Adoption of health information technology in the mobile emergency care service

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Abstract

Purpose – Health is at the center of society concerns, being characterized by the dilemma of contributing to the population well-being, while demanding high financial investments at the same time. In this sense, information technology (IT) becomes essential for the progress of the sector, directly impacting on how care practices are performed. This study aims to analyze the adoption of mobile devices in the mobile emergency care service (MECS) of the state of Rio Grande do Sul, Brazil.

Design/methodology/approach – The authors carried out a multi-method study with an initial qualitative exploration through a focal group, followed by a survey. Potential determinants and impacts of mobile device use on the work context of the MECS teams were identified. Following, we tested the proposed conceptual model applying a questionnaire to 350 professionals from a total of 160 bases throughout the State. Partial least squares structural equation modeling was used to test the hypotheses herein.

Findings – The authors found that Satisfaction with the Use of Mobile PHC (PHC – Primary Health Care) is determined by the application compatibility with MECS work, followed by the performance expectancy with the use of the technology and the technical support provided to the users – acting as important facilitators of this process; while the technological complexity inherent in the use of the technology appears as the main barrier to the success of this technology. Besides, the authors found that both intensity of Use and Satisfaction with the Use of the technology provide different benefits to those involved (teams, patients and the organization).

Research limitations/implications – As limitations of the study, the authors point out to the fact that the data are from a single Brazilian State, and therefore, its results cannot be generalized. Another limitation is that the study considered only the use of a specific mobile technology, which requires caution when using this information in contexts where the health information technology is different, besides the fact that the findings may not be compatible in environments where IT adoption is voluntary.

Practical implications – The study can help managers of public and private organizations in the planning and implementation of different technologies, whether mobile or applied to the health context, as well as in the expansion of their use in their respective institutions.

Social implications – The research contributes to other studies that realize that the adoption of IT can cause relevant changes to health being associated to productivity gains and improvement of the quality of service provided to society through different forms and solutions.

Originality/value – The adoption and use of IT – such as mobile devices – impacts on how care practices are performed in the MECS, providing different benefits to those involved (teams, patients and the organization).

1. Introduction

Society has been constantly concerned with health-related issues, especially considering they demand high financial investments while being paramount for the well-being of the population at the same time. In a context marked by budget cuts and growth in demand for health services – heavily influenced by the ageing population with a corresponding rise in chronic diseases (Ingebrigtsen et al., 2014) – the adoption of different information technologies (ITs) has emerged as an alternative to achieve greater efficiency and effectiveness in health-care activities (Silva, Rodrigues, de la Torre Diez, Lopez–Coronado, & Sallem, 2015).

Among the main examples of IT applied to health, some of them already present in Brazil, Electronic Health Record (Gagnon, Ghandour, Talla, Simonyan, & Godin, 2014; Perez & Zwicker, 2010), health information exchange systems (Ingebrigtsen et al., 2014; Vest, 2010), telemedicine (Wen, 2008), computerized physician order entry (CPOE) and decision support systems (Buntin, Burke, Hoaglin, & Blumenthal, 2011), as well as mobile devices such as the personal digital assistant – PDA) (Tan, Siah, Ooi, Hew, & Chong, 2014), smartphones and tablets (Barra & Sasso, 2010; Silva et al., 2015) have been highlighted in the literature. The present study adds to current literature that examines the use of applications installed in smartphones; more specifically, in emergency calls made outside the hospital base.

Recently, there has been a greater presence of applications using mobile devices, especially the smartphone, both by the public in general and health professionals (Silva et al., 2015), mainly because it is a new technology that combines communication and mobile computing through a portable device. In an increasingly mobile society, wireless IT infrastructure supports numerous applications, whether linked to mobile commerce, supply chain management or more recently to health care (Wu, Li, & Fu, 2011). Similarly, the advance of mobile devices powered by 3G, 4G and wireless technology has enabled the creation of a wide variety of service applications to perform mobile health care easily and conveniently, such as medical consultations, hospital records and location-based services (Silva et al., 2015).

One of these recently implemented applications occurred in the mobile emergency care service (MECS) of the state of Rio Grande do Sul, Brazil. To automate the communication between the teams and the Regulation Center, freeing the 192 line and making the service more agile, the State Health Department of Rio Grande do Sul initiated, between 2013 and 2014, the implementation of a Mobile PHC system (PHC – primary health care). The application, which works through the use of a smartphone made available to each service team, automates a good part of the activities performed by the teams when receiving a call. However, the adoption of this system by the different MECS's units scattered throughout the state has been done in a systematic way, replacing the exclusive use of telephony as a form of communication between the teams and their respective regulation center (Secretaria Estadual Da Saúde Do Rs, 2016), with occurrence of units where acceptance and use of Mobile PHC are more successful than others.

The information systems (IS) literature has suggested different facilitators and inhibitors of the adoption of technologies in the organizational environment and in health-related areas; however, there is a lack of studies addressing the use of IT in mobile emergency care services. Studies of this nature may interfere with the decision whether to adopt new technology and to identify and measure its potential benefits to users, patients and the health system as a whole. Toward a better understanding of this context, we propose the following research question: How can the acceptance of mobile applications by users and their impact on service performance be explained by facilitating or inhibiting factors in the mobile emergency care service? We intend to answer this question by proposing a model that explains and predicts the factors that facilitate and hinder the acceptance of the use of Mobile PHC and its impact on the performance of the teams.

