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Estimating the underestimation profile of health service need s through telephone counseling centers

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KEYWORDS

Underestimation, Health demand, Health system, Logistic regression, Statistics.

ABSTRACT

The public and private health systems around the world face an expansion of services in parallel with the demand for improved quality and cost savings. Quality and efficiency of such systems are affected by the underestimation of the needs for patient care, compromising the clinical condition of the patient and system costs. The objective of this study is to identify the factors that determine the underestimation of the need for health services in Brazil. The survey used data collected from medical advice call center reports, totaling 19.690 observations; 2.166 of these have involved underestimation of needs, wherein the complexity of the intention of the patient is smaller than the recommendation proposed by the physician, which is divided into very or less critical. Through a logistic regression model, it was possible to estimate the critical factors in determining the underestimation in very and less critical needs for health services in Brazil. The closeness to the weekend increases the probability of a very critical underestimation. Daytime hours feature a very critical underestimation tendency. In terms of age groups, we can see a probability of very critical underestimation in younger individuals. This study showed that the user profile that was most likely to have very critical underestimation of the demand for health care was that of the underage individual who calls on weekends and in the early hours of the day.

PALAVRAS-CHAVE

Subestimação; Demanda de saúde, Regressão logística, Estatísticas.

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RESUMO

Os sistemas de saúde público e privado em todo o mundo enfrentam uma expansão dos serviços em paralelo com a demanda por melhor qualidade e redução de custos. A qualidade e eficiência de tais sistemas são afetadas pela subestimação das necessidades de atendimento ao paciente, comprometendo a condição clínica do paciente e os custos do sistema. O objetivo deste estudo é identificar os fatores que determinam a subestimação da necessidade de serviços de saúde no Brasil. A pesquisa utilizou dados coletados em relatórios de call-center de aconselhamento médico, totalizando 19.690 observações; 2.166 destes envolveram subestimação das necessidades, em que a complexidade da intenção do paciente é menor do que a recomendação proposta pelo médico, que se divide em muito ou menos crítica. Por meio de um modelo de regressão logística, foi possível estimar os fatores críticos na determinação da subestimação nas necessidades muito e menos críticas de serviços de saúde no Brasil. A proximidade do fim de semana aumenta a probabilidade de uma subestimação muito crítica. O horário diurno apresenta uma tendência de subestimação muito crítica. Em termos de faixas etárias, podemos ver uma probabilidade de subestimação muito crítica nos indivíduos mais jovens. Este estudo mostrou que o perfil do usuário com maior probabilidade de subestimação muito crítica da demanda por assistência à saúde foi o do menor que liga nos finais de semana e nas primeiras horas do dia.

1 Introduction

The Brazilian health system is formed by public and private systems. The private system is represented by health insurance plans and self-employed professionals, whereas the public system is represented by the Unified Health System (SUS - Sistema Único de Saúde). The latter safeguards all Brazilians universal access to health care. However, such a configuration of the Brazilian health system does not ensure user satisfaction with the services provided. According to the Federal Council of Medicine (2014), 93% of Brazilian respondents consider the public and private health systems in Brazil to be poor or very poor.

An increasingly used resource in this segment to improve the service level is the adoption of Information and Communication Technologies (ICT), which enable health care providers to offer patients health care (Westbrook et al., 2009; Niv et al., 2018). The main stakeholders of the e-healthcare industry are employers, patients, providers and health insurance plans (Mukherjee and McGinnis, 2007; Kim et al., 2019). Mobile health or m-health is a subset of e-healthcare, comprising several health services that may be provided by the mobile phone and other communication devices (Weinstein et al., 2013; Castillo et al., 2017).

The scope of e-health studies has expanded in recent years. Some research initiatives are: the impact of medical advice phone centers on reducing costs of the system (Guimarães et al., 2015; McFarland et al., 2017) highlights the main uses of m-health on smartphones and tablets, through developing numerous applications (Handel, 2011) and presents a system that evaluates the priority of a call to a nursing station based on the patient's context and information, including the recommendation for the most appropriate care (Ongenae et al., 2014) and another group of researchers evaluated the quality, as perceived by users, and with service efficiency (Mechael, 2009; Akter et al., 2010; Babich et al., 2016).

