Ischemic Heart Disease Lethalities in the State of Rio de Janeiro Between 1999 and 2003

Gláucia Maria Moraes de Oliveira, Carlos Henrique Klein, Nelson Albuquerque de Souza e Silva,
Paulo Henrique Godoy, Tânia Maria Peixoto Fonseca

*Faculdade de Medicina da Universidade Federal do Rio de Janeiro, Escola Nacional de Saúde Pública – Fiocruz,
Secretaria de Estado de Saúde do Rio de Janeiro - Rio de Janeiro, RJ - Brazil*

OBJECTIVE

To estimate the lethality rate of acute and chronic ischemic heart disease (IHD) procedures, coronary artery bypass graft (CABG) procedures and percutaneous transluminal coronary angioplasty (PTCA) procedures in the hospitals that are registered as service providers for the Hospital Information System / Single Healthcare System (SIH/SUS) plan in the state of Rio de Janeiro (RJ) between 1999 and 2003.

METHODS

The procedures considered as CABGs and PTCAs were provided by Datasus (SUS databank). The rates were standardized in accordance with gender, age, and disease severity. The common factors among these procedures are that they are highly complex cardiovascular procedures performed in RJ in the year 2000. The IHD groups are: angina, acute myocardial infarction, other acute IHDs and chronic IHDs.

RESULTS

Lethality rates for angina, acute myocardial infarction (AMI), other acute and chronic IHDs were 2.8%, 16.2%, 2.9% and 3.9%, respectively, in RJ. The lethality rates for CABG and PTCA, adjusted by age, sex and diagnostic groups, were elevated ranging from 1.9% to 12.8% for CABG procedures and as high as 3.2% for PTCA. When medical therapy was performed the rates were 2.3% for CABG and 11.1% for PTCA.

CONCLUSION

There has been a progressive increase in the number of CABG and PTCA procedures to treat IHDs in RJ. Lethality rates were above the desirable level, mainly for chronic IHD hospital admissions (5.4% and 1.7%, respectively). Optimized medical therapy appears to be a worthwhile therapeutic option, reserving CABG and PTCA procedures for the cases with the worst prognoses. Lethality rates for AMI with medical therapy was comparable to current rates when thrombolytics were not used (16.7%).

KEY WORDS

ischemic heart diseases, hospital lethality, coronary artery bypass graft, percutaneous transluminal coronary angioplasty, Rio de Janeiro

The hospital admission authorization records are currently the best tools available to evaluate data related to hospital admissions at the health care facilities (diagnoses, expenditures, procedures and hospital lethality rates, among others). Although created as a payment system for hospital services rendered, it can and has been used also as a source of useful health information for management decisions. Improvements in the quality of the information depends to a large extent on whether or not the health professionals understand the importance of adequately completing the forms that are used as an information source[1].

There are two sets of admission data that can be used to study cardiovascular disease lethality rates: hospital admission authorizations for the hospital service providers and hospital admission authorizations paid to these facilities. The difference between the two sets is that the hospital admissions for the service providers contain data that have not yet passed through all the critical review channels of the Hospital Information System of the Single Healthcare System (SIH-SUS), including the reliability of the data and the availability of financial funding. In the second set, the paid hospital admissions, the information has already passed through the critical review process and effectively represents admission expenditures[1].

In the mid 1990's it was estimated that in Brazil, 80% of medical and hospital assistance was provided by SUS[2]. From 1999 to 2003 in the state of Rio de Janeiro (RJ), SUS expenditures for hospital admissions due to all causes were on average 191 million US dollars per year. This figure represented a yearly expenditure of US$ 13.20 per inhabitant of which 60 cents were spent on admissions for ischemic heart diseases (IHD). In 1997, 3.3% of the SUS hospital admission expenditures in Brazil were for IHDs[2], while in the state of RJ expenditures for IHDs between 1999 and 2003 represented 4.6% [1].

Highly complex procedures (HCPs) account for almost 70% of the average annual admission expenditures of 8.7 million US dollars for IHD hospital admissions. In one fifth of IHD admissions HCPs were performed. From the total number of HCPs for IHDs, 37% were for surgical coronary artery bypass grafts (CABG) and 62% for percutaneous transluminal coronary angioplasty (PTCA)[1].

