

## Use of Demonstrably Effective Therapies in the Treatment of Acute Coronary Syndromes: Comparison between Different Brazilian Regions. Analysis of the Brazilian Registry on Acute Coronary Syndromes (BRACE)

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### Abstract

**Background:** Little is known in our country about regional differences in the treatment of acute coronary disease.

**Objective:** To analyze the behavior regarding the use of demonstrably effective regional therapies in acute coronary disease.

**Methods:** A total of 71 hospitals were randomly selected, respecting the proportionality of the country in relation to geographic location, among other criteria. In the overall population was regionally analyzed the use of aspirin, clopidogrel, ACE inhibitors / AT1 blocker, beta-blockers and statins, separately and grouped by individual score ranging from 0 (no drug used) to 100 (all drugs used). In myocardial infarction with ST elevation (STEMI) regional differences were analyzed regarding the use of therapeutic recanalization (fibrinolytics and primary angioplasty).

**Results:** In the overall population, within the first 24 hours of hospitalization, the mean score in the North-Northeast ( $70.5 \pm 22.1$ ) was lower ( $p < 0.05$ ) than in the Southeast ( $77.7 \pm 29.5$ ), Midwest ( $82 \pm 22.1$ ) and South ( $82.4 \pm 21$ ) regions. At hospital discharge, the score of the North-Northeast region ( $61.4 \pm 32.9$ ) was lower ( $p < 0.05$ ) than in the Southeast ( $69.2 \pm 31.6$ ), Midwest ( $65.3 \pm 33.6$ ) and South ( $73.7 \pm 28.1$ ) regions; additionally, the score of the Midwest was lower ( $p < 0.05$ ) than the South region. In STEMI, the use of recanalization therapies was highest in the Southeast (75.4%,  $p = 0.001$  compared to the rest of

the country), and lowest in the North-Northeast (52.5%,  $p < 0.001$  compared to the rest of the country).

**Conclusion:** The use of demonstrably effective therapies in the treatment of acute coronary disease is much to be desired in the country, with important regional differences.

### Introduction

According to the latest data released by the World Health Organization (WHO) (2008), Coronary Artery Disease (CAD) remains the main cause of worldwide mortality, accounting for approximately 16% of all deaths in developed countries, and approximately 12% in developing or underdeveloped ones<sup>1</sup>. The vast majority, in absolute numbers, occurs in the latter group of countries (82% in 2004, last information available)<sup>2</sup>. In Brazil, CAD was responsible for 96,386 deaths according to 2009 data provided by the Datasus (approximately 9% of all deaths in the year), the vast majority related to acute myocardial infarction<sup>3</sup>.

As expected, Acute Coronary Syndromes (ACS - unstable angina and acute myocardial infarction with or without ST-segment elevation) are responsible for high costs in healthcare, and the implementation of public and private policies to minimize the effects of these numbers depends on comprehensive studies in order that properly reflect their diagnostic and therapeutic management.

Brazil has participated in several national and international multicenter studies/registries<sup>4-6</sup> on unstable myocardial ischemic syndromes, which has allowed surveys on the approaches used in the participating centers; however, these centers do not necessarily reflect the country's reality as a whole, as they are chosen taking into account specific features such as complexity, presence of certain procedures, previous experience in research, location etc. Frequently, data are obtained from participating centers in international multicenter studies, thus following the criteria for patient and center selection in accordance with the requirements of the study itself.

### Keywords

Coronary disease / epidemiology; myocardial infarction / therapy; myocardial ischemia; medical records.

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Thus, hospital registries with a stratified and random selection of centers, in order to obtain more reliable and comprehensive data about what occurs in Brazil are mandatory. The BRACE study aimed to fill this gap and evaluates regional differences regarding the use of demonstrably effective therapies to treat patients with ACS (“therapeutic variables of performance”).

## Methods

### Main Objective

The main objective of the present study is to analyze the behavior of specialized services representing different regions of the country, regarding the use of demonstrably effective therapies in the treatment of patients with acute coronary disease (use of acetyl salicylic acid, clopidogrel, beta blockers, statins and recanalization therapy).

### Sample design

Of a sample of 123,774 healthcare establishments registered at the Ministry of Health, 576 public and private hospitals were identified that met the criteria of having a Cardiology Unit and Intensive Care Unit (ICU). Considering the study setting, and taking into account the minimum number of patients to be included, a sample of 70 to 80 centers was calculated as the ideal number of hospitals, based on the methodology that will be outlined below.

