Influence of Medical Coverage on the Treatment and Prognosis of ST-segment Elevation Myocardial Infarction. SCAR Registry Subanalysis

Influencia de la cobertura médica sobre el tratamiento y el pronóstico del infarto con supradesnivel del ST. Subanálisis del registro SCAR

HERNÁN COHEN ARAZI[MTSAC], PATRICIA BLANCO[MTSAC], CLAUDIO HIGA[MTSAC], STELLA MARIS MACÍN, MAURO GARCÍA AURELIO, GABRIEL DIONISIO, GASTÓN GÓMEZ, JIMENA FERRARI

ABSTRACT

Background: The Acute Coronary Syndromes in Argentina (SCAR) registry analyzed in-hospital myocardial infarction outcome in patients with different medical coverage provided by the healthcare system; this has led to the present subanalysis derived from the SCAR registry.
Objective: The aim of this study was to determine the influence of medical coverage on myocardial infarction in-hospital prognosis.
Methods: The SCAR registry was a cross-sectional, prospective, multicenter study including 476 patients with ST-segment elevation acute myocardial infarction (STEMI). Medical coverage was classified in prepaid health insurance, social security insurance, PAMI and without medical coverage (except public coverage).
Results: Eighty percent of STEMI patients received reperfusion therapy, 75% by primary transluminal coronary angioplasty (PTCA). PTCA was more frequent in those with prepaid health insurance [OR 5.5 (2.5-12.4); p<0.001] and less frequent in PAMI patients [OR 0.47 (0.24-0.87), p=0.02] or in those without any medical coverage [OR=0.34 (0.2-0.6), p<0.001].Thirteen percent of patients were transferred to another hospital, more frequently if they were PAMI patients (p=0.002). Time to PTCA was longer in PAMI patients [240 (88-370) min, p=0.0005] and shorter in patients with prepaid health insurance [80 (42-120) min, p<0.001]. Overall in-hospital STEMI mortality was 8%, 2.8% in patients with prepaid health insurance, 4.3% in patients with public medical coverage, 6.88% in patients with social security insurance and 25% in patients covered by PAMI (ANOVA <0.001). Mortality was significantly lower in patients with prepaid health insurance [OR=0.27 (0.08-0.91), p=0.035] and higher in PAMI patients, even after adjusting by sex, age and comorbidities [OR 2.40 (1.1-5.8), p=0.05].
Conclusion: STEMI treatment and mortality were different according to the type of medical coverage.

Key words: Myocardial Infarction/therapy - Myocardial Infarction/mortality - Health service coverage

RESUMEN

Introducción: El registro sobre Síndromes Coronarios Agudos en Argentina (SCAR) analizó la evolución intrahospitalaria del infarto de miocardio en nuestro país en pacientes que contaban con diferentes coberturas del sistema de salud, lo cual ha llevado al presente subanálisis derivado del registro SCAR.
Objetivo: Determinar la influencia de la cobertura médica en el pronóstico intrahospitalario del infarto de miocardio.
Material y métodos: El registro SCARfue un estudio transversal, prospectivo y multicéntrico, que incluyó 476 pacientes con diagnóstico de infarto agudo de miocardio con supradesnivel del segmento ST (IAMST). La cobertura médica se diferenció en prepaga, obra social, PAMI y sin cobertura (solo estatal).
Resultados: El 80% de los IAMST recibieron reperfusión, el 75% por angioplastia transluminal coronaria primaria (ATCP). La ATCP fue más frecuente en quienes tenían prepaga [OR 5,5 (2,5-12,4); p < 0,001] y los pacientes con PAMI [OR 0,47 (0,24-087); p = 0,02] o sin cobertura recibieron menos ATCP[OR 0,34 (0,2-0,6); p < 0,001]. El 13% fueron derivados a otro centro, más frecuentemente si tenían PAMI (p = 0,002). El tiempo hasta la ATCP fue mayor en pacientes con PAMI [240 (88-370) min; p = 0,0005] y menor si tenían prepaga [80 (42-120) min; p < 0,001]. La mortalidad intrahospitalaria del IAMST fue del 8%, 2,8% con prepaga, 4,3% con cobertura estatal, 6,88% con obra social y 25% con PAMI (ANOVA < 0,001). Tener prepaga se asoció con una mortalidad menor [OR 0,27 (0,08-0,91); p = 0,035] y tener PAMI se asoció con una mortalidad mayor, aun ajustado por sexo, edad y comorbilidades [OR 2,40 (1,1-5,8); p = 0,05].
Conclusión: El tratamiento y la mortalidad del IAMST fueron diferentes según la cobertura médica.