The increased use of phones, especially the more recent use of mobile phones and smartphones, has introduced an important frontier for e-health, which is the possibility of doctor-patient interaction by distance communication (Albritton et al., 2018). According to Mukherjee and McGinnis (2007) and Njeru et al. (2017) the potential of e-health technologies to educate patients and promote management improvements is unlimited. Health system operators can make use of certain information and counselling practices to reduce the flow of patients, redirecting them to real demand. Patients intending to enter emergency care can be redirected to general practitioners' offices for less complex procedures or can make an appointment through medical advice systems via call centers.

Given that the potential demand of the health system is not usually the adequate demand of the real needs of the patient, the medical advice platform enables the user to obtain information that provides him or her with an appropriate use of the available health service. For instance, the user can contact this service both in non-emergency and emergency situations by dialing a few digits and, thus, receiving medical information, consultation, treatment, screening, diagnosis, forwarding and advice by registered doctors (Ivatury, 2009; Lv et al., 2016).

Turner et al. (2002) present a study on the implementation of medical advice centers in Australia and shows that the advice proposed by the center diverged from the original intention of the patient. The advice center recommended patients to seek an appointment instead of hospital emergency units; the percentage was 54% for adults and 78% for children. In a study on the inadequate use of emergency services in England, McHale et al. (2013) show that a higher percentage of inadequate care occurs with children in early childhood. In Brazil, Carret et al. (2009) and Guimarães et al. (2015) presented similar results, wherein the proportion of inadequate demand for health services in young people and children is significantly higher.

With respect to gender, (Guimarães et al., 2015; McHale et al., 2013) note that males are more likely to use health services inappropriately; however, previous studies emphasize otherwise (Sarver et al., 2002; Carret et al., 2007). Another factor considered in the literature that can interfere with the patient's initial demand is the time of day in which the service is demanded. Oktay et al. (2003), Bianco et al. (2003), Carret et al. (2007), McHale et al. (2013) and Guimarães et al. (2015) found that incorrect service occurred with lower intensity in the early daytime hours.

Improved health education equips patients

with the ability to take better preventive measures that will save patients money as well as decrease health system costs (Mukherjee and McGinnis, 2007; Bunik et al., 2007; Babich et al., 2016) identified the cost saving potential in making use of medical advice centers. Kile et al. (2008) recognizes that the use of a phone can potentially reduce emergency care services by diverting unnecessary emergency visits, leading to a potential reduction in service costs, health system costs and overcrowding of hospital emergency rooms.

However, when the patient underestimates his actual health condition, whereby, the patient stays home or seeks an appointment at a clinic instead of going to the hospital, the consequences can be more serious. Jat et al. (2015) found that the underestimation of the severity of health conditions in pregnant patients led to a delay in seeking proper assistance and contributed to maternal deaths. One of the reasons for possible underestimation is that the advice offered by the call center is not always accurately interpreted by the patient (Leclerc et al., 2003; Njeru et al., 2017; Morony et al., 2018). This quality of service was studied by Mayo (1999) and corroborated by Chang et al. (2002). One of the points raised was the importance of the time spent in the conversation with the patient in improving the understanding, and nursing advice performed well in interventions with patients.

The underestimation of service priorities was inserted as a performance indicator to detect life risk situations by the emergency medical dispatchers in the study by Lindström et al. (2011). On the other hand, Laugsand et al. (2010) in their study on the underestimation by the health care provider with patients who have symptoms of cancer, show that this action causes undertreatment of the symptoms and had less favorable results.

Guise et al. (2014) and Keijser et al. (2016) note that the patient’s safety risks associated with telephone assistance, including the underestimation of the knowledge required to use the technology (Hopp et al., 2006) demonstrates that hiding emotions at work is linked to human health, while Seok et al. (2014) studied the relationship between emotion at work and the use of medical services (consultations, hospitals and pharmaceutical drugs) in Korea. They concluded that those who underestimate their emotions, or who hide them, are more inclined to use the medical services, which may be more harmful in women than in men.

In this context, the objective of this article is to identify factors that determine the underestimation of the need for health services from data from calls to a medical advice call center. The impact that underestimation may have on the patient’s health and on the health system costs is also highlighted. The use of telephone counseling centers can help minimize underestimation of needs. Articles about underestimation are rarely found. This study may contribute important information for patients and public and private health system managers.