These data confirm the social importance of cardiovascular diseases (CVD) for SUS. A higher level of medical knowledge concerning the cases admitted to the hospital can provide managers with the required information to minimize this problem.

The purpose of this study was to estimate the lethality rates of IHDs and the most frequently used HCPs: CABG and PTCA in the state of Rio de Janeiro, between 1999 and 2003, using the hospital admissions paid by SIH/SUS as the data source.

METHODS

All data presented in this study were taken from the records of the hospital admissions paid by SUS in the state of Rio de Janeiro (RJ), between 1999 and 2003. All observations made in this study regarding IHD patient care refer exclusively to services supplied by SUS.

The CABG procedures, excluding those in which there were valve replacements (32011016, 32038011, 32039018 and 32040016) and PTCA procedures (32023014 and 32035012) were selected from the Datasus databank for hospitals that have performed one hundred or more interventions[3]. We prefer to not identify the hospitals by means of letter codes, nature, nor location, since the disclosure of these characteristics would be enough to identify them due to their small number.

Lethality rates were adjusted using log-poisson models that consider the effects of age (year to year), gender and IHD diagnostic group of the patients in a manner that any remaining differentials are attributed to other factors.

The IHD groups are: angina (CID-10 I20), acute myocardial infarction (CID-10 I21 to I23), other acute IHDs (CID-10 I24) and chronic IHDs (CID-10 I25)[4].

RESULTS

The total number of admissions paid by SUS between 1999 and 2003 was reduced from approximately one million in the first year to roughly 881 thousand in the last year. However, the number of IHD admissions in this timeframe increased from 12,200 to 14,500, which is equivalent to an increase in the IHD admission ratio from 1.2% in the first year to 1.6% in the last year.

From the total of 68,375 IHD admissions during the study period, 41.3% were diagnosed with angina pectoris, 34% with acute myocardial infarction and 10.6% within the scope of the chronic IHD classification.

The quantity and expenditure ratios for HCPs performed on patients admitted for IHDs revealed an even greater impact for the study period. Consequently, if in 1999 HCPs were performed on 16% of the IHD admissions with a relative expenditure rate of 66%, in 2003 these ratios increased to 25% and 79%, respectively.

From the total number of IHD admissions, 7.4% were admitted for coronary artery bypass grafts and 12.4% for coronary angioplasty. In the acute myocardial infarction cases, 1.4% underwent surgical revascularization and 3.4% underwent coronary angioplasty. In the cases of angina pectoris and other acute IHDs, 17.6% underwent revascularization procedures and for chronic IHDs 79.1%.

Overall hospital lethality rates for IHD admissions, authorized by SUS in the state of RJ during the study period, were 7.5 deaths for every 100 admissions. This death risk varied considerably depending on the corresponding

IHD disease group as classified by the International Classification of Diseases (CID-10). Table 1 shows the lethality rates according to the IHD disease group and the therapeutic procedures adopted for the admissions.

The lethality rates for the IHD groups range from a little less than 3% for angina and other acute IHD diagnoses, excluding AMI, to 4% for chronic IHDs to 16.7% for acute myocardial infarctions (AMI).

Overall lethality rates for CABG were 7.5%, and for PTCA 1.7%. These indices also vary in accordance with the IHD group. CABG lethality rates for angina admissions were the highest with one death in every 10.6 surgeries. Even for chronic IHDs the lethality rate reached 5.4%. It is worth emphasizing that the lowest hospital lethality

rate was for the diagnosis of AMI (5.2%).