Palabras clave: Infarto del miocardio/tratamiento - Infarto del miocardio/mortalidad - Cobertura de servicios de salud

Abbreviations

ACS	Acute coronary syndrome	**SAC**	Argentine Society of Cardiology
AMI	Acute myocardial infarction	**SCAR**	Acute Coronary Syndrome Registry in Argentina
PAMI	Integral Medical Care Program	**STEMI**	ST-segment elevation acute myocardial infarction
PTCA	Primary transluminal coronary angioplasty		

INTRODUCTION

Some reports suggest that socio-economic (1) and cultural (2) conditions could influence the prognosis of acute myocardial infarction (AMI). On the other hand, several studies have assessed the relationship between health coverage and treatment strategies and outcome in acute coronary syndromes (ACS). (3-5)

The Argentine healthcare system includes 38% medical coverage by social security insurance, 12% by the Integral Medical Care Program (PAMI) of the National Institute of Social Services for Retirees and Pensioners and 10% by prepaid health insurance. Finally, there are approximately 40% of individuals who only have access to public hospital care, with State funding.

The Acute Coronary Syndrome Registry in Argentina (SCAR) was designed to analyze ACS in-hospital prognosis in our country. In previous SCAR publications, myocardial infarction clinical, therapeutic and outcome characteristics were evaluated. (6) The aim of this subanalysis was to assess whether there were differences in the treatment and prognosis of ST-segment elevation AMI (STEMI) according to medical coverage.

METHODS

The SCAR Registry was a cross-sectional, prospective, multi-center study conducted by the Research Area and the Council for Cardiovascular Emergencies of the Argentine Society of Cardiology (SAC). Data were collected in a database by researchers associated to SAC centers across the country and sent on paper or through the web. The study included patients diagnosed with STEMI according to the definitions described in the original paper, (6) who were admitted to the critical care units of 87 centers: 35 (41%) from the Autonomous City of Buenos Aires, 15 (17%) from the Greater Buenos Aires and 37 (42%) from the rest of the country. In 55.22% of these centers there was a training system for medical residents, 77.3% had a hemodynamic service (95% with 24-hour availability) and 74.3% had a cardiovascular surgery service. Patients were consecutively recruited over a period of three months, between March and October 2011, while the registry was active. Patient's medical history, risk factors and clinical outcomes, laboratory results, established treatment and in-hospital outcome were recorded. This study classified medical coverage to analyze its influence on the results.

Statistical analysis

Continuous variables are expressed as mean±standard deviation or median and interquartile range; according to their normal or non-normal distribution. Student's t-test, the Kruskal Wallis test, the Wilcoxon rank-sum test or ANOVA were used for comparison, as applicable. Normality was tested using the Shapiro-Wilk test. For the regression analysis a simple logistic regression model was manually initiated to obtain the raw coefficients. For continuous variables the linearity assumption was confirmed. The selected variables were then included in a multiple logistic regression model, and those variables that modified the coefficients>10% or with p <0.10 were considered significant. In the final model, p <0.05 was considered statistically significant. Each model variable was evaluated by the Wald test and the likelihood ratio test, and by the variation of the coefficient with respect to the one estimated for that variable in the simple model.