2 Theoretical Framework

In this section, the topics will be presented: Information technology in the health service and Previous studies about E-healthcare.

2.1 Information technology in the health service

The use of information technology in the area of health services has been progressing considerably in recent years and helping to create digital solutions that help improve people's quality of life and even save lives (Mesko and Győrffy, 2019). Due to this digital advance, in the 2000s the concept of E-healthcare appeared in the world (Wu et al., 2006; Sharma et al., 2019). According to the Healthcare Information and Management Systems Society (HIMSS, 2019) E-healthcare can be conceptualized as a healthcare service system that uses information and communication technologies to provide healthcare services to its users.

The provision of the service through this type of health service system ranges from the communication between partners of the same network of hospitals to the care of patients in the most diverse and remote locations.

In this sense, health information technology is advancing rapidly, bringing improvements to professionals, patients and hospital organizations (Gams et al., 2019). Transforming power tools such as Artificial Intelligence, Internet of Things (IoT), robotics, Big Data, etc., are already part of the daily routine of health professionals and directly impact the patient's life (Xiang et al., 2020).

Thus, among the main benefits of using information technology in the health area, we highlight: 1- Automation of medicine, 2- Improvement in patient care, 3- More accurate

diagnoses through high-definition exams and telemedicine, 4- Safety and accuracy in surgical procedures, 5- Reduction of diagnostic errors and surgical procedures and 6- Use of decision support systems for assertive management (Hamza et al., 2019; Majumdar et al., 2020).

In view of the characteristics and tools used in E-healthcare, in the next section some previous Studies on E-Healthcare will be presented.

2.2 Previous studies about E-healthcare

Due to the importance of the problematic of E-healthcare system, many authors have been studying this theme.

Sarabdeen and Moonesar (2018), although considering that E-healthcare is a system that lowers health costs and improves the quality of service provision, affirms that among the problems of this type of system, the protection of data privacy of patients may be a barrier to the non-materialization of provision of service. In this way, the authors sought to investigate the privacy protection laws of available E-healthcare data and the perception of people who use E-healthcare services. Thus, the authors used descriptive statistics and correlational analysis in a sample of 46 health professionals and 187 health service users in Dubai. As a conclusion, the authors found that the available health data protection laws are limited in scope and that users felt they could rely on E-healthcare service systems.

Giansanti and Maccioni (2019) proposed a new model of respiratory rehabilitation in the field of Telemedicine and e-Health, in order to reduce the impact of respiratory disease on the quality of life of the patients. As it was an initial research, the practical results of the integrated model of Telemedicine and e-Health were not evidenced. The proposed model was built in an environment for domiciliary rehabilitation based on lung incentive gamified devices integrated into the e-Healthcare system.

Marino et al. (2019), sought to evaluate the implementation of screening programs and early detection in the prevention of breast cancer and cardiovascular diseases with the establishment of a remote diagnosis through Telemedicine in a sample composed of 321 women submitted to breast cancer screening and 109 individuals undergoing cardiovascular screening, such study was developed in southern Italy. For the sample studied, the authors concluded that the use of telemedicine significantly reduces the costs of breast cancer tracking and major cardiovascular diseases. Therefore, the use of telemedicine has proven to be a promising approach to provide various health services, especially for patients who are in the most remote and difficult to reach places.

Calvillo-Arbizu et al. (2019), developed an e-Health system for renal patients, adopting design practices focused on the user, usability and accessibility standards. As a result of this process, a multifaceted system was created and meeting the needs of each user. Thus, the improvement of the proposed system is directly linked to the use by different types of users.

García et al. (2019) developed a cell phone application for cerebrovascular accident detection that uses the cloud to store and analyze data, in order to provide statistics for public institutions. To validate the applicability of the application, 90 tests were performed checking the three most important symptoms of strokes: smile detection, voice recognition to determine if a sentence is correctly repeated and whether arms can be lifted. The research results showed that the application developed, through the test, determines whether or not users have symptoms of cerebrovascular accident.

Gams et al. (2019) presented a vision of the progress of environmental intelligence and artificial intelligence to aid medical diagnosis. In line with the studies by Gams et al. (2019), Xiang et al. (2020) sought to investigate the perceptions, receptivity and demands related to the implementation of artificial intelligence in the medical field. For this purpose, an online questionnaire was applied to 2780 participants and then the linear regression model was used. Among the results, the authors found a high level of receptivity (approximately 100%), a high level of demands (approximately 80%) and a high level of expectations (100%) regarding the implementation of artificial intelligence in the medical field.

