● Original article

COMPUTERIZATION OF PRIMARY HEALTH CARE INFORMATION SYSTEMS: ADVANCES AND CHALLENGES

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ABSTRACT: Objective: to analyze the implantation of the e-SUS Primary Health Care strategy in the West Region of Minas Gerais, Brazil. **Method:** descriptive case study, with data from 62 people responsible for implementation in 54 municipalities, between May and June 2015, as well as two interviewees and analysis of the following documents: "Implantation of the e-SUS PHC in SRS Divinópolis" (*Implantação do e-SUS AB na SRS Divinópolis*) and "Municipalities, by Implantation of the e-SUS PHC in SRS Divinópolis" (*Municípios por Situação de Implantação do e-SUS AB na SRS Divinópolis*). The data were analyzed by descriptive statistics and Content Analysis, using the Atlas ti software, version 7.0. **Results:** in 44 (81.5%) of the municipalities, only the simplified data register was implemented, and 22 (40.7%) of the municipalities are in scenario three of implantation, 34 (54.8%) of those responsible for implantation are not permanently contracted staff. **Conclusion:** The implantation has weaknesses related to infrastructure and shortcomings in the professionals' training and resistance. It is necessary to review the planning of the implantation, taking its complexity into account.
DESCRIPTORS: Health Information Systems; Information Technology; Health Informatics; Nursing Informatics; Primary Health Care.

INFORMATIZAÇÃO DA ATENÇÃO BÁSICA A SAÚDE: AVANÇOS E DESAFIOS

RESUMO: Objetivo: analisar a implantação da estratégia e-SUS Atenção Básica na Região Oeste de Minas Gerais, Brasil. **Método:** estudo de caso, descritivo, com dados de 62 responsáveis pela implantação em 54 municípios, de maio a junho de 2015, além de dois entrevistados e análise dos documentos: "Implantação do e-SUS AB na SRS Divinópolis" e "Municípios por Situação de Implantação do e-SUS AB na SRS Divinópolis". Os dados foram analisados porestatística descritiva e Análise de Conteúdo, com suporte do software Atlas TI, versão 7.0. **Resultados:** em 44 (81,5%) dos municípios foi implantado apenas o cadastro de dados simplificado e 22 (40,7%) dos municípios estão no cenário três de implantação, 34 (54,8%) dos responsáveis pela implantaçãonão são servidores públicos efetivos. **Conclusão:** a implantação apresenta fragilidades relacionadas à infraestrutura, deficiências nas capacitações e resistência dos profissionais. É necessário rever o planejamento da implantação considerando sua complexidade.
DESCRITORES: Sistema de informação em saúde; Tecnologia da informação; Informática em saúde; Informática em enfermagem; Atenção primária à saúde.

INFORMATIZACIÓN DE LA ATENCIÓN PRIMARIA DE SALUD: AVANCES Y DESAFÍOS

RESUMEN: bjetivo: Analizar la implantación de la estrategia del e-SUS Atención Primaria en la Región Oeste de Minas Gerais, Brasil. **Método:** Estudio de caso, descriptivo, con datos de 62 responsables de la implantación en 54 municipios, entre mayo y junio de 2015, además de dos entrevistados y análisis de documentos: "Implantação do e-SUS AB na SRS Divinópolis" y "Municípios por Situação de Implantação do e-SUS AB na SRS Divinópolis". Datos analizados por estadística descriptiva y Análisis de Contenido, con ayuda del software Atlas TI, versión 7.0. **Resultados:** En 44 (81,5%) de los municipios se implantó sólo el registro de datos simplificado, 22 (40,7%) de los municipios están en la etapa 3 de implantación, 34 (54,8%) de los responsables de la implantación son empleados públicos efectivos. **Conclusión:** La implantación muestra debilidades relacionadas con infraestructura, capacitaciones deficientes y resistencia de los profesionales. Resulta necesario rever la planificación de la implantación, considerándose su complejidad.
DESCRIPTORES: Sistemas de Información en Salud; Tecnología de la Información; Informática en Salud; Informática Aplicada a la Enfermería; Atención Primaria de Salud.