2. Theoretical framework

In general, health information technologies (HITs) have drastically changed the way health professionals work (be they doctors, nurses, psychologists, among others), as well as the experiences of patients receiving care (Krist et al., 2015). Such technologies have the potential to improve health care, as well as the performance of the providers of this service, enabling improvements in the quality of care, cost reduction, better access to medical information and greater patient interaction with their own care (Blumenthal, 2010).

Regarding the scientific research developed on the subject, especially in Brazil, a limited number of studies that identify and measure the factors that influence the adoption and use of mobile technologies in the health area is observed, highlighting the studies developed by Perez and Zwicker (2010) and Barra and Sasso (2010). When we search for international publications, the reality is quite different. However, scholars still emphasize the need for further studies on the motives that lead health professionals to adopt mobile devices to effectively promote their diffusion in health-care settings (Ingebrigtsen et al., 2014; Wu et al., 2011), as well as researches that analyze the potential and challenges of using mobile technologies in health care (Kumar et al., 2013). Considering the investments that have been made in HIT, quantifying the impacts of their use on performance should continue to be an important focus of research (Agarwal, Gao, & Des Roches, 2010).

Identifying factors that influence the adoption of these technologies can provide insights to managers in the development of more effective strategies that, in turn, would allow health units to create new opportunities to increase the efficiency and effectiveness of their professionals (Chau & Hu, 2001). Regarding the use of mobile technologies, it has been shown to be beneficial in supporting professional work practices and patient care, through the possibility of rapid response, prevention of medication errors and data management and accessibility (PROGOMET et al., 2009). In emergency medical services, for example, it is of fundamental importance that the technology allows the medical staff to process the necessary information about the patients quickly and accurately (Rippen, Pan, Russel, Byrne, & Swift, 2013), which will directly affect the care provided, decrease sequelae or even save lives.

A review of the literature on the subject made it possible to identify 28 motivating and inhibiting factors of the adoption of HIT. The high number of constructs would make the proposed model extremely exhaustive and complex. Thus, it was considered appropriate to develop multi-method research, starting with a qualitative phase, followed by a quantitative one.

3. Methodology

The research is characterized as an exploratory-descriptive study, being operationalized through a survey. The quantitative approach had the initial support of a focus group to better understand the use of the Mobile PHC system and its impacts on MECS performance. In this sense, this research is classified as a mixed-method study, because it combines qualitative and quantitative research. Regarding ethical issues, the study was submitted to the Ethics Committee of the Federal University of Rio Grande (FURG), receiving the approval and registered in the Brazilian Platform under the number CAAE 57048316.3.0000.5324. Next, we detail how we propose the research model, followed by the construction of the hypotheses and the methodological procedures used in the survey.

3.1 Proposition of the research model

To identify the different determinants of mobile device use and its impacts on the working context of the Mobile Emergency Care Service (MECS) teams, we carried out a literature review followed by qualitative exploratory research. Therefore, a focus group was chosen from a MECS team, consisting of members who have been using the mobile PHC application for more than two years and have received formal training to use the technology.

The focal group was mediated by one of the authors, in the figure of the moderator, being guided by a semi-structured interview script. The activity occurred at the MECS unit of the professional team, corresponding to the place where the team awaits the calls from the Regulation Center. Six professionals participated in the focal group, two drivers, two nurses, one nurse technician and one physician. The activity lasted about 1 h, and the reports were recorded and later transcribed to enable the adequate analysis of the data, which was performed by the content analysis technique. The analysis obtained in the focus group showed that the use of the mobile device in the MECS is influenced by two sets of determinants, one formed by barriers: *resistance to change* and *technological complexity*; and the other by facilitators: *technical support*, *compatibility*, *performance expectancy* and *ease of use*. Concerning the benefits, these were identified and grouped according to the impact of the use of the mobile PHC system on each stakeholder group: users, patients and the organization.

Another point observed with the accomplishment of the focal group was that the use of Mobile PHC system in MECS is not voluntary, but mandatory. Given this reality, Brown, Massey, Montoya–Weiss, and Burkman (2002) provide evidence that a change in the dependent variable is appropriate when examining the acceptance of technologies in this context, contrary to a reality of voluntary use. Thus, along with *Use*, *Satisfaction* has been considered as more appropriate to evaluate the success of a technology when the use of an IS is mandatory (Brown et al., 2002; Sykes, 2015; Maillet, Mathieu, & Sicotte, 2015). Figure 1 presents the proposed model, elaborated from different antecedents and consequences of the use of HIT, considering the peculiarities of the context of mandatory use. It should be noted that after the proposal of the conceptual model, we returned to the MECS team, with which the focus group had been carried out. Through an interview with the team leader, we confirmed the coherence of the obtained reports along with the pertinence of the conceptual model, which portrays the context of acceptance and use of the mobile PHC application and the perceived impact of its implementation on the performance of users, patients and MECS itself.

