Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v46i1.65510

Mobile emergency care service in Floriano, Piauí: a golden time regression analysis

Matheus Halex Ferreira de Matos*, Emanuella Pereira Ribeiro, Julia Maria de Jesus Sousa, Ana Christina de Sousa Baldoino, Filipe Melo da Silva, Fernando Rocha dos Santos and Jailson Alberto Rodrigues

Universidade Federal do Piauí, BR-343, km 3,5, Bairro Meladão, 64800-000, Floriano, Piauí, Brasil. *Author for correspondence. E-mail: matheusferreira@ufpi.edu.br

ABSTRACT. To analyze the influence pattern of the defining variables that compose the Golden time developed by the Brazilian Mobile Emergency Care Service [*Serviço de Atendimento Móvel de Urgência*] (SAMU-192) in a municipality in Piauí. This is a documentary, descriptive study with a quantitative approach. A total of 337 medical records referring to the year 2018 were verified; data were collected at SAMU's decentralized base. A sphericity test was performed to verify the possibility of generating a linear model through Mauchly's test. Initially, an alpha below 0.46 was obtained, but the variables were negatively interfering in the model. After two more verifications, it was concluded that removing the variable did not influence the parsimony of the model. The generalized linear model showed statistical significance as to its fit (p-value<0.001) for the intercept and (p-value = 0.042) for the outcome variable – Golden time. It was possible to understand that SAMU is a viable action for first-aid efficiency and promptness, as well as for patient transport to appropriate reference services.

Keywords: Emergencies;emergency medical services; regression analysis.

Received on October 24, 2022.
Accepted on January 16, 2023.

Introduction

In the last two decades, Brazilian cities have been going through an intense and rapid process of urbanization and metropolization, without proper monitoring of policies particularly aimed at the safety and well-being of those who inhabit them. Among the problems related to this fact, a significant increase in deaths from external causes stands out, which include homicides, suicides, traffic accidents, drowning, etc. Such occurrences affect the male population aged between 15 and 39 years more intensely (Corrêa, Silva & Santiago, 2018).

Deaths from external causes are defined as trauma, injuries, or any health problems, whether intentional or unintentional, with a sudden onset. As of 1980, external causes became the second leading cause of death in Brazil, and the main one for individuals aged between 5 and 39 years old. This prominence has dragged on until the present day, alternating between the second and third cause of death in the country (Corrêa et al., 2018).

Data available in the Hospital Information System [*Sistema de Informações Hospitalares*] (SIH) of the Brazilian Unified Health System [*Sistema Único de Saúde*] (SUS), show that, in Brazil, trauma morbidity with external causes rose by 37.3% between 2002 and 2011, with a predominance of falls (41%) and traffic accidents (15%) (Lentsck, Sato & Mathias, 2019).

Nationwide, there has been an increase in the rate of mortality from external causes in the last 25 years. It is reported that, in 2000 and 2010, external causes accounted for 12.5% and 12.9% of deaths, respectively. Over the years, these types of death are the ones that most occur amongindividuals between 10 and 39 years of age and, currently, are also the leading cause of death among children from zero to nine years old (Batista, Barreto, Merino, Fracasso, & Baldissera, 2018).

One of the most important factors linked to the prognosis of a victim of injuries by external causes is the time elapsed between the event and the final care that this patient will receive, the so-called 'Golden Time'. It comprehends the first 60 minutes following the traumatic event (Golden Time), and this one-hour interval is defined as the time limit for first aid to be provided. Said term was coined by Dr. Adams Cowley, founder of one of the first trauma centers in the United States of America. He concluded that victims who received definitive assistance in a timely manner had a much higher survival rate than those cared for with some delay (Corrêa et al., 2018).

In this context, concerning what the scientific literature defends as to the reasons that influence response time in mobile pre-hospital care, and which interfere with the standard recommended by the 'Golden Time', is it actually implemented? And how does this happen? The objective of this work is to analyze the influence pattern of the defining variables that compose the Golden Time developed by Floriano's SAMU, in Piauí, Brazil.

Methodology

This is a documentary, descriptive study with a quantitative approach conducted in the city of Floriano, Piauí, between March 2020 and February 2021, at SAMU's decentralized base, in Floriano.

A total of 337 medical records referring to the year 2018 were verified, since this study derives from a developing research entitled 'GOLDEN TIME: An Analysis of the Response Time of Floriano's Mobile Emergency Care Service, PI'.