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● INTRODUCTION

The computerization of Primary Health Care (PHC) has emerged in various countries as an important strategy for the automatization of processes, and the improvement of information management.[1] International studies have demonstrated that the successful implantation of information technologies in PHC strengthens the working process and care practices. Furthermore, it improves the dispensing of medications, continuity of care, the search for information and patient safety.[1-3] In addition to this, computerization is related to greater efficiency in recovering clinical records and storing information about families and communities.[1-3]

The computerization of PHC, however, has also appeared as a challenge, principally among developing countries such as Brazil – due to weaknesses related to technological infrastructure, financing, professional qualification and the organization of processes in the context of the Unified Health System (*Sistema* Único *de Saúde* - SUS).[4-5]

In 2013, the Brazilian Ministry of Health, recognizing the need for the computerization of PHC, instituted the e-SUS Primary Health Care strategy (e-SUS PHC: in Portuguese, *e-SUS AB*). It aimed to restructure all information from Primary Health Care (PHC). This strategy aims for an electronic SUS, the premise being to contribute to the management of the information produced in the work process of the PHC teams.[6] The aim is to implement two software systems: the Simplified Data Collection system (SDC: *Coleta de Dados Simplificada - CDS*) and the Citizen's Electronic Health Records (CEHR: *Prontuário Eletrônico do Cidadão - PEC*). A separate aim is the availability of high performance Internet, computers and printers in all work posts, interconnected with other points in the care network.[6]

As a result, the e-SUS PHC strategy has as its possible contributions: the individualization of users' data and data related to professional activities; integration between the various information systems of the SUS; the elimination of duplicated work in recording and automation of processes; and the production of high quality information for supporting management and care.[6]

The National Guidelines for the Implantation of the e-SUS PHC strategy called for the identification of professionals who are trained for the coordination of the implantation and to diagnose the capacity of the human and technological resources.[6] There is also a need for the integration of local planning into the Regional Action Plan, the training of professionals for computerization and the viabilizing of support teams.[6] It is known that this computerization is part of the process of restructuring Health Information Systems (HIS), instituted under Ministerial Ordinance N. 2.073/2011, which indicates the need to define systems to be implemented and standardized in Brazil.[7]

No diagnostic analysis has been published about the process of computerization of PHC and, above all, the identification of the challenges which emerge in this context. As a result, the relevance and originality of this study is justified. In this regard, the following guiding question is raised: "How has the process of implementation of the e-SUS PHC strategy developed in the West Health Region of Minas Gerais?" This study aims to analyze the implantation of the e-SUS PHC strategy in the West Health Region of Minas Gerais, Brazil.

● METHOD

A descriptive case study, which used triangulation in two stages: field research and documentary research.

The use of triangulation allows the researcher to combine the requirements of the qualitative and quantitative methods.[8] The qualitative approach is justified by the need to investigate the subjective aspects of the participants related to the object. The quantitative approach, on the other hand, was used due to the need to characterize the participants and extract data in the documentary research.

The research scenario was the West Region of Minas Gerais, located in the southeast of Brazil, made up of 54 municipalities in six health regions, with a population of approximately 1.2 million inhabitants.

In the first stage, in May – July 2015, data were collected through an online questionnaire from all 108 persons responsible for the process of implantation of the e-SUS PHC strategy in the 54 municipalities in this region. The questionnaire was divided into two parts: characterization of participants (age, sex, educational background, occupation, training, employment status and reason why they were chosen as responsible); open questions about the actions undertaken for implantation and difficulties, and strategies for resolving these.

Up to three attempts at inviting the person to participate were made: addressed to the personal email of the 108 potential participants in the research. After the third attempt at contact, if no response was received, the participant was excluded from the study. As a result, 62 (57.4%) participants responded to the online questionnaire. One participant, in spite of accessing the questionnaire, declined to participate in the study.

The second instrument for data collection was a semistructured interview script given to the two professionals working in the Regional Health Superintendence Office (SRS), who were responsible for coordinating implantation in the region studied. This covered questions related to the management of the implantation.