1. The selected hospitals are representative of all the hospitals with ICU and Cardiology Unit in Brazil, stratified according to: geographic region, administrative characteristics (public or private), and whether it was a university hospital or not.
2. We adopted the methodology of “cluster sampling”. Cluster sampling consists in exclusive and collectively exhaustive subpopulations, i.e., every element of the population is classified in one and only one of the clusters. Based on that, we selected a random sample of clusters (hospitals).
3. For the selection of clusters, the “proportional stratified sampling” methodology was applied – with the geographic areas being considered as strata. As the clusters, the strata are exclusive and collectively exhaustive subpopulations, in a way that the strata are the most homogeneous in their formation and the most heterogeneous when compared to each other. Using to this cluster sample design, the proportionality was taken into account regarding the geographic areas the sponsor entity (public and private) as to whether or not it was a university hospital. That is, the same proportions found in the setting were maintained in the sample, for each of the variables of interest. Within each stratum, a random sample of hospitals was obtained.
4. Each hospital was contacted through its randomly selected Clinical Director and/or director of Cardiology Unit and invited to participate. Where they were unwilling or unable to participate, the hospital was

replaced by another, also at random, with exactly the same characteristics as the one initially selected.

5. For substitutions, in addition to the variables characterizing the strata (region, the administrative characteristics, university and teaching hospital status) we also considered the complexity of the hospital, when there was an equivalent center.

Of the initially contacted hospitals and that agreed to participate in the study, 33 were substituted, resulting in a final sample of 71 hospitals that supplied data to the study. As the characteristics of the replaced centers (region, administrative characteristics, university and teaching hospital status) were taken into account, randomization was maintained throughout research development.

### Sample size

The initial estimation of sample size was based on the need for reading/analysis of patient data segmented by variables such as geographic region, gender, age, ethnicity, habits of the patient and several others.

Based on this need, the final sample size was defined as 1,067 patients, considered sufficient for readings with such segmentations.

This sample size allows reading of the total data with a maximum margin of error of three points, considering a confidence level of 95%.

To determine the sample size, the following were specified:

- 1) (E) – Expected accuracy level for results, i.e., the margin of error (established as three percentage points upwards or downwards);
- 2) Level of confidence of the sample (set at 95%), which means: if the study was conducted 100 times, under the same conditions, in 95 of them the created interval should contain the true value of the parameter;
- 3) (p) – Estimate of the population proportion generating the highest variability (as the population proportion is unknown, we chose to define it as  $p = 0.5$ , thus adopting the highest variability, and ensuring the widest interval);
- 4) (z) – Z value (normal distribution) associated to the established level of confidence ( $z = 1.96$ ).

Considering the values adopted for each of the above items, sample size was determined through the formula:

$$\begin{aligned} N &= p(1-p)(z/E)^2 \\ N &= 0.5(1-0.5)(1.96/0.03)^2 \\ N &= 1067 \end{aligned}$$

With this minimum sample one ensures that, for any proportion found, the results can be read with a maximum error of three percentage points, with a confidence level of 95%.

In centers where there was no Research Ethics Committee (60% of the total – Brazilian reality!), The Ethics Committee in Research of HCFMUSP reviewed and approved the survey and are therefore responsible for resolving any questions or problems encountered at these sites.

In order to evaluate the consistency of information obtained at BRACE, especially regarding the sampling

distribution, questions such as incidence of myocardial infarction in the family of the respondent and incidence of death related to myocardial infarction were included in questionnaires of parallel national surveys carried out by Datafolha.

When the patient arrived at the hospital, the staff was directed to contact a “0800” number and the patient was registered into the system. The training of teams and monitoring tutoring was in charge of a specialized firm hired specifically for this purpose (Eurotrials).

The entire methodology was developed by specialized Datafolha staff, which was also responsible for its implementation, collection/storage of data in a specific database, and also by the survey results presented here.

The General Coordination of the study was supervised by the Study Group on Coronary Artery Disease, Emergency and Intensive Care (Geceti) of the Brazilian Society of Cardiology together with the Acute Coronary Disease Unit, Instituto do Coração (InCor) / HCFMUSP, with the support the Brazilian Ministry of Health. The study was registered at the specialized American website “RegistriesLive.org” (www.registrieslive.org).

### Statistical Analysis

When comparing categorical variables, the chi-square e Fisher exact tests were applied; the analysis of continuous variables was performed using the Mann-Whitney and Student *t* test, as indicated. The different regions of Brazil were compared at first, and each one of them was compared with the rest of the country in sequential analysis. Taking into account the individual use of therapeutic variables of performance, we developed a score for each patient, which could vary from 0 (no therapeutics used) to 100 (using the five treatments).

Subsequently, the scores of each region were compared using the ANOVA test for non-repeated measures with Tukey’s post-test. Because they had very similar results, the North and Northeast regions were grouped together for statistical analysis. P-value <0.05 (two-tailed) was considered significant. SPSS software release 16.0 was used for all analyzes.