It is observed a sequence of current research which prove the importance of the study of information technology and communication in the service sector, as well as the dissemination of the concept and practice of E-healthcare. Despite the fact that the topic is quite discussed in the literature, few studies are aimed at identifying the factors that determine the underestimation of the need for health services. Thus, this work aims to study this

theme.

3 Methodology

The data used in the survey are gathered from information contained in service reports from medical advice centers. The reports have the following information: the patient's age, sex, original intention in seeking care, recommendation by the medical advice center, and day and time of service. The information was collected continuously over a period of two months. Service users are customers of health plans or the public health system of municipalities contracting the service. It should be noted that, in the case of under 18-year-old users, the advice service was conducted by a responsible adult. This information was supplied by a medical advice center based in Recife, Brazil. This company provides medical advice service by telephone to users from different states and regions of Brazil.

The telemedicine service in Brazil is incipient, but it has been growing considerably. According to Globo (2020), one of the largest online appointment scheduling platforms, it scored an average of 1,200 appointments per day. Thus, taking into account the growing demand for online consultations, the pandemic by COVID-19 and some characteristic aspects such as safety in the movement of patients and doctors, agility and optimization of time, availability of access, the search for humanization in care and the rapid and effective diagnosis of these online consultations, the theme becomes highly relevant and therefore should be studied.

The variables extracted from this set of data are as follows: Age (continuous), Gender (1 = female, 2 = male), The patient's original intent for health care (1 = home care, 2 = visit to the clinic, and 3 = hospital visit), The medical advice (1= home care, 2 = visit to the clinic, and 3 = hospital visit), The part of the day (00:01 - 06:00; 06:01 - 12:00; 12:01 - 18:00; and 18:01 - 24:00), and Day (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday) of the phone call.

From the variables highlighted above, the six hypotheses were developed to identify factors that determine the underestimation of the need for health services from data from calls to a medical advice call center.

H1: Age affect the probability of underestimating of the need for health services.

H2: Gender affect the probability of underestimating of the need for health services.

H3: The patient's original intent for health care affect the probability of underestimating of the need for health services.

H4: The medical advice affect the probability of underestimating of the need for health services.

H5: The Part of the day affect the probability of underestimating of the need for health services.

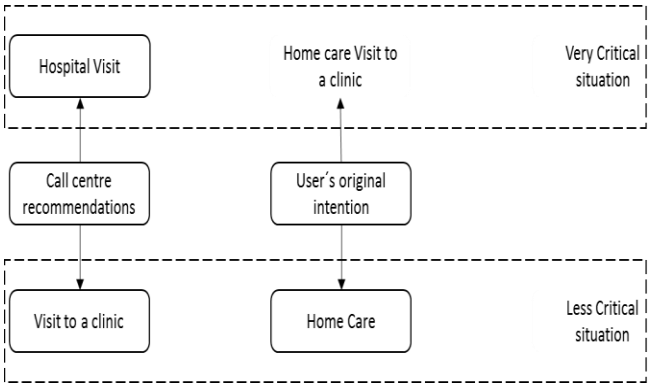
H6: Day affect the probability of underestimating of the need for health services.

The data used in the survey comprise all incoming calls in the period of two months, totaling 19.690 observations; 2.166 are situations of underestimation of needs wherein the complexity of the patient's intention is smaller than the recommendation proposed by the physician.

Bogdan et al. (2004) and Guimarães et al. (2015) assumed that the recommendation provided by a medical advice center is divided into the following three categories: home care (low intensity of care); visit to the clinic (intermediate intensity, not including emergency actions, such as visiting a general practitioner and scheduling an appointment); and hospital visit (high intensity of care, including emergency actions and going to hospitals).

The underestimation of the need for health care is divided into very critical underestimation when the patient should go to a hospital emergency, but prefers to stay at home (home care) or schedule an appointment (visit to a clinic) that then severely compromises the user's health due to failure to provide the adequate level of service, and less critical underestimation when the user should schedule an appointment (visit to a clinic), but prefers to stay at home (home care), compromising the individual’s health because of the delay in diagnosing and treating an illness. The latter may be considered less serious than the former. Figure 1 illustrates this situation.