All analyses were performed using STATA 9.0 (STATA Corporation, College Station, TX®) statistical package.

Ethical considerations

The study was conducted according to the Good Clinical Practice Guidelines and data protection law of Argentina. The protocol was approved by SAC's Ethics Committee. An informed consent was not necessary for inclusion in the registry as no personal data or monitoring was required, in agreement with the national Personal Data Protection Law 25.326 (Habeas Data law).

RESULTS

The study included 476 patients diagnosed with STEMI whose baseline characteristics are described in Table 1. Sixty-two patients (13%) did not own a property and 42% of these patients had no medical coverage. Among patients who did not own their house, lack of medical coverage was more frequent [OR 3.6 (2-6.6), p <0.001]. There was a difference with the 414 patients who owned a house, car or both, and in 83% of cases had some type of medical coverage (p=0.056). One hundred and seventeen patients (26%) were retired, 19 (4%) unemployed and the rest were housewives or active workers. Thirty-eight percent of retired patients had PAMI, 39% social security insurance, 18% prepaid health insurance, and 5% had no coverage. PAMI patients were older (73±10 years vs. 59±11.6 years, p <0.001), with higher prevalence of women (48% vs. 21%, p <0.001) and had greater history of heart failure (11 vs. 1.8%, p <0.001). Three hundred and eighty patients (80%) received reperfusion therapy. Having PAMI was associated with lower reperfusion therapy [OR = 0.47 (0.26-0.85), p=0.02].
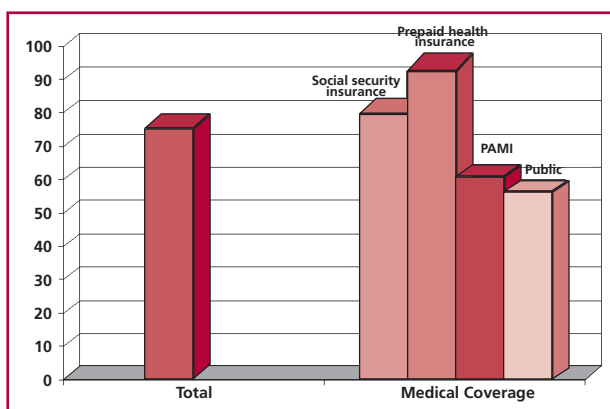
Primary transluminal coronary angioplasty (PTCA) accounted for 75% of reperfusions (Figure 1). This strategy was more common in those with prepaid health insurance [OR 5.5 (2.5- 12.4), p <0.001] compared with PAMI or without coverage patients.

Time from pain onset to hospital admission was 120 (60-330) minutes (Figure 2) and time since patient admission to the first healthcare center and PTCA was 104 (60- 230) minutes. Comparing PAMI

Table 1. Population characteristics

	STEMI (n= 476)
Age, mean±SD	61 ± 12.3
Male gender, %	75
BMI, mean±SD	27.9 ± 4.62
Diabetes, %	20
Insulin diabetes, %	11
Current smoker, %	42
Ex-smoker, %	22
Dyslipidemia, %	51
Family history, %	20
Hypertension, %	63
Previous AMI, %	13
Previous coronary angioplasty, %	10
Previous myocardial revascularization surgery, %	2
Hospitalization for heart failure, %	3
Chronic obstructive pulmonary disease, %	6.11
Stroke, %	3
Known coronary obstructions> 50%, %	18%
Chronic heart failure, %	2.36
Peptic ulcer, %	3.24
History of hemorrhage, %	2.14
Antiplatelet medication, %	29
ACEI or ARA II, %	39.3
Statins, %	18
Betablockers, %	25.2
Marital status (%)	
- married/couple	72
- widow	10
- separated/divorced	7
- single	6
Education level (%)	
- secondary	36
- tertiary/university	21.4
- primary	28.4
- illiterate	1.3
Occupation (%)	
- active worker	64
-retired	25
- unemployed	4
Properties (%)	
- house	36
- car	6
- house and car	45
- none	13
Medical coverage (%)	
- Social security insurance	42
- Prepaid health insurance	24
- PAMI	14
- Public	20

STEMI: ST-segment elevation acute myocardial infarction. SD: Standard deviation. BMI: Body mass index. AMI: Acute myocardial infarction. ACEI: Angiotensin-converting-enzyme-inhibitor. ARA II: Angiotensin II receptor antagonist. PAMI: Integral Medical Care Program.