3.2 Hypothesis construction

Studies that address Satisfaction as the main dependent variable are rare, using mostly the traditional *IS Success Model* provided by Delone and McLean (1992). Innovatively,
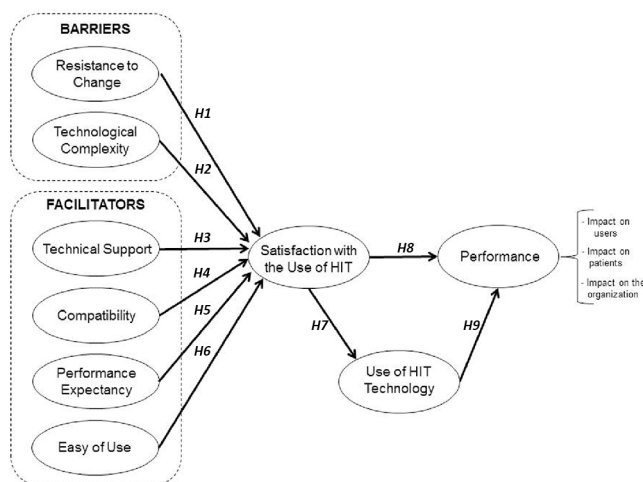
Figure 1.
Conceptual model

Maillet et al. (2015) proposed an adapted model in which Satisfaction and Use are presented as the main focal variables, using, however, different antecedents to those traditionally proposed by DeLone and McLean (1992). Maillet et al. (2015) found it difficult to find research to support their hypotheses that contained the variable Satisfaction, thus opting for the use of studies that tested the same antecedents as the constructs Use or Intention of Use, in contexts where the use of the system is mandatory. The same difficulty was faced in the present study, opting to follow the same strategy. Next, the theoretical construction that underlies the conceptual model of the research is presented.

Resistance to change is characterized as a personality trait of people who believe it is difficult to change their routines, thus becoming emotionally stressed in the smallest signs that changes might occur. It is understood as any conduct that aims to maintain the *status quo* in the face of pressures that seek to change it (Keen, 1981). Some studies such as Lapointe and Rivard (2005) have highlighted this issue, providing support for the negative effect of resistance on the use of HIT. Thus, we propose the following hypothesis:

H1. The degree of Resistance to Change will be negatively associated with the degree of Satisfaction with the use of a mobile application.

Technological complexity, on the other hand, refers to an individual's degree of perception of the difficulty in understanding and using a specific type of technology (Thompson, Higgins, & Howell, 1991). Any aspect of a particular technology may have an impact on the user's intention to accept it or not (Lu et al., 2003). It is emphasized that users will have difficulty meeting their needs when the complexity of the technology use increases. Literature presents some studies that prove this relationship (Au & Kauffman, 2008). Thus, we propose the following hypothesis:

H2. The degree of Technological Complexity of the system will be negatively associated with the degree of Satisfaction with the use of a mobile application.

In the IT context, technical support can be defined as the assistance provided to users of computer products by people with IT skills and knowledge. It comprises the technical aspects of users' needs such as specialized instructions, guidance, training and

consultation on the use of technologies (Pijpers, Bemelmans, Heemstra, & Van Montfort, 2001). Considering that the nature of health professionals' work is characterized by the scarcity of time and the intense flow of activities, technical support becomes fundamental to the success of a technology (Lu et al., 2003). Thus, the higher the level of technical support, the greater the probability of adoption is successful. When considering the relationship between technical support and satisfaction, two studies confirm this connection: Chatterjee, Chakraborty, Sarker, and Lau (2009) and Sykes (2015). Based on this discussion, we propose the following hypothesis:

H3. The degree of Technical Support offered to users will be positively associated with the degree of Satisfaction with the use of a mobile application.

Compatibility is the extent to which the user believes the technology is consistent with his/her values, needs and past experiences (Payton, Pare, LeRouge, & Reddy, 2011), i.e. the degree to which new technology applies to a job. Compatibility has been shown to be relevant and significant in studies in the context of the adoption of HIT, examples being the studies of Chau and Hu (2001); Lu et al. (2003) and Maillet et al. (2015). Therefore, if health professionals consider that technology in question is compatible with their work style and all aspects of their profession, they will be willing to use this technology (Hsieh, 2015). On the other hand, if an individual perceives the new technology as irrelevant to his/her work, he/she will be less likely to accept it (Son, Park, Kim, & Chou, 2012). Thus, we propose the following hypothesis:

H4. The degree of Compatibility of the system with the activities performed will be positively associated with the degree of Satisfaction with the use of a mobile application.

Performance Expectancy can be defined as the degree to which an individual believes that the use of technology will help him or her to obtain gains in performance at work (Venkatesh, Morris, Davis, & Davis, 2003). The impact of this construct was observed in other health studies (Adamson & Shine, 2003), standing out as the strongest factor in the prediction of use. Users value the usefulness of technology as a support to their work practices and, consequently, to improve their performance and quality of care (Maillet et al., 2015). Based on these settings, we propose the following hypothesis:

H5. The degree of Performance Expectancy of a system will be positively associated with the degree of Satisfaction with the use of a mobile application.

Ease of Use is understood to be the degree to which a person believes that the use of a particular technology is effortless. Thus, technologies that the individual perceives as being easier or less complex to use are more likely to be adopted and accepted by these individuals (Davis, 1989). Several studies have established ease of use as an important determinant of the intention and use of IT in the health-care context, especially the study presented by Gagnon et al. (2014), in which the ease of use proved to be the most relevant determinant of doctors' intention to adopt the electronic medical record, and Tan et al. (2014), who emphasized that health professionals were reluctant to adopt the PDA when they perceived its interface as unfriendly or difficult to operate. Research developed by Adamson and Shine (2003) confirmed the relevance of user-friendliness as a strong catalyst and is indispensable in promoting the use of IT applied to health. Therefore, we propose the following hypothesis:

H6. The degree of Ease of Use of the system will be positively associated with the degree of Satisfaction with the use of a mobile application.