This study included records of urgent or emergency cases that occurred on urban public roads in the municipality, with a demographic made up of all genders and ages, as well as cases that required the presence of an Advanced Support Unit [*Unidade de Suporte Avançado*] (USA), Basic Support Unit [*Unidade de Suporte Básico*] (UBS), or the like. Moreover, situations that required clinical, obstetric, traumatic and psychiatric care were included.

The dependent variable of the study was the time spent by SAMU-192, from the call to the end of the assistance to the victim; sex, race, type of vehicle used, number of victims, age, event location, victim's state, nature of the occurrence, destination, and requested support will be included as the defining variables of the study.

Data were collected at SAMU's decentralized base in Floriano by nursing students who were instructed by the coordination of said service on how to behave there, where to search information, and how to do so.

A sphericity test was performed to check the possibility of generating a linear model through Mauchly's test. Subsequently, linear modeling was used, by means of the GLM (generalized linear model) technique. A 0.05 alpha level of statistical significance was taken as a reference for making the inferences, and the confidence intervals of the verified parameters were presented.

The project for carrying out this study was submitted to the Research Ethics Committee of the Federal University of Piauí [*Universidade Federal do Piauí*] (approved under legal opinion No. 96443518.4.0000.5660), in accordance with Resolutions No. 466/2012 and 510/2017 of the National Research Ethics Committee [*Comissão Nacional de Ética em Pesquisa*] – CONEP.

Results and discussions

The reliability analysis through Cronbach's alpha shows the reliability of the measures; initially, the alpha value stood below 0.46, but then, analyzing the influences of the factors, it was possible to notice that the pulse, temperature, blood glucose and blood pressure variables negatively influenced the alpha value, as shown in Table 1. Thus, these variables were removed, and a new model was produced, which presented an alpha of 0.63.

Table 1. Description of the influence of the factors in relation to the Golden Time, Floriano, PI, 2018.

Variables	Scale average if item is removed	Scale variance if item is removed	Fixed total item correlation	Cronbach's alpha if item is deleted
Golden Time	3718.74	3060878.974	.174	.442
Ambulance type	3774.30	3183413.786	.198	.458
Sex	3772.15	3170799.558	.051	.457
Age	3666.52	3149805.453	-.029	.472
Clinic	3715.60	3067662.702	.084	.452
Arrival conditions	3168.49	2594061.253	.224	.416
Destination hospital	3590.49	2525993.161	.412	.360
Accompanied	3551.96	2412595.836	.462	.336
Request for support	3510.92	2446364.939	.393	.356
Blood pressure	3625.17	2966904.157	.222	.431
Breathing	3261.53	2907375.759	.023	.488
Saturation	3596.05	2625312.451	.119	.464
Temperature	2939.41	2900618.876	.125	.446
Blood glucose	3191.91	3029658.914	-.024	.495

With the new model excluding the pulse, temperature, blood glucose and blood pressure variables, there was a sign that the age variable would have the greatest negative influence on parsimonious fit, as shown in Table 2. However, in the third stage of model fit verification, by suppressing the age variable, it is possible to notice that, even though the latter is having a negative influence on the alpha value, calculated in the previous fitting stage, there was no real change in Cronbach's alpha value, that is, removing the variable did not influence the parsimony of the model.

Table 2. Description of the influence of the factors in relation to the Golden Time, with variables weighting, as indicated in the model, Floriano, PI, 2018.

Variables	Scale average if item is removed	Scale variance if item is removed	Fixed total item correlation	Cronbach's alpha if item is deleted
Golden Time	1454.65	1895238.090	.213	.619
Ambulance type	1510.21	2014429.459	.134	.636
Sex	1508.06	2002519.322	.059	.634
Age	1402.43	1978676.198	-.034	.660
Clinic	1451.51	1875009.086	.146	.628
Arrival conditions	904.39	1399508.788	.327	.607
Destination hospital	1326.39	1350057.941	.571	.513
Accompanied	1287.86	1245526.704	.641	.482
Request for support	1246.82	1235318.533	.596	.496

With regard to the F test, run with the aim of assessing inter-class correlations in both model fitting stages, statistical significance was reached (p-value = 0.001), as shown in Table 3. Inter-class correlation coefficients use a definition of consistency in which the variance between measures is excluded from the denominator variation. This estimate is calculated considering that the interaction effect is absent, because it cannot be estimated otherwise.