In the second stage of the research, in July – September 2015, a documentary study was undertaken, due to the need to identify the implantation status. The two documents that made up the corpus of the study were: "Implantation of the e-SUS PHC strategy in the Regional Health Superintendence Office (SRS) – West" (*Implantação da estratégia e-SUS AB na Superintendência Regional de Saúde (SRS) Oeste*) and "Municipalities by Implantation of the e-SUS PHC strategy in the SRS – West" (*Municípios por Situação de Implantação da estratégia e-SUS AB na SRS Oeste*). The following information was extracted: Software systems of the e-SUS PHC strategy installed, and Implantation scenarios of the e-SUS PHC strategy.

The data deriving from the characterization of the participants and from the documentary study were analyzed using descriptive statistics. The qualitative data, however, were analyzed using Content Analysis of the thematic-categorical modality.[9] With a view to systematizing the organization and analysis of the data, the Atlas ti software, version 7.0, was used.

The study was approved by the Research Ethics Committee of the Federal University of São João Del Rei, under Opinion N. 1.037.609.

● **RESULTS**

In the documentary research, predominance was ascertained of the e-SUS PHC software, a system with Simplified Data Collection (SDC), recorded as being installed in 44 (81.5%) of the municipalities and 186 (58.4%) of the primary healthcare centers (UBS), while the Citizen's Electronic Health Records (CEHR) system appeared as instalwled in only 3 (5.6%) of the municipalities and 44 (14%) of all primary health care centers (Table 1). A total of six municipalities (11.1%) had their own HIS – systems developed by the municipalities or acquired from private companies – integrated with the e-SUS PHC, SDC modality.

Table 1 - Software systems of the e-SUS PHC installed in the municipalities and in the Primary Healthcare Centers (UBS). West Health Region, MG, Brazil, 2015

	N. of municipalities	%	N. of UBS*	%
e-SUS PHC SDC installed	44	81.5	186	58.4
e-SUS PHC SDC via their own system	6	11.1	80	25.1
e-SUS PHC CEHR	3	5.6	44	14
None of the e-SUS PHC software systems	1	1.8	8	2.5
Total	54	100	318	100

Source: Document titled "Implantation of the e-SUS PHC in the SRS – West" (*Implantação do e-SUS AB na SRS Oeste*)
* Number of Primary Healthcare Centers in all the municipalities

Regarding the implantation scenarios (Table 2), the documents analyzed emphasize that most municipalities were in scenario 1 (UBS not computerized – only registration forms) and 2 (UBS without Internet, but with e-SUS PHC SDC), while only 3 (5.6%) of the municipalities were in scenario 6 (UBS with stable Internet and with only e-SUS PHC CEHR installed), considered the most advanced scenario of implantation. In relation to the implantation scenarios in which the municipalities' UBS were found, 147 (46.2%) of the UBS were in scenario 3. In contrast, only 38 (11.9%) of the UBS were in scenario 6.

Table 2 - Implantation scenarios of the e-SUS PHC in the municipalities and Primary Healthcare Centers (UBS). West Health Region, MG, Brazil, 2015

	N. of municipalities	%	N. of UBS*	%
Scenario 1: UBS not computerized – only registration forms	11	20.4	29	9.1
Scenario 2: UBS without Internet, but with e-SUS PHC SDC	14	25.9	60	18.9
Scenario 3: UBS with Internet and with e-SUS PHC SDC	22	40.7	147	46.2
Scenario 4: UBS with limited Internet, e-SUS PHC SDC and CEHR	4	7.4	44	13.8
Scenario 5: UBS with limited Internet, only with e-SUS PHC CEHR	0	0	0	0
Scenario 6: UBS with stable Internet, only with e-SUS PHC CEHR	3	5.6	38	11.9
Total	54	100	318	100

Source: Document: "Implantation of the e-SUS PHC in the SRS – West" (*Implantação do e-SUS AB na SRS Oeste*)
* Number of Primary Healthcare Centers in all of the municipalities

Regarding the characterization of those responsible for the process of implantation in the municipalities, on average they were 34 years old and had spent 16 years in education. Among those with degrees, 36 (72%) had graduated in nursing. Regarding the *lato sensu* postgraduate courses, most were specialized in the area of Primary Care/Family Health and in Management in Public Health, while no participant was specialized in the area of information technology (Table 3).