Satisfaction with the use of technology refers to the extent to which the user is satisfied with his/her interaction with technology (DeLone & McLean, 2003). It measures aspects of the user's perception of his/her experiences of using the technology, verifying that it has been psychologically accepted. Even though the use is mandatory, satisfaction is not, as it is a personal feeling (Hsieh, Rai, Petter, & Zhang, 2012). In their research, Chatterjee et al. (2009) and Petter, Delone, and Mclean (2008) suggest that the more satisfied an individual is with a determined technology, the more likely he/she is to use it again. Thus, we propose the following hypothesis:

H7. The degree of Satisfaction with the Use of a system will be positively associated with the Intensity of Use of a mobile application.

In general, satisfaction has been recognized as a key metric for the success of any IS (Brown et al., 2002; DeLone & McLean, 1992). In the health-care field, some studies have presented sufficient empirical results to guarantee support and coherence in the relationship of satisfaction with obtaining benefits in a network (Lapointe, Mignerat, & Vedel, 2011). It is also important to assess the impacts of HIT through measures that include aspects focused on different stakeholder groups (Wu et al., 2012). In this sense, it is understood that satisfaction with the use of technology can have positive impacts on the performance of the individual, as well as the group or team, and the organization itself. Thus, we propose the following hypothesis:

H8. The degree of Satisfaction with the use of a mobile application will have a positive effect on the performance of different stakeholder groups.

When we consider the influence of the use of technology on performance, its variability portrays a significant impact on the achievement of benefits, even if use is mandatory. As a result of use and user satisfaction, certain network benefits will occur (DeLone & McLean, 2003). This relationship has been tested and supported by studies presented by Chatterjee et al. (2009) and Petter et al. (2008). As for the different actors involved in health-care delivery, they may be affected differently by HIT, and may be impacted to a greater or lesser extent depending on the beneficiary. Therefore, considering this discussion, we propose the following hypothesis:

H9. The degree of Use of a mobile application will have a positive effect on the performance of different stakeholder groups.

3.3 Survey procedures

For the elaboration of the questionnaire used in this research, the questions referring to each one of the constructs were, for the most part, adapted from studies already validated and tested empirically. The only exception was the *Performance* construct, which had its items based on the results obtained in the qualitative stage of this research because we found no studies regarding the proposition of indicators that evaluate the impact of the use of HIT in the different stakeholder groups, such as the ones (users, patients and MECS) proposed herein. Furthermore, for the analysis, we decided to transform the 12 first-order items proposed in 3 second-order items, represented by the average of the items corresponding to each of the three groups of beneficiaries: patients, teams and the organization. The instrument underwent a process of refinement and validation, initially receiving the evaluation of a specialist in languages, a health professional working at the MECS and three specialists with theoretical and practical knowledge of IT. This procedure guarantees both

face and content validity of the questionnaire, which was composed by 44 questions, operationalized in a five-point Likert scale, varying from (1) totally disagree to (5) totally agree. Before the application, a pretest was carried out in one of the MECS's units, totaling 15 respondents, and no problem was pointed out or identified in the instrument. The questionnaire, presenting the references from where the constructs originated, is available in Appendix.

The study population was composed by 2,106 health professionals (nurses, doctors, nursing technicians and drivers) who work in 160 units that form the MECS service in the state of Rio Grande do Sul. Based on this information and using the criterion of sample size selection proposed by Hill and Hill (2002), we determined a total of 329 respondents as the minimum number of members needed to compose the sample in a representative manner. From a list provided by the State Coordination of MECS, containing information on all units, we identified the respondents of the study. All 160 units were contacted – initially, through a telephone call with made by the technical head of the unit and later by sending an e-mail with the attached questionnaire. By the end of the data collection, 360 questionnaires were answered, of which 350 were considered valid, composing the final sample of the study. The majority of the individuals surveyed were men (55.4 per cent), between 31 and 40 years of age (52 per cent) and with a high school education (35.4 per cent). Most of them are nurse technicians (40.3 per cent), followed by nurses (27.7 per cent), drivers (24 per cent) and doctors (6 per cent). On average, the respondents have been working for MECS for five years, and have been using Mobile PHC in their work routine for an average of two years.

Since the data were collected, we took some precautions to identify potential sources of method bias – a rather common problem in the conduction of behavioral research (common method bias) (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003) but still little explored in Administration studies published in Brazil. To do this, we performed Harman's single factor test and tested the correlation between all the constructs of the proposed model finding no evidence of common method bias. Afterwards, we analyzed the proposed model through structural equation modeling using the statistical software SmartPLS 3.0 (partial least squares).

4. Results and discussion

4.1 Measurement model

Through the measurement model, we seek to analyze the relationship between the constructs and their items. It is recommended that the factor loadings of all items are higher than 0.70 in their respective constructs, indicating a well-defined structure. Thus, we excluded five items, which presented factor loadings lower than the minimum recommended. After these exclusions, all factor loadings confirmed the validity and reliability of items and constructs (Table I).

The Composite Reliability (CR) of the instrument was then verified. As can be seen in (Table II), the CR value of all the constructs exceeded the minimum value of 0.80, suggested by Fornell and Larcker (1981), confirming the reliability of the scales. For convergent validity evaluation, the criterion of the average expected variance (AVE) was used. The value of the AVE for each construct must exceed the established minimum value of 0.50, which means that more than half of the variances observed in the items are accounted for by their hypothetical constructs (Fornell & Larcker, 1981). This result is reinforced by the factor loadings of the items being higher in their respective constructs.