Figure 1. Flow chart of representation of very critical and less critical situation



Source: The authors (2020)

All statistical analyses were performed using XLSTAT software (Addinsoft, 2016). First, an analysis was performed using chi-squared testing in both underestimation groups. Next, a binary logistic regression model was used in which the underestimated level was assumed as the dependent variable and the other requests were explanatory variables. In the regression model (Equation 1), the Stepwise Forward method was used. At each iteration, this inserts the significant variables of the model. In the end, the only parameters that remained were those that have a consistent relationship with the dependent variable.

The study was submitted to the Committee of Ethics in Research of the University of the State of Mato Grosso. The information used in the survey was obtained from a secondary dataset provided by the medical advice center, which has a service protocol that originates data without identifying the user (patient). The rapport of the Committee of Ethics is contained in Letter No. 008/2014-REC/UNEMAT.

4 Results and Discussion

In recent years, Brazil has faced a recessionary economic environment that is associated with high inflation. This combination has reduced the purchasing power of households and, consequently, the income available for health expenses, as evidenced by the number of Brazilians who have quit the private health system. In 2015, 766,000 Brazilians abandoned their health insurance plans, a decrease of 1.5% over the previous year, according to the Institute of Supplementary Health Studies (IESS, 2016), while there has been a drop in the tax collection, compromising the transfer of funds to the public health system. Therefore, it is fundamental for managers of public and private health systems to minimize costs and increase their efficiency. The literature shows that providing information to the patient reduces costs (Bunik et al., 2007; Kile et al., 2008; Guimarães et al., 2015).

In this way, nineteen thousand observations were collected and 2.166 showed situations of underestimation. Table 1 shows information from the sample, demographic characteristics and circumstances of the service of 2.166 telephone calls that were collected by a medical advice system when the patient initially underestimated the need for health services. It also shows the distribution of the very critical and less critical requests according to the aforementioned characteristics. Overall, 63.7% (n = 1.380) of the calls were considered very critical and 36.3% (n = 786) were considered less critical requests. Medical advice call center users are predominantly women (64.6%), and the predominant age group is those patients above 59 years of age (28.9%), which is followed by those between zero and fifteen years of age (19.6%). In the latter case, the requests for health care are made by the parents or guardians. Regarding the most frequent time for using the service, the period from 6:00 a.m. to 6:00 p.m., accounting for 69.7%, is the busiest. For the day of the week, patients called more often on Tuesdays (17.5%), Wednesdays (16.9%) and Fridays (16.1%).

According to Table 1, with respect to gender, an equal proportionality of data for both very critical underestimation and for less critical underestimation (χ 2 = 0.137; p-value = 0.711) can be observed. However, with respect to age, we see a significantly higher proportion of patients with a very critical underestimation attitude in the group from zero to fifteen years old (χ 2 = 25.527; p-value <0.001) and a higher proportion of patients with a less critical underestimation attitude in the group from 25 to 34 (χ 2 = 7.807; p-value = 0.005). The other groups (16-24 with χ 2 = 2.669 and p-value = 0.102; 35-44 with χ2 = 0.618 and p-value = 0.432; 45-59 with χ2 = 3.058 and p-value = 0.080; and over 60 years old with χ2 = 0.706 and p-value = 0401) do not present statistically significant differences in their proportions. In relation to the time that patients call, those with a very critical

underestimation attitude have a higher proportion in the 00:01 - 06:00 time slot (χ 2 = 28.208; p-value <0.001) and in the 06:01 – 12:00 time slot (χ 2 = 6.507; p-value = 0.011). However, we see a higher proportion of patients who have a less critical underestimation attitude in the 12:01 - 18:00 time slot (χ 2 = 17.484; p-value <0.001).

Table 1. Sample profile and demographic distribution of very critical and less critical requests according to explanatory variables.