### Results

The characteristics of the hospitals are described in Table 1. The distribution of hospitals, as expected by the method employed, shows a majority of them located in the

Southeast, followed by the Northeast, South, Midwest and North regions. Together, these institutions included a total of 1,150 patients in the registry. Approximately one quarter of hospitals belong to the public sector (18 hospitals, seven of federal, eight state and three municipal administration), and 10% were university ones.

The demographic characteristics of the study population are shown in Table 2. Of the total patients, 733 (63.7%) were males and 417 (36.3%), females; the mean age was 63.1 years and 797 patients (70.1%) were Caucasians. Upon arrival at the hospital, a history of hypertension was present in more than two-thirds of patients, diabetes mellitus in one-fourth and hypercholesterolemia in more than one-third of the population. More than half of the patients reported tobacco use (current or previous), and approximately one quarter had a history of myocardial infarction.

Data related to therapeutics used were obtained, in the registry, in two stages: prescription within 24 hours of hospitalization, and prescription at hospital discharge. Tables 3, 4 and 5 show the use of these therapies in the total population, and taking into account the different regions analyzed.

Acetylsalicylic acid (ASA) was administered to 89% of patients within 24 hours of hospitalization and 86% at discharge, being more often prescribed during this period in the South (91.2%,  $p = 0.007$  in relation to the rest of the country) and less often in the Midwest (80.2%,  $p = 0.002$ ). Regarding the use of beta blockers, 66.8% of the population received the drugs within the first 24 hours, and 69.8% at discharge; this analysis (at discharge) showed significant differences between regions, with the highest percentage of prescriptions of beta blockers in the South Region (79.3%,  $p = 0.001$ ) and the lowest in the Midwest (64.3%,  $p = 0.028$ ).

The use of angiotensin-converting enzyme inhibitors (ACEI) and angiotensin-receptor blockers (ARB), it was observed that 67.2% of patients received this class of drugs within the 24 hours and 70.6% at hospital discharge, whereas patients in the Midwest received this medication less often at discharge (64.3%,  $p = 0.012$ ). As for statins, they were prescribed to 78.7% of the population within 24 hours of hospitalization, also heterogeneously in different regions, being more commonly prescribed in the South (86.6% of the population,  $p < 0.001$ ) and less commonly

Table 1 – Participating hospitals per region

	South Prev./ Incl.	Southeast Prev./ Incl.	Midwest Prev. / Incl.	North Prev. / Incl.	Northeast Prev./ Incl.	Total n (%)
Total (%)	17.5 / 18.3	46.25 / 46.5	12.5 / 9.9	5.0 / 5.6	18.75 / 19.7	71 (100)
Type (%)						
Public	2.5 / 7.1	11.25 / 7.1	2.5 / 4.2	1.25 / 1.4	5 / 5.6	22.5 / 25.4
Private	15 / 11.3	35 / 39.4	10 / 5.6	3.75 / 4.2	13.75 / 14.1	77.5 / 74.6
University %	2.5 / 4.2	3.75 / 2.8	1.25 / 1.4	0 / 0	1.25 / 1.4	8.75 / 9.9

Prev. - previewed; Incl. - included.

**Table 2 – Demographic characteristics of the studied population**

Regions	South	Southeast	Midwest	Northeast	North	Total
Total patients included	269	399	259	173	50	1150
Male sex (n; %)	184; 68.4	265; 66.4	159; 61.4	91; 52.6	34; 68	733; 63.7
Mean age (years)	63.3	63.1	61	65.64	64.92	63.6
Ethnicity (n; %)						
Caucasian	221; 82.1	298; 74.7	145; 56	99; 57.2	34; 68	797; 69.3
Black	11; 4.1	26; 6.5	40; 15.4	10; 5.8	3; 6	90; 7.8
Brazilian mulatto	32; 11.9	73; 18.3	73; 28.2	56; 32.4	12; 24	246; 21.4
Asian	2; 0.7	1; 0.2	1; 0.4	0; 0	0; 0	4; 0.3
History of SAH (N; %)	175; 65	283; 70.9	180; 69.5	120; 69.3	41; 82	799; 69.5
History of DM (N; %)	64; 23.8	101; 25.3	62; 23.9	49; 28.3	12; 24	288; 25
History of HCL (N; %)	128; 47.6	138; 34.6	66; 25.5	68; 39.3	19; 38	419; 36.4
Family history of CAD (N; %)	169; 62.8	166; 41.6	106; 40.9	99; 57.2	12; 24	552; 48
Smoking (N; %)	180; 66.9	221; 55.4	157; 60.6	78; 45.1	30; 60	666; 57.9
Current	95; 35.3	128; 32.1	68; 26.2	37; 21.4	11; 22	339; 29.5
Previous	85; 31.6	93; 23.3	89; 34.4	41; 23.7	19; 38	327; 28.4
Previous AMI (n;%)	67; 24.9	82; 20.5	60; 23.2	35; 20.2	13; 26	257; 22.3
Previous CA (n; %)	129; 47.9	195; 48.8	76; 29.3	62; 35.8	26; 52	488; 42.4
Previous HF (n; %)	28; 10.4	22; 5.5	26; 10	5; 2.9	2; 4	83; 7.2
Previous PCI (n; %)	59; 21.9	48; 12	24; 9.3	19; 11	7; 14	157; 13.6
Previous CABG (n; %)	39; 14.5	37; 9.3	17; 6.6	16; 9.2	6; 12	115; 10
Previous CRF (n;%)	15; 5.6	11; 2.7	3; 1.1	5; 2.9	3; 6	37; 3.2
Previous CVA (n; %)	21; 7.8	20; 5.0	14; 5.4	11; 6.4	2; 4	68; 5.9
Previous PAD (n; %)	25; 9.3	21; 5.3	4; 1.5	3; 1.7	3; 6	56; 4.9
Previous COPD (n; %)	22; 8.2	29; 7.3	13; 5	11; 6.4	6; 12	81; 7