The hospital lethality rate for PTCAs varied from 0.8% for angina pectoris to 1.1% for other acute IHDs, to 1.7% for chronic IHDs, to 6% for AMIs.
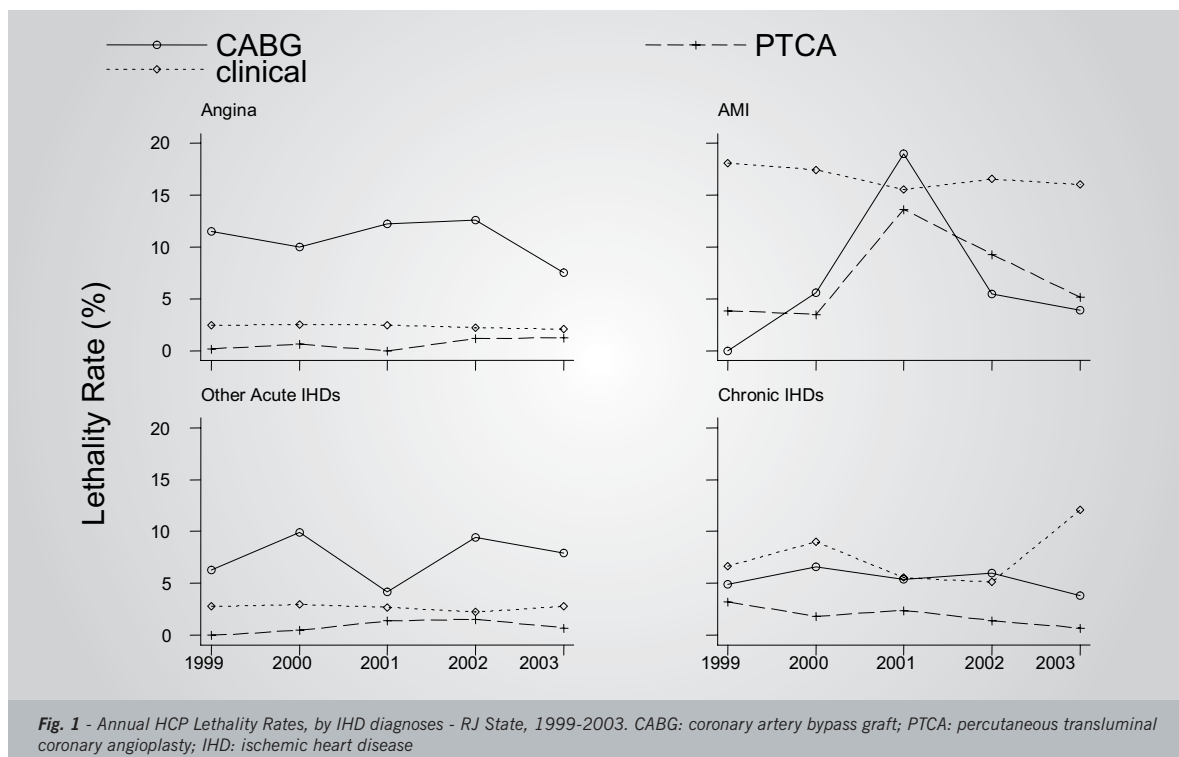
A closer analysis of these lethality rates examines the evolution of these indices throughout the study period. Figure 1 shows the lethality rate trends for HCPs (CABG and PTCA) and for the medical treatments for the four IHD diagnostic groups.

The PTCA lethality rates for angina pectoris diagnoses varied from 0.2% to 1.3% during the study period, while the rates for other acute IHD diagnoses varied from 0% to 0.7%. PTCA lethality rates for chronic IHD diagnoses revealed a progressive downward trend from 3.2% to

Table 1 – Gross lethality rates, by hundreds, in IHD admissions according to IHD group and therapeutic procedures in the hospitals in the state of RJ (SIH/SUS) between 1999 and 2003

Procedures IHD Group	Revascularization*		Angioplasty		Others (clinical)**		Total (Procedures)***	
	Lethality (%)	n	Lethality (%)	n	Lethality (%)	n	Lethality (%)	n
Angina	10.6	1,842	0.8	2,977	2.4	23,394	2.8	28,245
AMI	5.2	3,30	6.0	803	16.7	22,095	16.2	23,308
Other Acute	7.5	708	1.1	1,133	2.7	7,599	2.9	9,507
Chronic IHD	5.4	2,216	1.7	3,565	6.9	1,517	3.9	7,315
Total (IHD)	7.5	5,096	1.7	8,478	8.3	54,605	7.5	68,375

*Excludes CABG procedures with valve replacements. ** Other treatments, excluding pacemaker implants, infarctectomies and aneurysmectomies. *** Includes other treatments, including CABGs with valve replacements. AMI = acute myocardial infarction; IHD ischemic heart disease*

Fig. 1 - Annual HCP Lethality Rates, by IHD diagnoses - RJ State, 1999-2003. CABG: coronary artery bypass graft; PTCA: percutaneous transluminal coronary angioplasty; IHD: ischemic heart disease

0.7%. PTCA lethality rates for AMIs increased reaching a peak in excess of 15% in 2001 before returning to an approximate level of 5% in 2002 and 2003.