Discriminant validity was tested through the criterion of cross loadings, in which it is expected that the factor loading of each indicator is greater than all its cross loadings, as well as by the criterion that the square root of the AVE of each construct is greater than all

Items	COM	TEC	PER	EXP	EOU	RES	SAT	SUP	USE
COM1	*0.792*	−0.207	0.479	0.465	0.486	0.281	0.423	0.285	0.293
COM2	*0.880*	−0.191	0.479	0.538	0.586	0.341	0.509	0.473	0.319
COM3	*0.842*	−0.205	0.447	0.569	0.479	0.320	0.462	0.468	0.326
TEC1	−0.126	*0.809*	−0.130	−0.040	−0.092	0.032	−0.171	−0.040	−0.051
TEC2	−0.264	*0.874*	−0.213	−0.182	−0.172	−0.010	−0.207	−0.218	−0.080
IMO	0.509	−0.225	*0.943*	0.632	0.462	0.278	0.575	0.402	0.353
IMP	0.518	−0.182	*0.953*	0.692	0.522	0.280	0.589	0.402	0.367
IMU	0.565	−0.188	*0.960*	0.726	0.551	0.318	0.571	0.407	0.381
EXP1	0.498	−0.116	0.614	*0.888*	0.507	0.377	0.482	0.438	0.242
EXP2	0.565	−0.097	0.629	*0.918*	0.560	0.325	0.437	0.502	0.331
EXP3	0.638	−0.163	0.706	*0.917*	0.624	0.315	0.500	0.542	0.359
EOU1	0.530	−0.171	0.526	0.542	*0.833*	0.310	0.433	0.453	0.242
EOU2	0.431	−0.104	0.245	0.372	*0.729*	0.283	0.273	0.337	0.276
EOU3	0.464	−0.079	0.427	0.510	*0.752*	0.315	0.293	0.334	0.359
RES1	0.305	−0.019	0.248	0.315	0.295	*0.827*	0.239	0.196	0.173
RES2	0.294	−0.006	0.239	0.287	0.315	*0.866*	0.279	0.204	0.203
RES3	0.344	0.054	0.284	0.340	0.367	*0.810*	0.248	0.237	0.266
SAT1	0.572	−0.231	0.580	0.533	0.432	0.319	*0.917*	0.464	0.375
SAT2	0.450	−0.186	0.511	0.449	0.381	0.228	*0.901*	0.382	0.389
SAT3	0.474	−0.192	0.548	0.426	0.389	0.277	*0.886*	0.413	0.394
SUP1	0.417	−0.130	0.311	0.423	0.384	0.155	0.364	*0.826*	0.272
SUP2	0.391	−0.172	0.346	0.454	0.386	0.149	0.357	*0.832*	0.207
SUP3	0.462	−0.155	0.431	0.524	0.484	0.291	0.434	*0.841*	0.283
SUP4	0.364	−0.085	0.310	0.401	0.381	0.231	0.393	*0.826*	0.309
USE2	0.273	−0.087	0.394	0.322	0.314	0.137	0.330	0.259	*0.790*
USE3	0.313	−0.037	0.261	0.264	0.262	0.221	0.356	0.279	*0.819*
USE4	0.306	−0.060	0.242	0.234	0.289	0.266	0.331	0.230	*0.767*

Notes: COM = Compatibility; TEC = Technological Complexity; PER = Performance; EXP = Performance Expectancy; EOU = Easy of Use; RES = Resistance to Change; SAT = Satisfaction; SUP = Technical Support; USE = Use

Table I.
Factor loadings of the items in the constructs

	Mean	CR	AVE	COM	TEC	PER	EXP	EOU	RES	SAT	SUP	USE
COM	4.13	0.88	0.70	*0.84*								
TEC	3.25	0.83	0.71	−0.24	*0.84*							
PER	3.44	0.97	0.91	0.56	−0.21	*0.95*						
EXP	3.97	0.93	0.82	0.63	−0.13	0.72	*0.91*					
EOU	4.25	0.82	0.60	0.62	−0.16	0.54	0.62	*0.77*				
RES	4.08	0.87	0.70	0.38	0.01	0.31	0.37	0.39	*0.84*			
SAT	3.57	0.93	0.81	0.56	−0.23	0.68	0.52	0.45	0.31	*0.90*		
SUP	3.71	0.90	0.69	0.49	−0.16	0.42	0.55	0.50	0.25	0.47	*0.83*	
USE	3.85	0.84	0.63	0.37	−0.08	0.39	0.34	0.37	0.26	0.43	0.32	*0.79*

Notes: COM = Compatibility; TEC = Technological Complexity; PER = Performance; EXP = Performance Expectancy; EOU = Easy of Use; RES = Resistance to Change; SAT = Satisfaction; SUP = Technical Support; USE = Use

Table II.
Correlation matrix and average extracted principal constructs variance

the correlation coefficients in the corresponding column (Fornell & Larcker, 1981). To meet this criterion, it was necessary to exclude two more items. When analyzing Table II, it is possible to verify that the values meet the predefined criterion.

4.2 Structural model

Through the structural model, it is possible to evaluate the predictive and causal relationship among the constructs. Thus, the path coefficients (β) and their statistical significance (t) are estimated to test the hypotheses; the coefficients of determination (R^2) of the endogenous variables are also calculated to evaluate the predictive capacity of the model. To verify the consistency of the model and the statistical significance of the established connections, the bootstrapping technique was adopted with 500 random simulations. The results obtained are t values for each connection and to be considered significant, this value should be higher than 1.96 ($p < 0.05$), which represents a 95 per cent confidence interval. As shown in Figure 2, only two connections did not reach this value (Resistance to Change => Satisfaction, and Ease of Use => Satisfaction), which represents the non-confirmation of *H1* and *H6*. All the other hypotheses had empirical support.