Table 3. Distribution of inter-class correlations, in accordance with the Golden Time and the variables studied, Floriano, PI, 2018.

Stage 1	Intraclass correlation	95% Confidence Interval		F test with Real Value 0			
		Lower limit	Upper limit	Value	df1	df2	Sig
	.056a	.040	.077	1.837	335	4355	.000
	.456c	.366	.537	1.837	335	4355	.000
Stage 2	.157a	.125	.193	2.672	335	2680	.000
	.626c	.563	.683	2.672	335	2680	.000

When the data was linearly modeled, Maurchly's test resulted in significance (p-value =<0.001), evidencing the sphericity of the test, in which the null hypothesis is verified. As displayed in Table 4, the generalized linear model showed statistical significance as to its fit (p-value<0.001) for the intercept and (p-value = 0.042) for the outcome variable, Golden Time.

Table 4. Correlation of the Golden time effects, in accordance with the variables studied, Floriano, PI, 2018.

Origin	Type III Sum of Squares	df	Mean Square	Z	Sig.
Interception	137491968.279	1	137491968.279	627.058	.000
Golden Time	19894183.579	66	301427.024	1.375	.042
Error	58982313.055	269	219265.104		

The contrast test for the variables, presented in Table 5, indicates the presence of the intercept (factor 1), with the possibility of statistical significance in the fit in several models, namely; linear fit, cubic fit, fifth-order fit, and even twelfth-order fit. In the model where the dependent variable (Golden Time) was weighed by the intercept (factor 1), there would be a possibility of statistical significance only in the sixth-order and twelfth-order quadratic fits. However, this was not observed in the model when generalized linear fitting was performed.

Removing the variables, in accordance with the Chronbach's test run for the model, indicated parsimony in the general model, and the intercept remained significant, making it possible to infer that any of the models can be used and there will be no change in the significance of the test, as shown in Table 6.

Table 5. Description of the fit of the models, in accordance with the contrasts of the variables, Floriano, PI, 2018.

Origin	Intercept	Type III Sum of Squares	df	Mean Square	Z	Sig.
Intercept	Linear	41054871.791	1	41054871.791	288.707	.000
	Quadratic	27128.100	1	27128.100	.152	.697
	Cubic	7249116.529	1	7249116.529	57.428	.000
	Order 4	153263.534	1	153263.534	.833	.362
	Order 5	8202040.813	1	8202040.813	88.042	.000
	Order 6	878140.110	1	878140.110	7.920	.005
	Order 7	485767.461	1	485767.461	4.710	.031
	Order 8	7389808.866	1	7389808.866	61.948	.000
	Order 9	4781559.498	1	4781559.498	33.559	.000
	Order 10	104172.575	1	104172.575	.803	.371
	Order 11	17514635.171	1	17514635.171	135.056	.000
	Order 12	1548611.888	1	1548611.888	24.101	.000
Intercept * Golden	Linear	9163063.945	66	138834.302	.976	.533
	Quadratic	21323641.371	66	323085.475	1.806	.001
	Cubic	8747491.269	66	132537.747	1.050	.385
	Order 4	14631507.911	66	221689.514	1.205	.155
	Order 5	7024370.538	66	106429.857	1.142	.232
	Order 6	9927693.659	66	150419.601	1.357	.049
	Order 7	5991547.318	66	90781.020	.880	.728
	Order 8	8601161.413	66	130320.627	1.092	.309
	Order 9	8862765.706	66	134284.329	.942	.604
	Order 10	6291498.470	66	95325.734	.735	.932
	Order 11	10514869.147	66	159316.199	1.228	.132
	Order 12	6739307.352	66	102110.717	1.589	.006
Error(intercept)	Linear	38252540.544	269	142202.753		
	Quadratic	48122507.270	269	178894.079		
	Cubic	33955611.566	269	126229.039		
	Order 4	49485516.866	269	183961.029		
	Order 5	25060195.838	269	93160.579		
	Order 6	29825684.162	269	110876.149		
	Order 7	27743894.008	269	103137.152		
	Order 8	32089289.179	269	119291.038		
	Order 9	38327406.754	269	142481.066		
	Order 10	34897684.367	269	129731.169		
	Order 11	34885084.384	269	129684.329		
	Order 12	17284622.672	269	64255.103		

Table 6. Description of the fit of the models, in accordance with the Golden Time contrasts, based on variables weighting, Floriano, PI, 2018.