CABG lethality rates were consistently higher for angina pectoris and other acute IHDs than for chronic IHDs but maintained an approximate level of 5% for chronic IHDs and a level in excess of 10% for angina pectoris. CABG lethality rates for AMIs were also above the 5% mark, with a notable peak in 2001 of close to 20%.

In regard to admissions for noninvasive interventions, hospital lethality rates remained steady at levels of approximately 3% for angina pectoris and other acute IHDs and at levels in excess of 15% for AMI; however, a slight downward trend was noted during the five year period. Lethality rates for chronic IHDs were also fairly stable registering levels slightly higher than 5% between 1999 and 2002, but with a sudden upturn in 2003 to a level in excess of 10%.

Generally speaking, between 1999 and 2003, CABG lethality rates were reduced, fluctuating between 9% and 6%; PTCA rates increased fluctuating between 1.5% and 1.6%, and the rates for medical treatment recorded a slight drop from 8.8% to 8.2%. CABG lethality rates for AMIs were the most unstable which is probably due to the lower number of CABG interventions in this diagnostic group.

During this same timeframe, lethality rate tendencies for angina and chronic IHDs dropped (from 3.2% to 2.3%, and from 4.9% to 3%, respectively) and AMIs presented a slight drop (from 17.3% to 15%), while the other acute IHD diagnoses presented an upward trend fluctuating between 2.7% and 3%.

The lethality rate information also demonstrates the differences that exist between the hospitals that provide services to SUS. Table 2 shows the lethality rates for ten hospitals selected by highly complex intervention volumes (CABG and PTCA).

Hospitals that did not perform at least 100 CABGs and 100 PTCAs during analysis timeframe, between 1999 and 2003, were excluded from the table. However, the last line of the table lists the combined data for the state of Rio de Janeiro, including the results of all admissions in all hospitals. The lethality rates were adjusted using log-poisson models.

It should be noted that the models vary between the columns and as such comparisons are only valid between the lethality rates figures in the same column. As to the figures corresponding to the number of admissions and interventions no adjustments were made.

The variation between lethality rates, adjusted by age, sex and diagnostic groups, for CABGs performed in the selected hospitals was notable (from 1.9% to 12.8%), and higher than the PTCA rates (from 0 to 3.2%). Lethality rates for medical treatment also varied greatly. All data demonstrated an elevated variation in IHD lethality rates among the hospitals (from 3% to 15.3%).

DISCUSSION

These data refer to both public and private hospitals that were contracted to provide health care. The analysis is limited to the admissions paid by SUS between 1999 and 2003, and not the number of patients that includes 68,375 admissions. Therefore, the estimated lethality rates in this study refer to paid admissions and not patients. It can be assumed that the rates might have been

Table 2 – Lethality rates, by hundreds, for CABG, PTCA and other treatments (clinical) for IHD admissions, adjusted for age, gender and diagnostic groups using log-poisson models, in ten hospitals selected from the state of RJ (SIH/SUS), between 1999 and 2003

Procedures Hospitals	CABG * % (n)	PTCA % (n)	Others ** % (n)	Total (IHD) *** % (n)
A	9.0 (614)	0.9 (1,390)	9.2 (929)	7.3 (2,944)
B	5.7 (567)	1.0 (862)	1.1 (434)	7.3 (1,869)
C	12.8 (244)	0.8 (757)	5.3 (1,518)	4.6 (2,536)
D	11.5 (1,132)	3.0 (186)	0.0 (1,188)	15.3 (2,528)
E	7.2 (138)	0.0 (504)	(****)	5.6 (666)
F	1.9 (196)	2.4 (427)	6.8 (349)	4.0 (998)
G	10.2 (434)	2.8 (1,720)	9.6 (108)	7.1 (2,266)
H	4.1 (419)	2.2 (250)	7.0 (1,863)	6.4 (2,586)
I	7.2 (239)	3.2 (275)	10.6 (506)	7.9 (1,040)
J	2.7 (913)	2.6 (1,058)	2.3 (2,398)	3.0 (4,376)
RJ State *****	7.5 (5,096)	1.7 (8,478)	8.3 (54,605)	7.5 (68,375)