Table 3 - Characterization of the professionals responsible for the process of implanting the e-SUS PHC strategy. West Health Region, MG, Brazil, 2015. (continues)

Variable	Number of professionals	Percentage (%)
Position occupied in the SMS		
Management of the PHC	38	61
Responsible for the municipality's HIS	16	25.8
Typist	05	8
Municipal health Sec.	02	3.2
Line manager for data processing	01	1.7
Sex		
Female	49	79
Male	13	21
Educational level		
Degree	50	80.6
No degree	12	19.4
Postgraduate qualification - *lato sensu*		
Has specialization	26	41.9
Does not have specialization	36	58.1
Employment status		
Permanent staff member	28	45.2

Staff member - Political appointee	17	27.4
Contractee	15	24.2
State employee (CLT regulations)	01	1.6
Outsourced	01	1.6
Training offered by the SES/SRS		
Trained professionals	55	88.7
Professionals – not trained	07	11.3

Based on the analysis of the qualitative data, the following categories and subcategories were identified.

Category 1: Actions undertaken for the implantation of the e-SUS PHC strategy

In the subcategory titled "Actions directed towards the population's registration and adaptation in the work routine, viabilizing the implantation of the e-SUS PHC", initially, the registration of the population and the use of the forms for this purpose were recognized as actions for making the implantation of the e-SUS PHC strategy possible:

The professionals are working on the individual forms, procedures, and individual and collective dental activity in order to get used to it [...]. (E08)

The population is being registered using the e-SUS forms and all attendance is already being undertaken through these forms. (E28)

These excerpts shed light on the use of the forms that feed the SDC system; however, no interviewee emphasized the recording of the information on the CEHR.

The process of registration of the population through the forms triggered some effects on the work routine.

[...] *a schedule was developed to divide the care and the filling out of the forms* [...].(E15)

We made joint efforts with the team in order to speed up the above-mentioned process. (E53)

In addition to this, emphasis was placed on the involvement of everybody in the filling out of the forms, the coexistence of the manual and electronic registration, as well as the rework and monitoring of the data entry.

The forms on collective activity, procedures and attendance were filled out manually by all professionals [...] *and the UBS receptionist entered it all on the system.* (E39)

We monitor the typing in the Primary Health Care Management by checking the files typed in the system. (E38)

I check the forms on a weekly and monthly basis, and do the corrections with the professionals when there are errors. (E42)

The contracting of professionals was recognized as an additional cost, caused by the need to register the population.

We had to contract a professional to type up the registration, causing further expense to the municipality. (E37)

Even with contracting staff, it is not enough to meet the demand. (E47)

Those responsible for implantation undertook actions for raising health professionals' awareness, in an attempt to motivate them to cooperate in this process.

[...] *Dialogue with the team's professionals, emphasizing the benefits of the e-SUS, substituting the SIAB which is an archaic and underfunded program.* (E40)

The "Training in the State/Regional and Municipal spheres with a view to implanting the e-SUS PHC" formed a separate subcategory. In this regard, training was recognized as actions for making the implantation of the e-SUS PHC strategy viable. Some interviewees evaluated the training offered by the SES/SRS positively; others, however, reported a certain dissatisfaction with this action.

The training was useful, and instructed us sufficiently for the process of using the system. (E05)

The training was very tense, as the people doing the training didn't know how the new system actually worked. (E39)

It was very superficial, without much knowledge of the topic – because they don't work in practice. (E49)

The interviewees also emphasized that the training was taking place for the UBS professionals in the municipalities, alongside other instructional actions seeking to make the implantation of the e-SUS PHC strategy viable.

We are offering training to the Family Health Strategy professionals regarding the use and functioning of the system – and also for how to fill out the forms which are used in the SDC. (E23)

[...] *Guidance for the professionals from the centers on the importance of the e-SUS, and on the quality of the data which are entered.* (E30)

Category 2: Difficulties for the implantation of the e-SUS PHC strategy in the municipalities

In the first subcategory, titled "Immature information technology and co-existence with paper", the participants emphasized topics which have a negative impact on the implantation of the e-SUS PHC strategy, as well as on the care provided to the population.