Fig. 1. Percentage of transluminal coronary angioplasty according to medical coverage. PAMI: Integral Medical Care Program.

with prepaid health insurance, time to PTCA was lower if they had prepaid health insurance, 80 (42-120) minutes, and higher if they had PAMI, 240 (88-370) minutes, p<0.001 (Figure 3). Sixty-two patients (13%) were referred to another center, more often if they had PAMI (p=0.002): 24.6% of PAMI vs. 10% of social security insurance patients (p=0.04), 6% of prepaid health insurance patients (p=0.05), and 16% of those with no medical coverage (p=0.64). The most common reasons for referral were medical coverage (18%) and the search for hemodynamic centers (66%).

In-hospital mortality due to STEMI was 8% in the SCAR registry. Mortality was different according to health coverage: 2.8% in patients with prepaid health insurance, 4.3% with public medical coverage, 6.88% with social security insurance and 25% with PAMI (ANOVA p<0.001; prepaid health insurance vs. social security insurance p=0.16, prepaid health insurance vs.public medical coverage p<0.001, and prepaid health insurance vs. PAMI p=0.001). Prepaid health insurance was associated with lower mortality [OR 0.27 (0.08- 0.91), p=0.035] and conversely, PAMI was associated with higher mortality [OR 6 (2.93-12.3) p≤0.001].

A multivariate analysis was performed to adjust PAMI patients by age, gender and comorbidities. The variables associated with higher mortality are shown in Table 2. After adjusting for these variables in the multivariate analysis, PAMI was associated with increased mortality, although in the significance limit (OR 2.40 (1.1-5.8), p=0.05) (Table 2).

During PTCA, TIMI 2/3 flow grade was achieved less frequently in PAMI patients (81%) compared to other medical coverage (95%, p<0.001). In the 7 patients in whom PTCA was performed within 120 minutes after admission, TIMI 2/3 flow was achieved; however, in 25% of patients who underwent angioplasty after more than 120 minutes, this level of recanalization (p=0.14) was not attained. When TIMI 2/3 flow was not achieved, mortality was higher (OR7.6 (1.07-54), p=0.04).
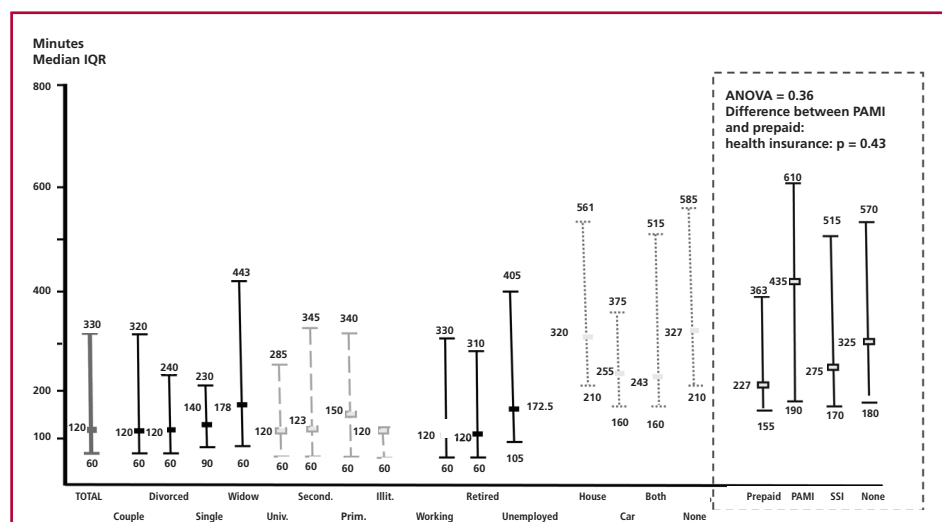
Fig. 2. Time from onset of pain to admission (minutes). IQR, interquartile range. PAMI: Integral Medical Care Program. Univ: University. Second.: Secondary. Prim.: Primary. Illit.: Illiterate. SSI: Social Security Insurance.