*Excludes CABG procedures with valve replacements. ** Other treatments, excluding pacemaker implants, infarctectomies and aneurysmectomies. *** Includes other treatments, including CABGs with valve replacements. **** Value excluded due to low number of admissions (18). ***** Includes all state-of-the-art complex medical procedures in all hospitals in the state of RJ (A to J only includes the hospitals that performed at least 100 CABG procedures in the study period). CABG: coronary artery bypass graft; PTCA: percutaneous transluminal coronary angioplasty; IHD: ischemic heart disease*

higher if the estimates had been based on the number of patients, since many of the patients could have been admitted more than once with an IHD diagnosis, for either medical therapeutic procedures or complex procedures.

We acknowledge that more specific information concerning the medical history of the patients is required, as well as in respect to associated morbidities that would allow the calculation of adjustment scores for a more precise comparison of hospital performance. However, this information is not contained in the admission records and perhaps not even in a standardized format in the registers of all hospitals. Therefore, the implementation of a recording system for complex procedures is required in Brazil. Nevertheless, even though the admission records may be incomplete, we cannot disregard them as they are the only comprehensive base of information currently available.

The procedure distribution in the hospitals is in agreement with the payment logic for services provided to SUS and the distribution depends on the availability of these services in those institutions whether they are public or private, universities or non-teaching facilities. The diagnoses are another limitation in the use of the hospital admission records. There is a high probability that information regarding the number of deaths and HCPs would be much more reliable than diagnosis information. The diagnoses could contain wrong assumptions as seen with the AMI lethality rate results, for example, the CABG lethality rates are lower than expected in relation to other IHD diagnostic groups; however, this problem does not occur with the PTCAs (Table 1). Also, the reasonable fluctuation in AMI lethality rates for patients who underwent CABG or PTCA procedures in the study period can be explained by the small number of observations in each year.

Cardiovascular diseases are the number one cause of death in Brazil and the state of RJ where roughly 30% of the total number of deaths is caused by cardiovascular diseases. They are also the second highest cause of hospital admissions, excluding pregnancies, childbirth and post partum care, only superseded by respiratory diseases. They represent the leading cause of disability retirements, roughly one third of the total. Cardiovascular diseases, including cerebrovascular diseases and IHDs, are the leading cause of DALYS (Disability Adjusted Life Years)[5]. In the state of RJ, IHDs are the second leading cause of cardiovascular disease fatalities, superseded only by cerebrovascular diseases[6].

Lethality rates for AMIs in the state of RJ (18.4%, in 1995)[7] and in the state of São Paulo (17.1%, in 1997)[8] were relatively high in comparison with clinical trial figures for other countries[9], of 5.9% with and 13.1% without the use of thrombolytics. AMI case records in the United States from 1994 to 1998, revealed lethality rates of 18.1% to 19.7%[10]. Multicenter studies conducted in Europe revealed lethality rate variations between 18%

and 21%, in the last decade of the 20th century[11]. Health system data records from various countries revealed lethality rates twice as high as those recorded in clinical trials. This variation could have many explanations, such as the patient selection criteria used for the clinical trials, outpatient care may not have included optimized medical therapy and other possible factors (healthcare staff training, available resources, social conditions of the patients, etc.). Consequently, the statistics presented in this study for the state of RJ are comparable with the actual records.

It is possible to assume that the medical treatmentdeath risk for AMI patients would be much lower if determined interventions were implemented in the early treatment stages. These interventions include the use of thrombolytics and other proven AMI drug therapy treatments such as ASA, beta-blockers and ACE inhibitors.

A study conducted in the city of Rio de Janeiro compared a random sample of 391 admission registers with AMI diagnoses from the 1997 hospital admission authorizations. The results showed correct diagnoses in 91.7% of the cases, an admission lethality rate of 20.6%, intravenous thrombolysis for 19.5%, ASA administration for 86.5%, beta-blocker administration for 49% and ACE inhibitor administration for 53.3%[12]. Considering that roughly two thirds of the patients admitted remain in the Killip 1 classification[13], it can be assumed that if the medical therapeutics recommended by random studies[9] had been used the lethality rate would have been lower.