The biggest difficulty is the large number of forms, papers that we have to fill out, which takes up a lot of our time, reducing the time available for providing care to the community. (E15)

The constant updating of the SDC system, which is not yet mature, also rendered the process of implantation unviable;

In the beginning, the program was very vague and you couldn't back it up – because of this we lost many forms which had been typed up, and then, when the version changed, these were lost and could not be recovered. (E22)

Another difficulty mentioned by the professionals for the implantation is the inadequacy of the SDC for the demands for specific information, which does not strengthen the professionals' work.

The program is still in its early stages, and there is no report for analyzing the information consolidated. It is not helping us to analyze the information so that we can work. (E10)

Furthermore, one can ascertain the interviewees' dissatisfaction regarding the development of the software which was undertaken without its users' participation, in addition to the limitation of the software relating to the impossibility of updating the data already recorded.

Unfortunately, the people who create these programs, most of the time, are far from the context. The construction is top-down, when it should be the other way around. (E10)

[...] *The program doesn't allow you to change data which has already been entered;* [...] *Anything which has already been sent to DATASUS gets lost.* (E10)

In the second subcategory, titled "People as barriers to the implantation process", the interviewees initially emphasized that the professionals are resistant to the changes:

During the meetings for information on the process for the team, many professionals show that they are fairly resistant to the change. (E40)

The dynamics of the population in the community was also recognized as a difficulty.

[...] *How do you add a member of the family, or exclude a service user who has died, or add a health condition?* (E10)

The municipality's population changes address frequently. (E09)

It is difficult to register the residence in the micro-areas [...].(E31)

The last subcategory, titled "Physical and financial resources as obstacles to implantation" emphasizes the absence of appropriate infrastructure for the demands posed by computerization, and dissatisfaction with the way that the implantation of the system is taking place.

[...] *We don't have the infrastructure for implanting the project, but for the Ministry, this is not seen as an obstacle – although for me, it is one of the biggest.* (E17)

This new system was passed to the municipalities, although the government had not computerized the health centers [...]. (E47)

● DISCUSSION

In spite of the establishing of national guidelines[6] for implanting the e-SUS PHC strategy, in practice, in the region studied, there is no systematized process and these directives are not applied appropriately. In the tables with the data from the online questionnaire, we ascertained that most of the professionals responsible for the implantation have neither training nor specialization related to the area of information technologies, are temporary staff, and have responsibility for management in primary care in addition to their other duties, along with being responsible for implanting the strategy in their municipalities.

This being the case, there are no criteria for choosing the person to be responsible for implanting the e-SUS PHC strategy. It is known that the lack of definition of roles and responsibilities in the leadership of the process of computerization in health leads to negative effects on the organization of the work process.[10] In addition to this, professionals' accumulation of roles weakens the organization of information within the organizational structure and encourages behaviors which are harmful to the management of the information.[11] In this regard, there is reasonable concern about the training of human resources, who are responsible for information technologies in the context of public health, which may be an important factor in the underutilization of these technologies.[10]

In relation to the status of the implantation, the installation of the SDC predominated, as did scenarios 2 and 3 for the UBS; and some municipalities had not begun the implantation. Triangulating the data collected, we observed that although the installation of the CEHR had been verified in the documentary research, in the interviews, there is no mention whatsoever from the respondents about its installation in the municipalities.

Such findings corroborate a study undertaken in the state of Mato Grosso, which in 2015 found that the CEHR had not been implanted in any of its municipalities.[12] This scenario varies strongly from that proposed by the Ministry of Health, which would be scenario 6 of implantation, in which the CEHR would be used in the UBS with stable Internet. It is emphasized that the use of the CEHR in the UBS represents the possibility for improving the recording of the care provided to the population, as well as the continuity of the care provided to the same, contributing to the management of the care.

International studies have corroborated these findings, indicating that the implementation of an electronic record system optimizes the integration of information, facilitates simplified access to the care, favors the early diagnosis of illness and improves the care practices.[13-15]

Confirming the observation that the implantation of the SDC system predominates, the filling out of its data collection instruments was recognized by the participants as one of the main actions in the process of implantation, and one that has significant effects on the teams' work – such as overload, reducing the time available for providing care, and impositions and resistance. These effects derive from filling out the forms and constitute the coexistence between paper and computerization. The coexistence between paper and technology indicates the immaturity of the technology itself[16] and tends to have a negative influence on the work process, making it inefficient, slow and less productive[17].