Demographic distribution	Frequency (%)				
	General (n=2.166)	Less critical (n=786)	Very critical (n=1,380)	χ^2	p-value
Gender					
Females	64.6	65.1a	64.3a	0.137	0.711
Males	35.4	34.9a	35.7a	0.137	0.711
Age					
0-18	19.6	13.9a	22.8b	25.527	<0.001
18-24	9.1	10.4a	8.3a	2.669	0.102
25-34	17.8	20.9b	16.1a	7.807	0.005
35-44	10.8	11.5a	10.4a	0.618	0.432
45-59	13.8	15.5a	12.8a	3.058	0.080
60 plus	28.9	27.9a	29.6a	0.706	0.401
The part of the day					
00:01 - 06:00	4.0	1.0a	5.7b	28.208	<0.001
06:01 - 12:00	36.1	32.6a	38.0b	6.507	0.011
12:01 - 18:00	33.6	39.2b	30.4a	17.484	<0.001
18:01 - 00:00	26.4	27.2a	25.9a	0.425	0.514
Weekday					
Monday	10.1	7.5a	11.6b	9.207	0.002
Tuesday	17.5	20.2b	15.9a	6.006	0.010
Wednesday	16.9	17.9a	16.4a	0.868	0.351
Thursday	13.5	15.9b	12.1a	6.206	0.013
Friday	16.1	19.1b	14.4a	8.058	0.005
Saturday	14.1	11.3a	15.7b	7.997	0.005
Sunday	11.8	8.0a	13.9b	16.770	<0.001

Values with different letters within the same row are significantly different (p≤0.05) according to the chi-square test to K proportions with Marascuilo procedure and multiple comparisons.

Source: The authors (2020)

With respect to the distribution of weekdays, there is a higher frequency of patients with a very critical underestimation attitude on Mondays (χ 2 = 9.207; p-value = 0.002), Saturdays (χ 2 = 7.997; p-value = 0.005) and Sundays (χ 2 = 16.770; p-value <0.001). On Tuesdays, Thursdays and Fridays, there was a higher proportion of patients with a less critical underestimation attitude (χ 2 = 6.006, p-value = 0.010; χ 2 = 6.206, p-value = 0.013; and χ 2 = 8.058 and p-value = 0.005, respectively).

Binary logistic regression models are used in the literature when the variable of interest has only two results and is influenced by independent variables. The choice of the binary logistic regression model in this study was based on similar work by McHale et al. (2013) and Guimarães et al. (2015). The proposed model is presented in Equation 1.

$$Logit\ i = ln\left(\frac{Odds\ Event}{1 - Odds\ Event}\right) =$$

$$Y = \beta 0 + \beta 1 X_{Day} + \beta 2\ X_{Part\ of\ day} + \beta 3\ X_{Age}$$

Onde:

$Logit\ i$ = Y = is the dependent variable related to probability of underestimating of the need for health services

$\beta 0$: is the intercept of regression

$\beta 1$: is the slope related to the independent variable X_{Day}

$\beta 2$: is the slope related to the independent variable $X_{Part\ of\ day}$

$\beta 3$: is the slope related to the independent variable X_{Age}

From the result of the binary logistic regression model, the relationship between the independent variables with the probability of the underestimated needs of the patient is obtained. As seen in Table 2, the critical variables that compose a very critical profile for the underestimation of needs for health services are, as follows: weekdays (OR: 1.058; 95% CI: 1009-1108), part of the day (OR: 0.803; 95% CI: .725 - 0.890), and age (OR: 0.947; 95% CI: 0.904 - 0.993).

Table 2 – Regression model

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Day	0.056	.024	5.538	1	.019	1.058	1.009	1.108
Part of the day	-0.21	.052	17.568	1	.000	.803	0.725	0.890
Age	-0.05	.024	5.104	1	.024	.947	0.904	0.993
Constant	1.172	.186	39.534	1	.000	3.228		

Source: The authors (2020)

From Table 2, it is possible to see that Equation 2 of the regression model occurred by:

$$Y = 3.228 + 1.058\ X_{Day} + 0.803\ X_{Part\ of\ day} + 0.947$$

X_{Age}

As seen in Table 2, the closeness to the last days of the week increases the probability of very critical estimation by 5.8% per day; as a result, on weekends, the probability of underestimating very critical situations is higher and may more severely compromise the patient's health. There is a higher probability of very critical underestimation in the early hours of the day, which decreases as the hours advance, and each period of the day has a 19.7% reduction in the probability of very critical underestimation. Underage individuals tend to be more likely to very critically underestimate considering that, for each additional year, the probability of very critical underestimation is reduced by 5.3%.