Health care coverage for IHDs in some Brazilian capital cities, excluding Rio de Janeiro, has decreased by 17.8% in the past two decades[14]. In Rio de Janeiro, Melo observed that AMI deaths registered in SIH/SUS in 2000, only accounted for 10% of the death certificates in the Mortality Information System (SIM)[15]. Due to this, it is important to emphasize that the data prepared for this study only considered the IHD case admissions that were authorized by SIH/SUS, and that the lethality rates presented do not refer to outpatient cases or those attended by facilities other than SIH/SUS.

The lethality rate for 41,989 CABG surgeries between 1996 and 1998, in 131 Brazilian hospitals, was 7.2%, with an inverse relationship between CABG procedure volumes and lethality rates[16]. According to the American Association of Thoracic Surgery, in 124,793 surgeries performed by more than 1,200 surgeons, in more than six hundred hospitals the CABG lethality rate was 3.2% and 5.0%, when volumes were higher or lower than one hundred interventions per year, respectively[17]. These rates were similar to those reported in hospitals in Ontario, Canada[18].

Recently, CABG lethality rates reported by surgeons in the United States varied from 1.9% in low volume hospitals (up to 150 surgeries/year), to 0.78%, in those with large volumes (628 or more surgeries/year)[19]. In

the state of Rio de Janeiro, average CABG lethality rates between 1999 and 2003 were 7.6% (Table 1).

Lethality rates for PTCA procedures performed in the United States between 1998 and 2000, varied from 1.4% for hospitals that perform more than one thousand procedures per year to 2.6% for hospitals that perform between five and 199 cases per year[20]. In the state of RJ the average lethality rate between 1999 and 2003 was 1.7% (Table 1). For primary PTCA procedures, the lethality rate for hospitals in the United States averaged 3.5%[20], while in the state of Rio de Janeiro it was 6% (Table 1).

Jabbour et al[21], in a study involving various institutions in the United States, dispensed clinical treatment to all patients with stable angina pectoris, with or without a previous AMI history, and only patients that presented instability during the optimized medical therapy were submitted to an angiography study. During an average follow-up period of 4.7 years, 0.8% of the annual deaths were caused by cardiac problems and 2.2% by AMI. Only 24.5% of the patients required PTCA or CABG procedures during the follow-up period.

Lethality rates reported by Yusuf et al[22] in a five year period of clinical treatment were higher than those previously mentioned: 9.9% for single vessel diseases, 11.7% for two vessel diseases and 17.6% for three vessel diseases, consequently an annual lethality rate between 2% and 3.5% for non-optimized clinical treatment. An analysis in relation to chronic IHDs indicates the need for caution in HCP recommendations. Medical treatment of chronic IHDs is a low risk option and therefore appears to be an adequate first option, reserving HCPs for the more serious cases.

The lethality rates for both HCPs and clinical treatment for AMIs in the state of Rio de Janeiro were elevated and did not show the expected relation between lethality rates and procedure volumes. These high lethality rates and the relevant performance differences demonstrated among the institutions that provide services for SUS IHD patients indicate that an investigation into the possible causes of this phenomenon is urgently needed.

It has become necessary to proceed with a comprehensive retrospective investigation using the information contained in the hospital records. Prospectively, quality evaluation tools will need to be implemented to continually monitor the services provided to SUS.

REFERENCES

1. Fórum - Mortalidade Hospitalar no Infarto Agudo do Miocárdio e nos Procedimentos de Alta Complexidade Relacionados à Doença Coronariana no Estado Do Rio de Janeiro. 21°Congresso de Cardiologia da SOCERJ – Rio de Janeiro – Junho de 2004

2. Laurenti R, Buchall, CM, Caratin CVS. Ischemic heart disease. hospitalization, length of stay and expenses in Brasil from 1993 to 1997. Arq Bras Cardiol 2000; 74(6): 488-92.

3. Ministério da Saúde. DATASUS. Sistema de Informação Sobre Mortalidade. -SIM/DATASUS. Disponível em <http://www.datasus.gov.br>

4. Organização Mundial de Saúde. Classificação estatística internacional de doenças e problemas relacionados a saúde: Classificação Internacional de Doenças. 10ª ed. Revista. São Paulo: Edusp, 1995, 1.