Fig. 3. Time from patient admission to the first healthcare center to primary transluminal coronary angioplasty (minutes). IQR: Interquartile range. PAMI: Integral Medical Care Program. Univ.: University. Sec.: Secondary. Prim.: Primary. Illit.: Illiterate. SSI: Social Security Insurance.

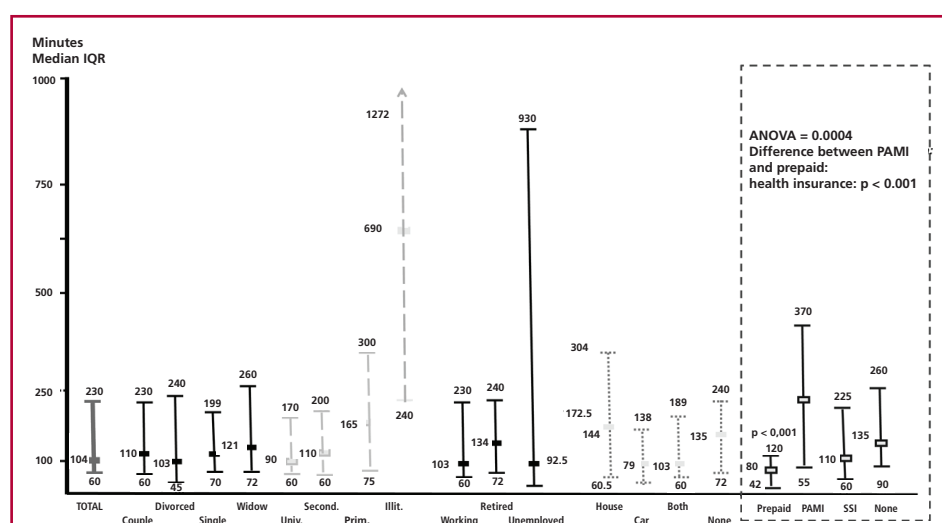## DISCUSSION

Some international studies attempted to explain the probable relationship between social and personal aspects and ACS prognosis; for example, people who had never married had 2.8 times higher in-hospital mortality after AMI, probably due to factors related to increased attention to health, regular health controls and healthy habits among those living with a partner. (7) The education level also identified prognostic differences during the initial and long-term AMI stages; in the less educated mortality was up to 3 times higher. (2)

Medical coverage was crucial for the treatment and outcomes of AMI. (8)

Our study shows a difference in access to revascularization procedures and in-hospital outcome for STEMI according to medical coverage. Patients with prepaid health insurance had more PTCA intervention and with faster reperfusion times and PAMI patients received less PTCA and with excessively long reperfusion times. Mortality was 6 times higher in the

latter group regardless of age and comorbidities.