The R^2 values, in turn, evaluate the portion of the variance of the dependent constructs that is explained by the structural model. According to the results, it can be stated that
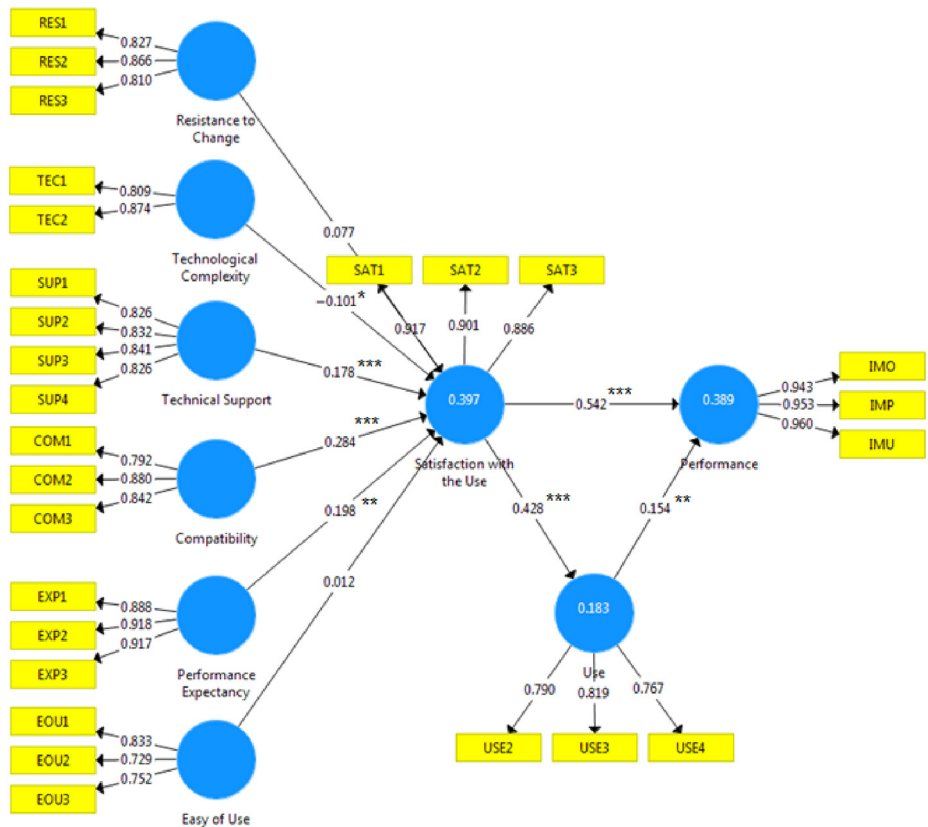

Figure 2.
Research model results

Technological Complexity, Technical Support, Compatibility and Performance Expectancy explain jointly 39.7 per cent of the variance present in the Satisfaction with the Mobile PHC. On the other hand, Satisfaction of Use of the Mobile PHC explains, alone, 18.3 per cent of the variance of the Use of the application. Finally, Satisfaction of Use with Mobile PHC and Use of Mobile PHC accounts for 38.9 per cent of the existing variance of the Performance construct. Given these values, it can be considered that the model has an explanatory power varying from medium to large effect size.

Considering the established and tested connections between the constructs, the disconfirmation of *H1* means that even the health professional who does not want the Mobile PHC to change the way they make their decisions, how they interact with their workforce, or how they work, does not influence their satisfaction with the use of the technology. The probable non-confirmation of this construct as a barrier can be explained by the fact that the technology in question has already been used in the vast majority of the units investigated for at least two years and has become a mature technology. That is, the resistance occurred at the beginning of the deployment. What may also have contributed to this overcoming of resistance is the high compatibility (average = 4.13, Table II) of the technology with the work routine of MECS teams, not significantly altering the way the activities are performed with or without the presence of the mobile device.

Regarding the direct relationship between Technological Complexity and Satisfaction with the Use of Mobile PHC, we found a negative and significant correlation ($\beta = -0.101$; $p < 0.05$), confirming *H2*. Some authors have suggested that Technological Complexity arises as one of the main obstacles in the acceptance of mobile computing devices (Son et al., 2012). It is critical that developers design the features and interface of the application with the quality, availability and speed of data transmission via the internet, available at different times and locations. It is worth noting that usually this part of the infrastructure is not included in the scope of services offered by the technical support provided by the development or maintenance team. To make the operation of these computational programs satisfactory, it is desirable that it reconfigures itself according to the availability of the signal strength of the connection so as to minimize the impact of this delay on user satisfaction. However, hardly all settings remain equally attractive, making the application less efficient under certain operating circumstances. In this sense, the complexity of information and communication technologies can negatively affect user's ability to meet their needs and, in the worst case, even result in the abandonment of the technology (Aldunate & Nussbaum, 2013).

Technical Support has a positive and significant impact on the Satisfaction with the use of Mobile PHC ($\beta = 0.178$; $p < 0.001$), confirming *H3*. The confirmation of technical support as a facilitator can be evidenced by the good evaluation that it received from users of the application (mean = 3.71, Table II). This result is in line with the evidence provided by Sykes (2015), who confirmed the relevance and importance of support structures (such as training, online support and help desk) on the satisfaction of users of an ERP, which is of mandatory usage. Chatterjee et al. (2009) also showed that the reliability of mobile devices and available organizational support are important indicators of usage and user satisfaction with this type of technology. The same authors point out that in the context of health care, where speed and accuracy are critical aspects, the performance of the technology is essential.

