination of the care provided by PC.

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