SAH - systemic arterial hypertension; DM - diabetes mellitus; HCL - hypercholesterolemia; CAD - coronary artery disease; AMI - acute myocardial infarction; CA - chest angina; HF-heat failure; PCI - percutaneous coronary intervention; CABG - coronary artery bypass graft; CRF - chronic renal failure; CVA - cerebrovascular accident; PAD -peripheral artery disease; COPD - chronic obstructive pulmonary disease.

**Table 3 – Overall use of therapeutic variables of performance in the total study population**

	1st 24 hours	Hospital discharge
ASA (n;%)	1024 (89%)	930 (86%)
Clopidogrel (n;%)	687 (59,7%)	542 (50,1%)
Beta-blocker (n;%)	768 (66,8%)	755 (69,8%)
ACEI/ARB (n;%)	773 (67,2%)	763 (70,6%)
Statin (n;%)	905 (78,7%)	894 (82,7%)

ASA - acetyl salicylic acid; ACEI - angiotensin-converting enzyme inhibitor; ARB - angiotensin receptor blocker.

prescribed in the Midwest (72.6%,  $p = 0.006$ ). At hospital discharge, 82.7% of the population were prescribed statins, with an unequal distribution in different regions of Brazil, with the highest percentages in the South (92%,  $p < 0.001$ ) and lowest in the Midwest (76.6 %,  $p = 0.003$ ).

Clopidogrel was administered within 24 hours of hospital admission in 59.7% of cases, with an unequal distribution throughout the country ( $p < 0.001$ ). Populations in the Southeast (67.4%,  $p < 0.001$ ) and South (65.1%,  $p = 0.042$ )

were more likely to receive clopidogrel, while only 42.2% of the population of North-Northeast Region received this drug on the first day of hospitalization (OR 0.410,  $p < 0.001$ ). At hospital discharge, this antiplatelet agent was prescribed to 50.1% of the population, with its prescription being more frequent in the South (57.4%,  $p = 0.009$ ) and less frequent in the North-Northeast regions (35.1%,  $p < 0.001$ ).

Tables 6 and 7 show the mean score of the use of therapeutic variables of performance in the several regions

**Table 4 – Use of therapeutic variables of performance within the first 24 hours of hospitalization**

	South n (%)	Southeast n (%)	Midwest n (%)	Northeast n (%)	North n (%)	p
ASA	248 (92,2)	347 (87)	232 (89,6)	154 (89%)	43 (86%)	0,282
Beta-blockers	190 (70,6)	252 (63,2)	180 (69,5)	111 (64,2)	35 (70)	0,215
ACEI / ARB	171 (63,6)	277 (69,4)	179 (69,1)	117 (67,6)	29 (58)	0,301
Statin	233 (86,6)*	312 (78,2)	188 (72,6)**	130 (75,1)	42 (84)	0,001
Clopidogrel	175 (65,1) <sup>#</sup>	269 (67,4) <sup>##</sup>	149 (57,5)	68 (39,3) <sup>§</sup>	26 (52) <sup>§</sup>	<0,001

ASA - acetyl salicylic acid; ACEI - angiotensin-converting enzyme inhibitor; ARB - angiotensin receptor blocker. \*  $p < 0.001$  (OR=2.01) in relation to the rest of the country; \*\*  $p = 0.006$  (OR = 0.64) in relation to the rest of the country; #  $p = 0.042$  (OR=1.34) in relation to the rest of the country; ##  $p < 0.001$  (OR = 1.65) in relation to the rest of the country; §  $p < 0.001$  (OR = 0.41) when comparing North/Northeast region and the rest of the country.