5. Schramm JMA, Valente JG, Leite IC et al Perfil epidemiológico segundo os resultados do estudo de carga de doença do Brasil – 1998. In: Projeto Carga de Doença. Rio de Janeiro: ENSP/Fiocruz, 2002. 1 CD-ROM.

6. Oliveira GMM. Mortalidade cardiovascular no Estado do Rio de Janeiro no período de 1980 a 2000. Rio de Janeiro, 2003. Tese (Doutorado) - Universidade Federal do Rio de Janeiro.

7. Escosteguy CC, Medronho RA, Portela MP. Avaliação da letalidade hospitalar do infarto agudo do miocárdio no estado do Rio de Janeiro através do uso do Sistema de Informação Hospitalar/SUS. Cad Saúde Coletiva 1999; 7: 39-59.

8. Marcopito LF, Goldfeber AJ, Schenkman S. Infarto agudo do miocárdio no Estado de São Paulo. Mortes ocorridas em hospitais, de 1979 a 1996, e letalidade hospitalar no SIH/SUS, de 1984 a 1998. Arq Bras Cardiol 2000; 74: 39-42.

9. ACC/AHA. American College of Cardiology / American Heart Association Task Force Report. 1999 Update: Guidelines for the Management of Patients With Acute Myocardial Infarction. J Am Coll Cardiol 1999; 34: 890-911.

10. Every NR, Frederick PD, Robinson M, Sugarman J, Bowlby RN, Barron HV. A Comparison of the National Registry of Myocardial Infarction 2 with the Cooperative Cardiovascular Project. J Am Coll Cardiol 1999; 33: 1886-94.

11. Mahon NG, O'Rorke C, Codd MB, McCann HA, McGarry K, Sugrue DD. Hospital mortality of acute myocardial infarction in the thrombolytic era. Heart 1999; 81: 478-82.

12. Escosteguy CC, Portela MP, Medronho RA, Vasconcellos MTL. Infarto agudo do miocárdio: perfil clínico-epidemiológico e fatores associados ao óbito hospitalar no Município do Rio de Janeiro. Arq Bras Cardiol 2003; 80(6): 593-9.

13. Killip T, Kimball JT. Treatment of myocardial infarction in a coronary care unit: A two year experience with 250 patients. Am J Cardiol 1967; 20: 457-65.

14. Lessa I. Assistência médica e óbitos por doença arterial coronariana no Brasil, 1980-1999. Arq Bras Cardiol 2003; 81(4): 329-35.

15. Melo ECP. Infarto agudo do miocárdio no Município do Rio de Janeiro. Rio de Janeiro, 2004. Tese (Doutorado) - Escola Nacional de Saúde Pública – Fiocruz.

16. Noronha JC, Travassos C, Martins M, Campos MR, Maia P, Panezzutti R. Avaliação da relação entre volume de procedimentos e a quantidade do cuidado: o caso de cirurgia coronariana no Brasil. Cad Saúde Pública 2003; 19(6): 1781-9.

17. Clark RE. Outcome as a function of annual coronary artery bypass graft volume. Ann Thor Surg 1996; 61: 21-6.

18. Tu JV, Sykora K, Naylor CD. Assessing the outcomes of coronary artery bypass graft surgery: How many risk factors are enough. J Am Coll Cardiol 1997; 30: 1317-23.

19. Jones RH. The Year of Cardiovascular Surgery. J Am Coll Cardiol 2004; 43: 1706-14.

20. Epstein AJ, Rathore SS, Volpp KGM, Krumholz HM. Hospital Percutaneous Coronary Intervention Volume and Patient Mortality, 1998 to 2000. Does the Evidence Support Current Procedure Volume Minimums? J Am Coll Cardiol 2004; 43: 1755-62.

21. Jabbour S, Young-Xu Y, Graboys TB et al. Long-term outcomes of optimized medical management of outpatients with stable coronary artery disease. Am J Cardiol 2004; 93: 294-9.

22. Yusuf S, Zucker D, Peduzzi P et al. Effect of coronary artery bypass graft surgery on survival: overview of 10-year results from randomized trials by the Coronary Artery Bypass Graft Surgery Trialists Collaboration. Lancet 1994; 344: 563-70.