Hence, it can be inferred that the user's profile and service circumstances with higher probability of very critical underestimation of the demand for health services are, as follows: underage individuals on weekends and in the early hours of the day. The proposed model is statistically significant because it rejects the null hypothesis ($\beta 0$, $\beta 1$, $\beta 2$ and $\beta 3 = 0$) in the likelihood ratio test, according to Equation 2. Therefore, the estimated parameters are significant, which is endorsed by the low p-value.

The Wald test corroborates to confirm the significance of the proposed logistic regression model. As shown in Table 2. Each estimated parameter is significantly different from zero. That is, the relationship between the dependent variable and Day (H6), Part of the day (H5) and Age (H1) is confirmed.

In line with the results found in this research, the authors McHale et al. (2013) Carret et al. (2009) and Guimarães et al. (2015) showed that age is a determining factor in the inadequate demand for health services such that the lower the age, the higher the probability of inadequate demands. This study also showed that age also affects the severity of the decision and that within such underestimation there are different levels of health risk, because as age increases, the probability of very critical underestimation decreases, decreasing by 5.3% for each additional year.

Another important finding is that most calls come from women, which is consistent with the results of Oktay et al. (2003), Carret et al. (2007) e Guimarães et al. (2015). However, this study showed no statistically significant difference in the underestimation attitude between genders.

In this study, the highest incidence of calls occurs in the early hours of the day, wherein the time slot from 06:01 to 12:00 (36.1%) is the one with highest incidence, unlike what authors such as Bianco et al. (2003), Carret et al. (2007) e Guimarães et al. (2015) have written in their papers, including that the quantity of mistaken calls was lower in the early hours of the day. It is important to note that from 00:01 to 12:00, very critical underestimation is more frequent. It is also important to highlight that the regression model reinforces this idea, showing that from the first hours of the day, for each increase of 6 hours in the slot, there is a reduction in the probability of a very critical underestimation by approximately 19.7%.

The closeness to the last days of the week increases the probability of very critical estimation by 5.8% per day; as a result, on weekends, the probability of underestimating very critical situations is higher and may more severely compromise the patient's health. There is a higher probability of very critical underestimation in the early hours of the day, which decreases as the hours advance, and each period of the day has a 19.7% reduction in the probability of very critical underestimation. Underage individuals tend to be more likely to very critically underestimate considering that, for each additional year, the probability of very critical underestimation is reduced by 5.3%.

Several authors, such as Bianco et al. (2003), Afilalo et al. (2004) and McHale et al. (2013) demonstrated that patients have an inadequate demand attitude for health services, especially on the weekend. This survey shows that very critical underestimation occurs on Saturdays, Sundays and Mondays. In this sense, this study explores something deeper than the inadequate demand and its relationship with age, the time of day or day of the week, which also indicates the severity of the inadequate underestimation and its possible effects on patient lives.

The role of underestimation of the need for commitment to the individual's health has been studied by Kile et al. (2008) in his article on the contribution of underestimation for maternal death, as well as by Laugsand et al. (2010) who show that results are not as beneficial regarding cancer treatment in their study on underestimation by the health care provider. The severity of human health can also be associated with underestimation of

emotions at work according to Hopp et al. (2006) and Seok et al. (2014). As a result, identifying this patient's profile requires increasing the probability of saving lives.

With such a purpose, a more thorough study was conducted by performing a more detailed identification of the patient who underestimates the need to care for his own health by analysing the gender, age, day of the week and time of his call to the medical advice call center. Sixty-four percent of the patients who underestimate the doctor's advice were identified to correspond to the very critical underestimation group, increasing the potential harm to the patient's health.

Another factor presented in the literature that compromises the clinical condition of patients is the fact that the user may or may not follow the guidance provided by the service provider. Bogdan et al. (2004) demonstrated that 68% of patients disagreed with the actions originally recommended by the nurses and 46% chose an action in which the health care was lower than what had been suggested. A different result was reported by Kempe et al. (2006), who conducted a study of all pediatric patients whose families had contacted the call center after work, concluding that approximately 75% of those families followed their recommendations to stay home or go to the emergency. Another notable point is the quality of service, Chang et al. (2002) e Lindström et al. (2011) confirmed that the quality of service is an important factor for interventions to have a higher probability of success.