**Table 5 – Prescription of therapeutic variables of performance at hospital discharge.**

	South n (%)	Southeast n (%)	Midwest n (%)	Northeast n (%)	North n (%)	p
ASA	229 (91,2)*	328 (87,9)	202 (80,2)**	134 (85,9)	37 (75,5)	0,001
Beta-blockers	199 (79,3) <sup>#</sup>	262 (70,2)	162 (64,3) <sup>##</sup>	104 (66,7)	28 (57,1)	0,001
ACEI / ARB	188 (74,9)	270 (72,4)	162 (64,3) <sup>§</sup>	107 (68,6)	36 (73,5)	0,086
Statin	231 (92) <sup>§</sup>	304 (81,5)	193 (76,6) <sup>§§</sup>	126 (80,8)	40 (81,6)	<0,001
Clopidogrel	144 (57,4) <sup>£</sup>	200 (53,6)	126 (50)	53 (34) <sup>££</sup>	19 (38,8) <sup>££</sup>	<0,001

ASA - acetyl salicylic acid; ACEI - angiotensin-converting enzyme inhibitor; ARB - angiotensin receptor blocker. \*  $p = 0.007$  (OR=1.916) in relation to the rest of the country; \*\*  $p = 0.002$  (OR = 0.56) in relation to the rest of the country; #  $p < 0.001$  (OR = 1.886) in relation to the rest of the country; ##  $p = 0.028$  (OR = 0.716) in relation to the rest of the country; §  $p = 0.012$  (OR = 0.683) in relation to the rest of the country; §  $p < 0.001$  (OR = 2.909) in relation to the rest of the country; §§  $p = 0.003$  (OR = 0.597) in relation to the rest of the country; £  $p = 0.009$  (OR = 1.461) in relation to the rest of the country; ££  $p < 0.001$  (OR = 0.468) when comparing North/Northeast region and the rest of the country.

analyzed. As it can be observed, similarly to the individual analyses of the previously described therapies, the North-Northeast region had significantly lower performance when compared to the other regions of the country, both regarding the use of drugs within the first 24 hours of admission, and drug prescription at hospital discharge. Additionally, at the discharge, the Midwest Region had a lower performance, when compared to the South Region.

When assessing the overall rates of reperfusion therapy use in patients with AMI with ST elevation (fibrinolysis or primary angioplasty), the disparity persists among the country regions ( $p = 0.001$ ), with reperfusion therapies most often used in the Southeast (75.4% - OR 1.858, 95% CI 1.274 to 2.709,  $p = 0.001$ ) and less frequently in the North-Northeast region (52.5% - OR 0.475, 95% CI 0.316 to 0.714,  $p < 0.001$ ) (Fig. 1).

When patients with contraindications to the use of reperfusion therapy, mainly to fibrinolytic agents (recent surgery or trauma, bleeding or coagulopathy, persistent hypertension, concomitant disease, time from onset of symptoms greater than 12 hours, current treatment with anticoagulant) are excluded from this sample, the scenario persists with statistically significant differences, albeit less exuberant, with the therapy being less used in the North-Northeast (82.9%,  $p = 0.003$ ), and more used in the South region (96.3%,  $p = 0.044$ ).

## Discussion

The BRACE registry is, to the best of our knowledge, the first national registry in its field to apply the present methodology to assess the reality of the country as a whole, in regard to hospital treatment of acute coronary disease. This has important implications on the obtained results and appraisal of epidemiological data for purposes of public policies, as it can be used to direct efforts in areas where the greatest need is evident.

In general, the use of the therapies reviewed here is lower than that reported in current registries, even those that specifically included patients from developing countries. For example, the ACCESS<sup>6</sup> registry, which included more than 12,000 patients from Latin America, Africa and the Middle East, reports percentage (at hospital discharge) of 90%, 76%, 89% and 76%, respectively, for ASA, beta-blockers, statins and clopidogrel, rates that are well above those found in our country. However, these differences, at least in part, must be related to the methodology employed, as in the ACCESS registry, center selection (as in similar registries) was not exactly representative of the country as a whole, as recognized by the authors in their publication.

Regarding the main objective of this publication, it was shown that there are significant regional differences in the use of demonstrably effective therapies in the treatment of ACS, which is somewhat expected in a large country with continental dimensions and recognized heterogeneities, such as Brazil.