Compatibility of the system with professional activities was also found to be the main predictor of Satisfaction with the Use of Mobile PHC ($\beta = 0.284$; $p < 0.001$), supporting *H4*. It is identified that the greater the user's perception that the technology is compatible with most aspects of their work and that it fits their working style, the greater will be the satisfaction of this professional with the use of technology in the performance of their tasks.

An analogous result was found by Maillet et al. (2015) while investigating Electronic Patient Registration System usage. This means that the higher the perception of health professionals regarding the compatibility of HIT with their daily work routines, the greater the likelihood of the acceptance of these technologies.

Similarly, we verified that Performance Expectancy also affects positively and significantly the Satisfaction with the Use of Mobile PHC (β = 0.198; p < 0.01), confirming *H5*. It is noticed that the greater the perception that the use of the application increases productivity and improves the performance and the quality of the work of the health professional, the greater will be the satisfaction with its use, regarding attendance and exceeding expectations. Studies that corroborate this finding, also performed in contexts in which the IT use was mandatory, are ones presented by Adamson and Shine (2003) and Maillet et al. (2015).

The Ease of Use, on the other hand, did not show a significant relationship with Satisfaction with the Use of Mobile PHC (p > 0.05), rejecting *H6*. In this sense, the user realises that ease in the usage of this technology or becoming skilled in its use does not significantly affect the satisfaction of this professional with the technology. One explanation for this result would be that today, access and use of smartphones have become so common among people that their use in the workplace closely resembles how they use that technology in their private lives.

Regarding Satisfaction with the Use of Mobile PHC and its relation with the intensity of use, a strong positive and significant relationship was identified (β = 0.428, p < 0.001), thus supporting *H7*. In this sense, the greater the satisfaction of the health professional with the use of the Mobile PHC, the more intense will be its use. Another possible finding is that even if the use is done in a mandatory way by the requirement of superiors, user satisfaction enhances its use. Other studies have also tested this relationship, concluding that high levels of satisfaction have a significant increase in use (Chatterjee et al., 2009; DeLone & McLean, 2003).

Considering the direct influence of Satisfaction with the Use of Mobile PHC on the performance of the different stakeholder groups, we verified a high positive and significant impact (β = 0.542, p < 0.001), proving to be the main connection of the model, which supports *H8*. In other words, the greater the health professional's perception of their satisfaction with the use of Mobile PHC, the greater the impact on performance. Observing the averages obtained for the three groups of beneficiaries – IMU, IMP and IMO – presented in the Appendix, it is possible to perceive that the greatest beneficiaries of the use of this technology are the professionals who use it, confirming that the Mobile PHC promotes efficiency and effectiveness in carrying out their tasks (Buntin et al., 2011), as well as contributing to the better communication of the teams with their respective regulatory centers (Prgomet, Georgiou, & Westbrook, 2009). The second largest beneficiary of the Mobile PHC, according to the respondents' perspective, is the patients' group. The gains seen are also regarding higher efficiency and effectiveness in providing care. In emergency medical services, it is essential that the technology allows health teams to process relevant information about patients quickly and accurately (Rippen et al., 2013), as is the case with the mobile application under evaluation, which directly impacts the effectiveness of the service performed.

The impact of lesser intensity, but still important concerning benefits offered, occurs in the institution itself. According to the respondents, the greatest gain obtained with the use of the Mobile PHC for MECS is the possibility that the technology will serve the Central Regulation as support for better decision-making (Junglas, Abraham, & Ives, 2009; Prgomet et al., 2009). In addition, the application also helps to enable the Regulation Center to respond to calls in a fast and agile way, making it possible to attend patients faster, in addition to taking a larger number of calls per day. Results similar to the ones presented herein were also found by Chatterjee et al. (2009) and Petter et al. (2008) who, in their review of empirical

research, have confirmed the existence of sufficient support to claim that satisfaction has a considerable impact on obtaining network benefits.

Finally, we identified that Use also affects positively and significantly the Performance (β = 0.154; p < 0.01), but with a lower intensity than Satisfaction, confirming *H9*. This result allows us to conclude that, even in contexts where the use of technology is mandatory, both use and satisfaction have a significant impact on the achievement of benefits, although user satisfaction with technology has an impact almost four times greater than the effect provided by the intensity of use. Therefore, it is not enough for organizations simply to require their employees to use a certain technology without being concerned with the satisfaction of these users with their use as well.

5. Final considerations
The present study brings important contributions to IS area and, more specifically, to the context of HIT. Notably, the health-care services offered to the population have faced numerous difficulties, with IT emerging as an important ally to improve the sector and overcome these barriers. Based on the literature review and the qualitative exploration, a model was proposed containing antecedents and consequences of the adoption and use of mobile devices in the Mobile Emergency Care Service of the state of Rio Grande do Sul, Brazil. We identified that Satisfaction with the Use of Mobile PHC is determined by the Application Compatibility with MECS work, standing out as its main predictor, followed by the Performance Expectancy with the use of the technology and the Technical Support provided to users – acting as important facilitators of this process; while the Technological Complexity inherent in the use of Mobile PHC appears as the main barrier to the success of this technology. Another finding was that even though the use of the mobile application is mandatory, it was perceived that the use of technology is significantly affected by the user's satisfaction with it. In this sense, both Use and Satisfaction with the Use of the Mobile PHC provide a series of benefits, measured herein through the perceived impacts on the different stakeholder groups (users, patients and organization), highlighting Satisfaction with the Use of the application as the main predictor of benefits.