The relationship between economic problems and the impact on healthcare is a constant concern. A study performed in Brazil found an increased death gradient according to socioeconomic status, and in women there was greater risk of AMI in the most deprived group (RR=1.93, 95% 1.79-2.07). Differences in health controls, diet and physical activity can partially explain these observations; however, less access to emergency care can intensify these differences (9). In the US, the expansion of healthcare coverage reduced mortality (10), but in France the universal medical coverage (Couverture Médicale Universelle Complémentaire, CMUC) showed that similar results could be obtained only when all patients had the opportunity of being treated in the same institutions with the same therapeutic procedures all over the country. (3)

Epidemiological studies of the American Public Health Department showed that despite ensuring an expanded medical coverage, there are still benefits in

Table 2. Variables associated with mortality

Variable	OR (95% CI)	p
-Age	1.08 (1.05-1.1)	0.001
-Female gender	2.2 (1.11-4.5)	0.023
-Hypertension	2.15 (0.96-4.8)	0.06
-Smoking	0.37 (0.17-0.84)	0.018
-Heart failure	15.1 (5-46)	0.001
-Systolic blood pressure at admission	0.98 (0.97-0.99)	0.001
-Glycemia at admission	1.006 (1.002-1.01)	0.001
-Coronary angioplasty within 90 minutes	0.34 (0.11-0.98)	0.04
Mortality multi variate analysis		
PAMI coverage	2.40 (1.1-5.8)	0.05
Age	1.06 (1.02-1.1)	0.001
Previous heart failure	8.45 (2.43-29.37)	0.001

PAMI: Integral Medical Care Program.

the type of care received during AMI when patients have private coverage, which are associated with better survival. (11) Something similar was observed in the universal healthcare system in Canada, where, despite efforts to improve access to major coronary procedures, there was a big difference in specialized cardiology services in Ontario according to patient purchasing power; people with lower income had limited access to invasive procedures and higher AMI mortality per year. (1)

In Latin America, the socio-economic situation, sub-optimal medical training, assistance pressure exerted by healthcare administrations,investment in the doctor-nurse ratio, the restriction on resource availability and quality of available resources, are all factors that could explain the differences in mortality compared to other regions (12). Our country has had the misfortune of recurrent economic and financial crises that have exercised a direct negative impact on mortality (13) and have undoubtedly impaired healthcare quality. The SCAR registry showed a reduction in mortality compared to that observed in 1999 (14), yet higher than expected, considering that it included patients from high complexity centers and with a high percentage of reperfusions performed by PTCA. This does not reflect the reality of the whole of Argentina, but perhaps only of the segment with better chances of successful outcomes.

Analyzing medical coverage, it could be seen that patients with prepaid healthcare insurance had faster access to PTCA, which seems related to significantly lower in-hospital mortality (2.8%). On the contrary, it is more complex to explain unequivocally the results observed in PAMI patients. The reason for the greater number of referrals to other centers considering the proved relationship between delay and mortality should also be assessed. PAMI is a capitation system that provides comprehensive health coverage to 4.5

million beneficiaries who have free choice of providers corresponding to their jurisdiction, with the possibility of changing every 6 months. With the information available in the SCAR registry, conclusions about the reasons for delays within the healthcare system cannot be obtained. These results, however, reinforce the need to revise circuits to avoid delays, and unnecessary (15) or remote transfers which may result in myocardial loss and even loss of the opportunity for reperfusion, thus leading to increased mortality (16).

Limitations

Study limitations emphasize that only centers associated to the SAC agreeing to participate were included in the registry, limiting the possibility of extrapolating data to the whole country. Furthermore, no long-term monitoring was performed.

CONCLUSION

This analysis shows that healthcare coverage may be related to differences in the treatment received in STEMI which could influence in different ways on AMI prognosis. It is important to work in improving global healthcare without neglecting compliance with quality indicators that impact on the prognosis.