**Table 6 – Mean scores of use of therapeutic variables of performance within the first 24 hours of hospitalization**

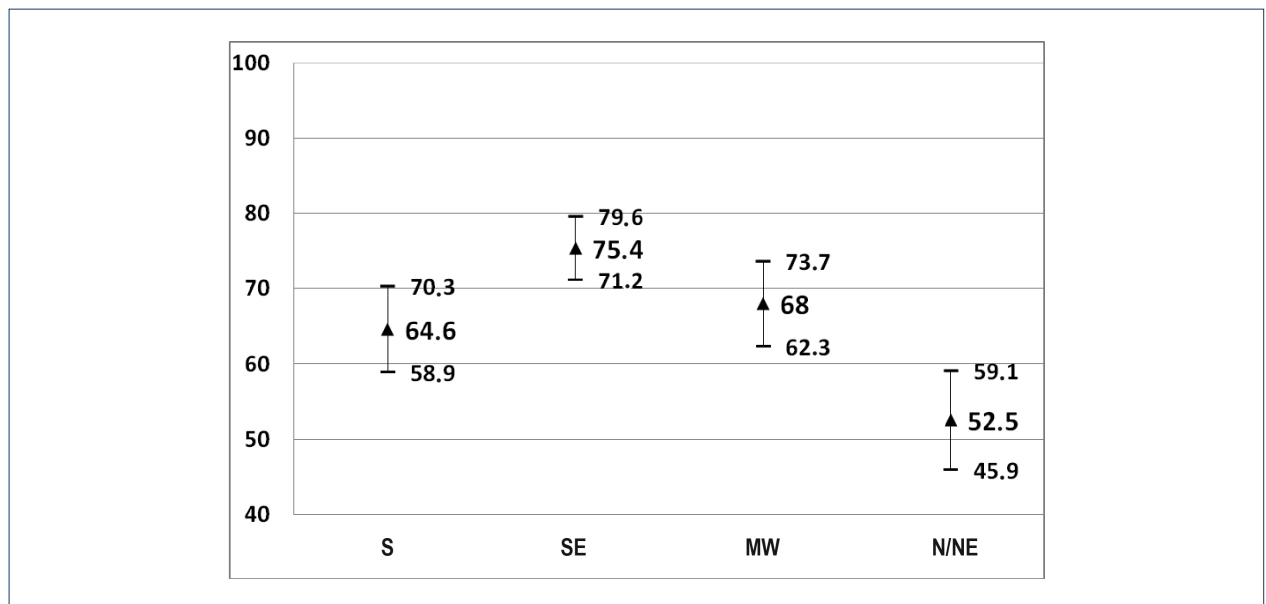
Regions	Mean score	D.P.	95% L.C.I.	95% U.C.S.
Midwest	82.01*	22.11	79.30	84.71
North/Northeast	70.49	27.56	66.86	74.13
Southeast	77.69 *	29.45	74.80	80.59
South	82.38 *	20.95	79.86	84.89

S.D. - standard-deviation; L.C.I. - lower confidence interval; U.C.I. - upper confidence interval. \*  $p < 0.05$  vs. North/Northeast; other comparisons  $p = NS$ .

**Table 7 – Mean scores of prescription of the performance variables at hospital discharge**

Regions	Mean	S.D.	95% L.C.I.	95% U.C.I.
Midwest	65.25 *†	33.55	61.15	69.36
North/Northeast	61.35	32.88	57.01	65.68
Southeast	69.22 *	31.63	66.11	72.34
South	73.68 *	28.13	70.30	77.06

S.D. - standard-deviation; L.C.I. - lower confidence interval; U.C.I. - upper confidence interval. \*  $p < 0.05$  vs. North/Northeast, †  $p < 0.05$  vs. South.



**Figure 1 – Overall reperfusion therapy in AMI with ST elevation. S - South; SE - Southeast; MW - Midwest; N/NE - North/Northeast.  $p < 0.001$  in the comparison between SE and the rest of the country.  $p < 0.001$  in the comparison between N/NE and the rest of the country.**

While patients from the South and Southeast regions more often receive these therapies, patients in the North-Northeast regions are less likely to be treated as recommended by national<sup>7,8</sup> and international<sup>9-11</sup> guidelines. These results may explain, at least partially, epidemiological mortality data previously published in our country<sup>12</sup>, which has shown that mortality due to ischemic heart disease in the five regions of Brazil has decreased in the South and Southeast regions, remained stable in the Midwest and increased in the

Northeast. Or, more comprehensively, if we take into account observations of increase in mortality due to CAD in the less developed regions and decrease in more developed regions in the world<sup>13,14</sup>, one can hypothesize that the impact of improvement in the use of demonstrably effective therapies in the treatment of unstable myocardial ischemic syndromes would be greater in less developed countries, when compared to developed ones.

Specifically regarding the use of myocardial reperfusion therapy (fibrinolysis or primary PCI) in acute myocardial infarction with ST-segment elevation, the same pattern repeats itself.