Regarding the theoretical contributions of this study, we propose a model capable of explaining the main determinants of user satisfaction with the adoption of a health information technology and at the same time mobile, as well as the impacts of its use. In addition, it is observed that the Satisfaction with the Use of technology fits better than the intensity of Use as the main dependent variable in the investigation of IT acceptance in contexts of mandatory use, corroborating with the guidelines of Brown et al. (2002). About the managerial practice, the findings obtained herein may help managers of public and private organizations in planning and implementing different technologies, whether mobile or applied to the health context, as well as in the expansion of their use in their respective institutions. It is noteworthy that the system (in terms of compatibility and performance expectancy), the support structure required for its operation (measured here by available technical support) and the technology per se (measured by technological complexity) are essential for the success and acceptance of innovative mobile technologies such as the one approached in our research.

Among the main limitations of the study, we point out the fact that the data are from a single Brazilian state, and therefore, the results cannot be generalized. Another limitation is that the study considered only the use of a specific mobile technology, which requires caution when using this information in contexts where HIT is different, and may not be

compatible in environments where IT adoption is volitional. As for suggestions for future studies, we propose replicating the model developed and validated herein in other institutions, or with other HITs – whether mandatory or voluntary. Finally, we also suggest complementing the results of the present study by investigating the perception of managers and directors of institutions linked to health services regarding the potential benefits obtained with the deployment and expansion of the use of HIT as this theme has attracted attention from governments and organizations, making the field of study promising for scientific research.

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Appendix. Measurement items

(1) Easy of Use (EOU) – Davis (1989)
   - *EOU4. Learning to use Mobile PHC is easy for me*[*].
   - EOU2. Mobile PHC is easy to use.
   - EOU3. It is easy for me to become skillful at using Mobile PHC.
   - EOU1. I find it easy to get Mobile PHC to do what I want it to do.

(2) Compatibility (COM) – Chau and Hu (2001)
   - COM3. Using Mobile PHC fits into my work style.
   - COM1. Using Mobile PHC is compatible with most aspects of my work.
   - COM2. Using Mobile PHC fits well with the way I like to work.
   - *COM4. Mobile PHC is compatible with the way I generally work*[*].

(3) Performance Expectancy (EXP) – Venkatesh et al. (2003)
   - *EXP4. I find Mobile PHC useful in my job*[*].
   - *EXP5. Using Mobile PHC enables me to accomplish tasks more quickly*[*].
   - EXP3. Using Mobile PHC enhances the quality of my work.

- EXP2. Using Mobile PHC enhances my performance.
- EXP1. Using Mobile PHC increases my productivity.

(4) Resistance to Change (RES) – Lapointe and Rivard (2005)
- RES2. I don't want Mobile PHC to change the way I interact with other people on my job.
- RES3. Overall, I don't want Mobile PHC to change the way I work.
- *RES4. I don't want Mobile PHC to change the manner that I interact with patients*[*].
- RES1. I don't want Mobile PHC to change the way I make my job decisions.

(5) Technical Support (SUP) – Igbaria, Zinatelli, Cragg, & Cavaye (1997)
- SUP4. The Mobile PHC technical support provides useful and understandable instructions.
- SUP2. The Mobile PHC technical support provides satisfying responses.
- SUP1. The Mobile PHC technical support is easy to be reach.
- SUP3. The Mobile PHC technical support solves my problems quickly.

(6) Technological Complexity (TEC) – Son et al. (2012)
- *TEC4. I realize that Mobile PHC is a fragile device and can be easily damaged*[*].
- TEC1. I have difficulty in accessing or using Mobile PHC due to the Internet signal quality.
- TEC2. I have difficulty in accessing or using Mobile PHC due to the application crash or slowness.
- *TEC3. I have difficulty in navigating the menus or commands of Mobile PHC*[*].

(7) Use (USE) – Junglas et al. (2009) and Davis (1989)
- *USE1. I became very dependent on Mobile PHC*[*].
- USE4. I use Mobile PHC in my job as often as needed.
- USE3. Whenever possible, I use Mobile PHC in my job.
- USE2. I consider myself an intensive Mobile PHC user.

(8) Satisfaction with the Use (SAT) – Fang et al. (2014)
- SAT1. Extremely satisfied.
- SAT2. Extremely pleased.
- SAT3. All my expectations were exceeded.

Performance (PER) – developed by the authors, 2016

(1) IMU: Impact on users
- IMU1. Using Mobile PHC provides greater efficiency and effectiveness in accomplishing the team tasks.
- IMU2. Using Mobile PHC improves the team communication with the Regulation Center.
- IMU4. Using Mobile PHC reduces the time accomplishment of the team tasks.
- IMU3. Using Mobile PHC reduces the occurrence of errors in accomplishing the team tasks.

(2) IMP: Impact on patients
- IMP1. Using Mobile PHC provides greater efficiency and effectiveness in patient care.
  IMP2. Using Mobile PHC improves the communication about the patient.

- IMP4. Using Mobile PHC reduces patient care time.
- IMP3. Using Mobile PHC reduces the occurrence of errors in patient care.

(3) IMO: Impact on the organization

- IMO4: Using Mobile PHC provides the Regulation Center support for a better decision-making.

- IMO1. Using Mobile PHC allows the Regulation Center to answer calls faster.
- IMO3. Using Mobile PHC reduces the costs of services provided by the mobile emergency care service.
- IMO2. Using Mobile PHC provides greater user satisfaction (population) with the mobile emergency care service.

*The items in italic were deleted during pretest analysis.

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