Origin	factor1	Type III Sum of Squares	df	Mean Square	Z	Sig.
factor1	Linear	12579551.653	1	12579551.653	72.279	.000
	Quadratic	3987217.850	1	3987217.850	52.854	.000
	Cubic	1371909.556	1	1371909.556	19.543	.000
	Order 4	2021341.321	1	2021341.321	29.740	.000
	Order 5	1427984.791	1	1427984.791	25.682	.000
	Order 6	703323.851	1	703323.851	13.108	.000
	Order 7	15203573.359	1	15203573.359	147.713	.000
factor1 * Golden time	Linear	18925760.369	66	286753.945	1.648	.003
	Quadratic	4296103.019	66	65092.470	.863	.760
	Cubic	5428861.005	66	82255.470	1.172	.193
	Order 4	4023441.885	66	60961.241	.897	.696
	Order 5	3980490.456	66	60310.461	1.085	.323
	Order 6	6289492.345	66	95295.339	1.776	.001
	Order 7	7243236.148	66	109746.002	1.066	.355
Error(factor1)	Linear	46817212.288	269	174041.681		
	Quadratic	20292961.903	269	75438.520		
	Cubic	18883840.283	269	70200.150		
	Order 4	18283428.733	269	67968.137		
	Order 5	14956999.515	269	55602.229		
	Order 6	14433378.141	269	53655.681		
	Order 7	27687246.940	269	102926.569		

Time spent in pre-hospital care is composed of several time frames dedicated to each stage of care. The length of pre-hospital care comprises: response activation (from the time of the call until arrival at the scene); on-scene time (interval used for care at the emergency location until the moment when those involved head to the hospital), and transport intervals (from when the ambulance leaves the scene until its arrival at the hospital) (Patel, Waters, Blanchard, Doig & Ghali, 2012).

This passing of time between the moment when the call is received and the team's arrival at the scene is made up of 4 intervals: call registration time, decision-making time, team's waiting or preparation time, and time spent heading to the location of the occurrence (Souza, Morabito, Chiyoshi & Iannoni, 2013).

The response time may increase as a function of the time used for note taking, the time used for the coordinating doctor to talk to the requester, lack of ambulances, the positioning of ambulances in the city's regions, and traffic conditions (Pitteri & Monteiro, 2011).

It is routine in pre-hospital care for patients to stay in hospitals occupying ambulance stretchers while waiting for a bed. In the meantime, the emergency vehicle and teams have their intervention limited, which interferes with care and impacts SAMU's response time to the demands received at the emergency regulation center (Silva & Nogueira, 2009).

The incipience of the physical structure, the scarcity of material and human resources, as well as of ambulances, the failures in the integration with other services pointed out deficiencies that compromise the performance and quality of the assistance provided by SAMU. Despite all the difficulties, the importance of this service to society must be acknowledged (Silva & Nogueira, 2009).

The total response time was one of the indicators of care quality highlighted in a study that analyzed the implementation of SAMU in five Brazilian capitals. It identified that promptness in the provision of care is influenced by the peculiar characteristics of each city; the shortest response time that was reported resulted from an estimate, thus suggesting little accuracy as to the information (Minayo & Deslandes, 2008).

It has been stated that indirect communication with the user, by phone, the way of speaking, what to say, what not to say, and how to conduct a dialogue, can affect the performance of medical regulation assistant technicians, and that the working conditions of SAMU's telephone operators may be influenced when the risk of death on the other end of the line is considered, which can be mitigated if they feel they are participants and useful to society (Vegian & Monteiro, 2011).

There are other "unforeseen" factors that happen, such as the slowness of computerized systems, inadequate information in the system, in addition to questions from clients that do not fit the imposed phraseology, clients' imperfect diction and irritation, external noise, etc. (Vilela & Asunción, 2004).

The time used in this stage of work is mentioned by Al-Shaqsi (2010), when the author argues that, in order to evaluate service performance, one must consider call processing and screening, in addition to stating that poor call and screening management influences the service time as a whole (Al-shaqsi, 2010).