Both in the overall population, as well as when patients with justifications for not using these therapies (most due to time between symptom onset and hospital arrival > 12 hours) are excluded, clearly the patients in the North-Northeast region are also those who less often receive these treatments. Two important corollaries can be proposed from these findings: patients in some regions of the country tend to take longer to get to specialized medical services for the treatment of ACS (this fact can be explained by the delay in recognizing the urgency and the difficult access to healthcare services) and when they do get treated, they do not receive, at appropriate proportions, available demonstrably effective therapies.

Thus, it is clear that only the urgent implementation of educational measures aimed at the population about acute coronary disease symptoms and the need for specialized emergency medical service in the presence of these symptoms, as well as easier access to health care associated with the proper training of professionals involved in the process and organization of networks that increase system effectiveness can improve the described scenario. Within this context, proposals such as the one by the Ministry of Health, to provide second-generation fibrinolytic and antiplatelet treatment for the whole country and to implement 40 new Coronary Units in several regions of Brazil, among other measures (Minister Alexandre Padilha, SBC Congress 09/2011, InCor 12.13.2011 and Diário Oficial da União, 31/12/2011), are very welcome, and can contribute significantly to improve the treatment of acute coronary disease in our country.

### Study limitations

As any record, it also has some limitations. First, it should be noted that patients treated at isolated Emergency Units were not included in it. Due to a logistic problem, the current research was restricted to hospitals qualified by the Ministry of Health to care for cardiac cases, and which had an ICU. Second, as in almost all similar registries, there was no making sure that the data of all patients that came to the hospital with the characteristics required by the study were included in it. Finally, it must be recalled that the vast majority of centers had no previous experience in research; however, it is possible that they have improved their performance precisely because they participated in a study with the scope of present one<sup>15</sup>, which somehow could overestimate the country performance as a whole. Because of these limitations, the consistency of the obtained information was carefully checked by inserting questions on the subject in national surveys carried out by Datafolha. The answers to these questions allowed an estimation of the incidence of individuals that suffered a myocardial infarction, incidence of individuals that suffered myocardial infarctions that sought hospital care and incidence of infarction-related death, as well as its regional distribution. As mentioned before, the data thus observed were consistent with those obtained in the present registry, indirectly validating it.

### Conclusions

The present study clearly demonstrates the important regional differences that occur in Brazil regarding the adoption of appropriate medical procedures in patients with acute coronary disease. Given the high prevalence of this disease in our population, and the preventable adverse consequences associated with this heterogeneity, impact measures to improve the overall and regional performance of centers where these therapeutic approaches are employed in Brazil should be prioritized by our government and by the Scientific Societies involved in these processes.

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### Appendix 1 - Participating centers, city-state (main investigator)

Santa Casa de Maceió – AL (Sandra Batista dos Santos); Hospital Adventista de Manaus – AM (Ricardo Chaves); Real Sociedade Espanhola de Beneficência - Hospital Espanhol, Salvador – BA (Fábio Vilas Boas); Hospital Salvador, Salvador – BA (Cláudio Marcelo Bittencourt das Virgens); Hospital Geral de Vitória da Conquista – BA (Luis Cláudio Menezes de Carvalho); Hospital Antonio Prudente, Fortaleza – CE (Ricardo Lessa de Castro Júnior); Hospital Brasília – DF (Tullio Xavier Leirias); Instituto do Coração – DF (Luis Gustavo Ferreira); ProntoNorte, Brasília – DF (Rosana Costa Oliveira); MS Hospital dos Servidores do Estado, Rio de Janeiro – RJ (Luiz Maurino Abreu); Hospital Metropolitano, Serra – ES (Hermes Carloni Araújo); Hospital Memorial São Francisco, João Pessoa – PB (Francisco Ítalo Kumamoto); Hospital Dr. João Felício, Juiz de Fora – MG (Antonio Muniz); Hospital Ipiranga, São Paulo – SP (Fernando Lara Roquette); Santa Casa de Belo Horizonte – MG (Mário Lúcio Perez); Casa de Caridade de Carangola – MG (Rodrigo Di Mingo); Hospital Santa Rita, Contagem – MG (Álvaro Camisão de Souza); Hospital São Lucas, Governador Valadares – MG (Alexandre Becalli Rabelo); Hospital Vaz Monteiro, Lavras – MG (Marcos Cherem); Hospital São José do Avaí, Itaperuna – RJ (Antonio Carlos Botelho da Silva); Santa Casa de Misericórdia de Poços de Caldas – MG (José Tasca); Hospital Santa Genoveva, Uberlândia – MG (Eduardo Tiveron Veludo); Hospital de Cardiologia Procordis, Niterói – RJ (José Geraldo Amino); Hospital Regional de Mato Grosso do Sul, Campo Grande – MS (Emmanuel Nunes da Costa); Hospital Universitário Maria Aparecida Pedrossian – UFMS, Campo Grande – MS (Delcio Gonçalves Silva Junior); Hospital Santa Rita, Dourados – MS (Fernando Fonseca Gouvea); AMECOR, Cuiabá – MT (Ubirajara Lupoli Barbosa); FUSVAG, Várzea Grande – MT (Agnaldo Solon Arruda Ajambuja); Unidade de Emergência da UNIMED, Manaus – AM (Rovanda Guimarães Sena Marques); Hospital Regional Dr. Janduhy Carneiro, Patos – PB (Klauber Marques de França); Hospital Unimed, João Pessoa – PB (Eugênia Di Giuseppe Deininger); Hospital Agamenon