Besides this, the implantation of the e-SUS PHC strategy should not be focused only on the filling out of forms, as a bureaucratic definition, but on the development of the understanding and of the analysis of what is collected, and of how one can use this information for managing the collective. We recognize that the informational needs are influenced by the need to meet certain programs' or policies' directives, and to produce information about productivity or the achieving of financial goals.[11] However, in order to maximize the use of information technologies, it is necessary for the information to be discussed, debated and agreed upon, to obtain greater potential for retention and understanding.[18]

We emphasize that the registration of the population is a task linked to the previous information system, in order to obtain consolidated data through reports, and this is taking place.[16] The professionals, regarding the e-SUS PHC strategy, are undertaking registration again, when there is an absence of technologies capable of transferring data from the previous system. This is rework, and the error is repeated of implanting technologies which are not suited to the work process; on the contrary, it is expected that the professionals and the processes should be altered/adapted so that the technology may be implanted.[10-11,16-17] This is an aspect which requires attention: the system must meet the professionals' actual needs in order not to hinder the work process.[19]

The triangulation of the data related to the training of those responsible for implanting the e-SUS PHC strategy revealed contradictions. The quantitative data showed, on the whole, the undertaking of training offered by the SRS and SES. However, in the view of the participants, the training – in the form in which it took place – was not effective. These situations show the need to improve the process of training the professionals with a view to the success of the implantation process. Brazilian and international studies have shown that the absence of training related to the technology can result in its underuse, poor quality of the information collected, and analyses based on insufficient data.[10-11,16-17]

There is an urgent need for a systematic and continuous training process in the spheres of local, municipal and regional/state management. In its absence, one runs the risk of making the implantation process unviable – as well as maintaining the hegemonic status quo regarding the underuse of information systems geared towards local management.[4,11,16]

Some difficulties were noted in the implantation process: software which was not suited to the computerization needs; resistance on the part of the professionals; and lack of infrastructure in the UBS, among others. In this context, 'technology, people and infrastructure' emerged as dimensions which need to be valued and rethought so as to make the implantation process viable. It is necessary to develop and implant information technologies while taking into account the various dimensions that involve them.[19]

It is also necessary to value the computing infrastructure in terms of hardware and software; clinical content; human-computer interface; people; workflow and communication; internal governmental policies, procedures and culture; external rules, regulations and pressures; and constant measuring and monitoring.[19] Processes for implanting technologies in the context of the SUS should not be employed if they fail to take these dimensions into account as one runs the risk of developing them with a high chance of failure.

In relation to this study's limitations, one should first of all consider the possibility of the applicability of its results only in the scenario analyzed – as it does not allow generalization. However, we emphasize that the implantation process of the e-SUS PHC strategy is occurring across Brazil and that situations resembling those seen in this study may be present. As a result, this study's originality and ground-breaking character can contribute to the sizing of future assessments of the implantation of the e-SUS PHC strategy in other regions of Brazil.

● **CONCLUSION**

The process of implanting the e-SUS PHC strategy, although it improved over time, shows weaknesses related to those responsible for monitoring the implantation, due to insufficient infrastructure in the UBS, shortcomings in training, resistance on the part of the professionals and negative effects on the work. These findings indicate the need to review the planning of the computerization process, with a view to taking into

account the various dimensions that involve this. It is necessary to recognize politically the importance of computerization as support in the organization of the work in primary care and in management of the care.

The use of triangulation contributed to strengthening the observations, represented by alignments and contradictions, allowing the authors to progressively gain in their understanding of the object. We recognize, however, the need for further studies related to the e-SUS PHC strategy and its software systems. It is necessary to assess the effects of software systems on the organization of the work and the management of the care. In addition to this, it is also necessary to analyze the use and acceptance of these technologies in the perspective of the professionals.

● **ACKNOWLEDGMENTS**

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