The time of arrival at the scene can be influenced by several factors: geographic barriers and traffic conditions, situations of retention of teams in urgent services, which make teams unavailable while waiting for the patient to be received at the destination, location of addresses that are difficult to access, such as buildings, housing complexes, settlement zones, distances between the location of the ambulance and the addresses, as well as insufficient number of teams (Silva & Nogueira, 2012).

Conclusion

Analyzing the influence of the factors, it was possible to notice that the pulse, temperature, blood glucose and blood pressure variables negatively influenced the alpha value. These variables were removed, and another model was produced. The age variable would have the greatest negative influence; by removing said variable in the third stage, there was no real change in the alpha value, that is, removing this variable does not influence the parsimony of the model.

The present study made it possible to understand that the Mobile Emergency Care Service (SAMU-192) is a viable action for first-aid efficiency and promptness, as well as for patient transport to the appropriate reference services. The results above show that the mobile emergency care service in the municipality of Floriano meets the standard established by the Golden time.

The relevant limitation of the study was precisely the difficulty in finding studies addressing response-time indicators to elucidate the facts, which can be taken as a prospect for further research.

References

Al-Shaqsi, S. Z. K. (2010). Response time as a sole performance indicator in EMS: Pitfalls and solutions. *Open Access Emergency Medicine*, *2*, 1-6.

Batista, J., Barreto, M. S., Merino, M. F. G. L., Fracasso, N. V., & Baldissera, V. D. A. (2018). Perfil epidemiológico da mortalidade por causas externas entre beneficiários de planos de saúde no Brasil. *Revista de Enfermagem do Centro-Oeste Mineiro, 8*. DOI: https://doi.org/10.19175/recom.v8i0.1870

Corrêa, A.R., Silva, B. P. A. R., & Santiago, P. S. N. (2018). Atendimento pré-hospitalar: fatores facilitadores e dificultadores da assistência prestada por um grupo de regaste voluntário. *Revista de Enfermagem do Centro-Oeste Mineiro*, *8*. DOI: http://dx.doi.org/10.19175/recom.v7i0.2298

Lentsck, M.H., Sato, A.P.S. & Mathias, T.A.F. (2019). Epidemiological overview – 18 years of ICU hospitalization due to trauma in Brazil. *Revista de Saúde Pública, 53*(83) DOI: https://doi.org/10.11606/s1518-8787.2019053001178

Minayo, M. C. D. S., & Deslandes, S. F. (2008). Análise da implantação do sistema de atendimento pré-hospitalar móvel em cinco capitais brasileiras. *Cadernos de Saúde Pública, 24*(8), 1877-1886. DOI: https://doi.org/10.1590/S0102-311X2008000800016

Patel, A. B., Waters, N. M., Blanchard, I. E., Doig, C. J., & Ghali, W. A. (2012). A validation of ground ambulance pre-hospital times modeled using geographic information systems. *International Journal of Health Geographics*, *11*(1), 1-10. DOI: https://doi.org/10.1186/1476-072X-11-42

Pitteri, J. S. M., & Monteiro, P. S. (2011). Caracterização do serviço de atendimento móvel de urgência (SAMU) em Palmas-Tocantins, Brasil, em 2009. *Comunicação em Ciências da Saúde, 21*(3), 227-236.

Silva, N. C., & Nogueira, L. T. (2012). Avaliação de indicadores operacionais de um serviço de atendimento móvel de urgência. *Cogitare Enfermagem, Curitiba, 17*(3), 471-477. DOI: http://dx.doi.org/10.5380/ce.v17i3.29287

Souza, R. M. D., Morabito, R., Chiyoshi, F. Y., & Iannoni, A. P. (2013). Análise da configuração de SAMU utilizando múltiplas alternativas de localização de ambulâncias. *Gestão & Produção, 20*(2), 287-302. DOI: https://doi.org/10.1590/S0104-530X2013000200004

Vegian, C. F. L., & Monteiro, M. I. (2011). Condições de vida e trabalho de profissionais de um Serviço de Atendimento Móvel de Urgência. *Revista Latino-Americana de Enfermagem, 19*(4), 1018-1024. DOI: https://doi.org/10.1590/S0104-11692011000400022

Vilela, L. V. D. O., & Assunção, A. Á. (2004). Os mecanismos de controle da atividade no setor de teleatendimento e as queixas de cansaço e esgotamento dos trabalhadores. *Cadernos de Saúde Pública, 20*(4), 1069-1078. DOI: https://doi.org/10.1590/S0102-311X2004000400022