Magalhães, Recife – PE (Maria da Conceição Brandão Arruda Falcão); Hospital das Clínicas da UFPE, Recife – PE (Edgar Guimarães Víctor); Hospital Memorial de Petrolina – PE (Bedson José Lopes de Sá); UNICORDIS, Recife – PE (Levi da Cunha Pedrosa); Hospital Santa Maria, Teresina – PI (Dib Filho); Hospital Evangélico de Londrina – PR (Icanor Antonio Ribeiro); Hospital das Clínicas da UFPR, Curitiba – PR (Cláudio Leinig Pereira da Cunha); Hospital e Maternidade Parolin, Curitiba – PR (Mauro Leiria dos Reis); Hospital Quinta D'Or, Rio de Janeiro – RJ (Carlos Cleverton Lopes Pereira); Casa de Saúde Santa Teresinha, Rio de Janeiro – RJ (Martha dos Santos Cardoso); HEMOCOR, Rio de Janeiro – RJ (Rodrigo de Franco Cardoso); Hospital São José, Teresópolis – RJ (Robson Sobreira Pereira); Hospital São Lucas, Nova Friburgo – RJ (Waldir Malheiros); Casa de saúde nossa senhora do carmo -SOS Coração, Rio de Janeiro – RJ (Adriano Marçal Nogueira Junior); Hospital Pró Cardíaco, Rio de Janeiro – RJ (Roberto Esporcatte); Casa de Saúde Dix Sept Rosado, Mossoró – RN (Hernani de Paiva Gadelha Jr.); Hospital Nossa Senhora d Conceição, Tubarão – SC (Charles Martins de Castro); Hospital de Caridade e Beneficência, Cachoeira do Sul – RS (Carlos Eduardo Florence); Hospital Mãe de Deus, Porto Alegre – RS (Euler Roberto Fernandes Manenti); Hospital São Lucas da PUCRS, Porto Alegre – RS (Luiz Carlos Bodanese); Hospital Regina, Novo Hamburgo – RS (Ricardo Beuren); Hospital Santo

Ângelo, Santo Ângelo – RS (Gilmar Weber); Hospital Universitário Santa Maria, Santa Maria – RS (Valquíria Gallio Bulcão); Hospital Regional Hans Dieter Schmidt, Joinville – SC (Josiane Colver); Hospital Nossa Senhora da Conceição, Porto Alegre – RS (Pedro Pimentel Filho); Hospital de Caridade, Florianópolis – SC (Rodrigo Scolari); Santa Casa de Araraquara – SP (Othon Amaral Neto); Hospital Municipal de Governador Valadares – MG (Pedro Paulo Abranches Jr.); Hospital de Clínicas Mário Lioni, Duque de Caxias – RJ (Camilo de Lellis Carneiro Junqueira); Hospital de Base de Baurú - Hospital de Base Sétima Região, Bauru – SP (Samuel Fortunato); Hospital dos Fornecedores de Cana de Piracicaba - Domingos José Aldrovandi, Piracicaba – SP (Fábio Augusto Suzuki); Hospital Universitário de Presidente Prudente – SP (Henrique Issa Artoni Ebaid); Hospital Imaculada Conceição, Ribeirão Preto – SP (Divino Luiz Ratts Batista); Hospital Anchieta de São Bernardo do Campo – SP (Adriano Meneghini); Hospital Bandeirantes, São Paulo – SP (Mário Lúcio Alves Baptista Filho); Hospital Escola da Universidade de Taubaté – SP (Ruy Felipe Melo Viegas); Hospital Ana Costa, Santos – SP (Rider Nogueira de Brito Filho); Hospital Sírio-Libanês, São Paulo – SP (Ariane Vieira Scarlatelli Macedo); Hospital UNIMED de Sorocaba – SP (Hector Armando Archer Garcia); Hospital Geral de Palmas, Palmas – TO (Adriane Paula Gomes); Hospital e Maternidade Dom Orione, Araguaia – TO (Sandro Oliveira Sacre).

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