Conflicts of interest

None declared
(See author´s conflicts of interest forms in the web / Supplementary Material)

REFERENCES

1. Alter DA, Naylor CD, Austin P, Tu JV. Effects of socioeconomic status on access to invasive cardiac procedures and on mortality after acute myocardial infarction. N Engl J Med 1999;341:1359-67. http://doi.org/fkzs53

2. Ruberman W, Weinblatt E, Goldberg JD, Chaudhary BS. Education, psychosocial stress and sudden cardiac death. J Chron Dis 1983;36:151-60. http://doi.org/bn7zdr

3. Danchin N, Neumann A, Tuppin P, De Peretti C, Weill A, Ricordeau P, et al. Impact of free universal medical coverage on medical care and outcomes in low-income patients hospitalized for acute myocardial infarction: an analysis from the French National Health Insurance System. Circ Cardiovasc Qual Outcomes 2011;4:619-25. http://doi.org/dzrtbg

4. Hanley GE, Morgan S, Reid RJ. Income-related inequity in initiation of evidence-based therapies among patients with acute myocardial infarction. J Gen Intern Med 2011;26:1329-35. http://doi.org/cf5h8v

5. Cohen Arazi H, Higa C, Blanco P, Nani S, Fernández H, Hirschson A, et al. Mortality in myocardial infarction remains high in Argentina: The association with health insurance coverage. IJC Metab Endocr 2014;4:18-22. http://doi.org/6d3

6. García Aurelio MJ, Cohen Arazi H, Higa C, Gómez Santa María HR, Mauro VM, Fernández H et al. Acute Myocardial Infarction with Persistent ST-segment Elevation. SCAR (Acute Coronary Syndromes in Argentina) Multicenter Registry from the Argentine Society of Cardiology. Rev Argent Cardiol 2014;82:275-84. http://doi.org/4wz

7. Panagiotakos DB, Pitsavos Ch, Kogias Y, Mantas Y, Zombolos S, Antonoulas A, et al. Marital status, depressive episodes, and short-term prognosis of patients with acute coronary syndrome: Greek study of acute coronary syndrome (GREECS). Neuropsychiatr Dis Treat 2008;4:425-32. http://doi.org/c62q85

8. Shen JJ, Wan TT, Perlin JB. An exploration of the complex relationship of socioeconomic factors in the treatment and outcomes of acute myocardial infarction in disadvantaged populations. Health

Serv Res 2001;36:711-32.
9. Belon AP, Barros MBA, Marin-León L. Mortality among adults: gender and socioeconomic differences in a Brazillian city. BMC Public Health 2012;12:39. http://doi.org/fzv57r
10. Sommers BD, Baicker K, Epstein AM. Mortality and access to care among adults after state Medicaid expansions. N Engl J Med 2012;367:1025-34. http://doi.org/6dw
11. Fang J, Alderman MH. Does supplemental private insurance affect care of medicare recipients hospitalized for myocardial infarction? Am J Public Health 2004;94:778-82. http://doi.org/fjzd7x
12. Cohen MG. Latin America in international clinical trials. Where is the difference? Is it in the patients, the physicians, or the system? Rev Argent Cardiol 2003;71:6-15.
13. Gurfinkel EP, Bozovich GE, Dabbous O, Mautner B, Anderson F. Socioeconomic crisis and mortality. Epidemiological testimony of the financial collapse of Argentina.Thromb J 2005;3:22. http://doi.org/ckg579
14. Kevorkian R, Blanco P, Ferreirós E, Higa C, Gitelman P, Zylbersztejn H et al, en representación de los investigadores del Registro IAM-1999, de los miembros del Área de Investigación de la Sociedad Argentina de Cardiología y de la Sociedad Argentina de Cardiología. AMI 1999 - Registry. Rev Argent Cardiol 2001;69:488-500.
15. Iwashyna TJ, Kahn JM, Hayward RA, Nallamathu BK. Interhospital transfers among beneficiaries admitted for acute myocardial infarction at non revascularization hospitals. Circ Cardiovasc Qual Outcomes 2010;3:468-75. http://doi.org/b8ksp3
16. Wood FO, Leonowicz NA, Vanhecke TE, Dixon SR, Grines CL. Mortality in patients with ST-segment elevation myocardial infarction who do not undergo reperfusion. Am J Cardiol 2012;110:509-14. http://doi.org/6dx