As a result, medical advice via call centers, besides enhancing cost reduction in assistance, can influence the well-being of the patient who underestimates his or her need for health services from the moment he or she follows the provided recommendations. However, the use of the technology by the user must be studied as part of profile identification. Guise et al. (2014) and Keijser et al. (2016) note that the risks of underestimation are related to the knowledge required to use the technology. Tate et al. (2013) state that the use of mobile phone messages or specific applications on the smartphone can help minimize underestimation. Shahrokni et al. (2015) propose that the internet, through mobile devices for people over 65 years of age, could be used for interventions related to health.

5 Conclusion

This study explores beyond the inadequate demand, which has been, up to now, not previously presented in the literature; it explores the possibility of deterioration in the patient's health, either by a wrong initial decision or because patients do not follow the recommendations from medical advice call centers.

This survey shows that, based on the identification of the patient's profile and circumstances of the service that underestimate his need for health services (very critical and less critical), there is a need for the health system to readjust its strategy with respect to monitoring the patient after the call, through educational and promotional campaigns, and information policies through contact channels with the health system (m-health). These actions aim to increase the patient's life expectancy, making it necessary to assess the ability of the attendant to use the active call center (calling the patient) and understand the effort and time involved in such calls when determining whether the instructions were followed. Furthermore, the delay in providing assistance can be more expensive for the health system.

Hence, in this context, the combination of informational efforts and monitoring can reduce the patients' underestimation and his or her needs, helping cover the gap between the patients' thought about his or her health and real conditions, avoiding health complications from wrong decisions as well as reducing costs in the healthcare system.

6 Implications and Further Research

The research can make a link between the object of study, underestimation of health care needs and practical application for the benefit of society. The understanding that weekends, in the early hours of the day, and in groups of underage individuals, constitute the risk group for underestimation of needs, provides information that can support the development of health service management policies that provide information for publics more likely to underestimation. The adoption of information policies oriented by the results of the research tend to increase the right decision making in the demand for health services, bringing social contributions - preservation and quality of life from the adoption of health procedures, with the correct specification and at the

right time, as well as economic - reducing health care costs, late adoption of a treatment can aggravate the clinical condition of the patient, a fact that causes a more burdensome treatment.

For Paese and Aguiar (2012), the formulation of strategic policies in the health sector is composed of a set of stages, in which the formulating agent decides which parameters will directly impact on the organizational management. According to Campelo, Santos and Oliveira (2017) in this process of policy formulation, the organizational manager must take into account all the essential factors related to the decision process, as well as the profile to whom these policies are addressed.

Therefore, among the possible practical implications of this study for health service policy-makers through telephone counseling centers, it is highlighted that the identification of the factors that determine the underestimation of the need for health services can contribute to the organizational context, since it guides the organizational policy-makers in the health service scenario, establishing a set of relevant factors for the elaboration and implementation of these policies.

From this perspective, the results of this research, besides contributing as a managerial tool, contribute to the social area, since the manager will take into account the factors that determine the underestimation of the need for health services in the process of formulating organizational policies, linking the participation of civil society and other actors involved, instigating and questioning the elaboration of some management policies, thus providing an improvement in the service rendering process, since this will be integrated with the factors identified by the user of the service.

Although this study contributes to relevant information, as it helps to identify patients with the potential to seriously underestimate their need for health services, investigating the factors related to their profiles and care circumstances that contribute to such underestimation, limitations should be recognized.

The first limitation identified in this research refers to the delimitation of data collection in a single medical counseling center based in Recife, Brazil, which provides medical telephone counseling services to users of public health systems and to users of health plans. Another limitation is that the demographic variable district/region was not included in this study, which could be useful to analyze its effect along with the other variables (days of the week, gender and age). And finally, the causes of underestimation have also not been researched and identified in this study.

Thus, for future work it is recommended to expand data collection in more than one medical counseling center in various locations including the district/region demographic variable. Another recommendation with regard to future studies refers to the evaluation of the causes that lead women to make most of the calls since the study did not show a statistically significant difference in the attitude of underestimation between the genders. Furthermore, the current format of the study does not consider what happened to the patient after the underestimation and neither the reason why proximity to the weekend increases the probability of a very critical underestimation, this being another recommendation. At last, it is recommended to replicate this study in other countries to identify differences and similarities in the behavior of people using the m-health service.

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