

Original article

# Impact on Delay Times and Characteristics of Patients Undergoing Primary Percutaneous Coronary Intervention in the Southern Metropolitan Area of Barcelona After Implementation of the Infarction Code Program

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ABSTRACT

**Introduction and objectives:** A standardized protocol of emergent transfer for primary percutaneous coronary intervention for patients with ST elevation myocardial infarction, defined as the Infarction Code, was implemented in June 2009 in the Catalan regional health system. The objective of this study was to evaluate the impact of the new protocol on delay times, number of procedures and clinical characteristics compared with the previous period in the population of patients referred to our hospital.

**Methods:** All consecutive patients undergoing primary percutaneous coronary intervention in our hospital were prospectively registered. The clinical characteristics, delay times and mortality in the follow-up of the protocol implementation period (June 2009-May 2010) were analyzed and compared with the previous year (June 2008-May 2009).

**Results:** During the protocol period, 514 patients were included, compared with 241 in the previous year. Age, cardiovascular risk factors, anterior myocardial infarction and procedure characteristics were similar in the 2 groups. The first medical contact to balloon time was lower in the protocol period (median time 120 min vs 88 min;  $P < .001$ ). Patients in the protocol period showed a trend toward less severe disease (Killip III, rescue angioplasty). The multivariate regression analysis showed a significant association between 1-year mortality and age, Killip class  $\geq$  III at admission, anterior infarction and 3-vessel disease.

**Conclusions:** The introduction of the Infarction Code program increased the number of patients treated by primary percutaneous coronary intervention with a reduction in delay times and better clinical characteristics at presentation.

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## Impacto en tiempos de actuación y perfil de los pacientes tratados con angioplastia primaria en el área metropolitana sur de Barcelona al implantar el programa Código Infarto

RESUMEN

**Introducción y objetivos:** Desde junio de 2009 se ha implantado en Cataluña el Código Infarto, mediante el cual se plantea a los pacientes con infarto agudo de miocardio con elevación del ST en las primeras 12 h de evolución la realización de angioplastia primaria. El objetivo es describir el impacto de aplicar el Código Infarto a los pacientes atendidos en nuestro centro en cuanto a volumen, tiempos de actuación y perfil clínico en comparación con el periodo previo.

**Métodos:** Registro prospectivo de pacientes sometidos a angioplastia primaria en nuestro centro. Análisis de características clínicas, tiempos de actuación y mortalidad en el seguimiento de la fase de aplicación del Código Infarto (junio de 2009-mayo de 2010) y comparación con el año previo (junio de 2008-mayo de 2009).

**Resultados:** En el periodo del Código Infarto se incluyó a 514 pacientes (241 el año previo). Edad, factores de riesgo, extensión de la enfermedad coronaria, infarto anterior y características del procedimiento fueron similares en los dos grupos. Se observó una disminución del tiempo desde el primer contacto médico a la apertura de la arteria (120 frente a 88 min;  $p < 0,001$ ). Se detectó una tendencia a una menor gravedad de los pacientes en la fase Código Infarto (Killip III, angioplastia de rescate). En el análisis

Palabras clave:

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Mortalidad

Código Infarto

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multivariable, la mortalidad a 1 año se relacionó con el infarto anterior, la clase Killip  $\geq$  III, la edad y la enfermedad multivaso.

**Conclusiones:** La implantación del Código Infarto ha aumentado el número de pacientes tratados mediante angioplastia primaria, con una reducción en los tiempos de actuación y una mejora en el perfil clínico a su llegada.

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## Abbreviations

EMS: emergency medical service  
 FMCtoB: first medical contact to balloon time  
 PA: primary angioplasty  
 STEMI: ST-segment elevation myocardial infarction

## INTRODUCTION

Primary angioplasty (PA) is the treatment of choice in acute ST-segment elevation myocardial infarction (STEMI).<sup>1–3</sup> This recommendation is based on ensuring that the time between first seeking medical attention and opening the artery is less than 120 min; the second-line option is fibrinolytic treatment.<sup>4</sup> The benefit of PA with respect to fibrinolysis lies, in addition to a greater intrinsic efficacy of the procedure in reestablishing flow to the artery, in the speed with which it is performed.<sup>5,6</sup> Thus, the delay from the time the patient arrives in the emergency room to opening of the artery is a crucial factor in determining the efficacy of the procedure and the results.<sup>7</sup> Several registries have shown that short delay times are associated with better outcomes in terms of mortality.<sup>8,9</sup> Thus, systematic performance of PA should be accompanied by a system that guarantees rapid diagnosis and immediate transfer to carry out the PA. In Spain and other European countries, there are several examples of care programs for STEMI, based on the integration of a central triage system and a network of referral hospitals that offer reperfusion treatment and district hospitals according to a hub and spoke arrangement.<sup>10,11</sup> Such an approach has allowed more widespread use of reperfusion in the acute phase of infarction and has had a clear impact on clinical outcomes.<sup>12,13</sup>

On June 1, 2009, an integrated care network, known as the Infarction Code was implemented in Catalonia for systematic performance of PA. The objective of this study was to detect changes resulting from the implementation of the Infarction Code among patients with STEMI treated with angioplasty in the first 12 h of infarction in terms of the number of patients attended, delay times, and clinical profile on arrival. The 1-year outcomes were also analyzed.

## METHODS

This retrospective study was performed using a prospective registry that included all consecutive patients referred to our center for reperfusion by PA or rescue angioplasty, with a diagnosis of STEMI: typical chest pain and persistent ST elevation or new onset left bundle branch block.<sup>2</sup>

A single database was designed to collect the baseline data and data on the procedure in the catheterization laboratory. The clinical outcome in the coronary unit was then recorded.

This study comprised 2 periods of 1 year each: PreCode phase (June 1, 2008 to May 31, 2009), and the Infarction Code phase (June 1, 2009 to May 31, 2010).

## PreCode Phase

During this period, percutaneous reperfusion treatment by means of PA was performed on:

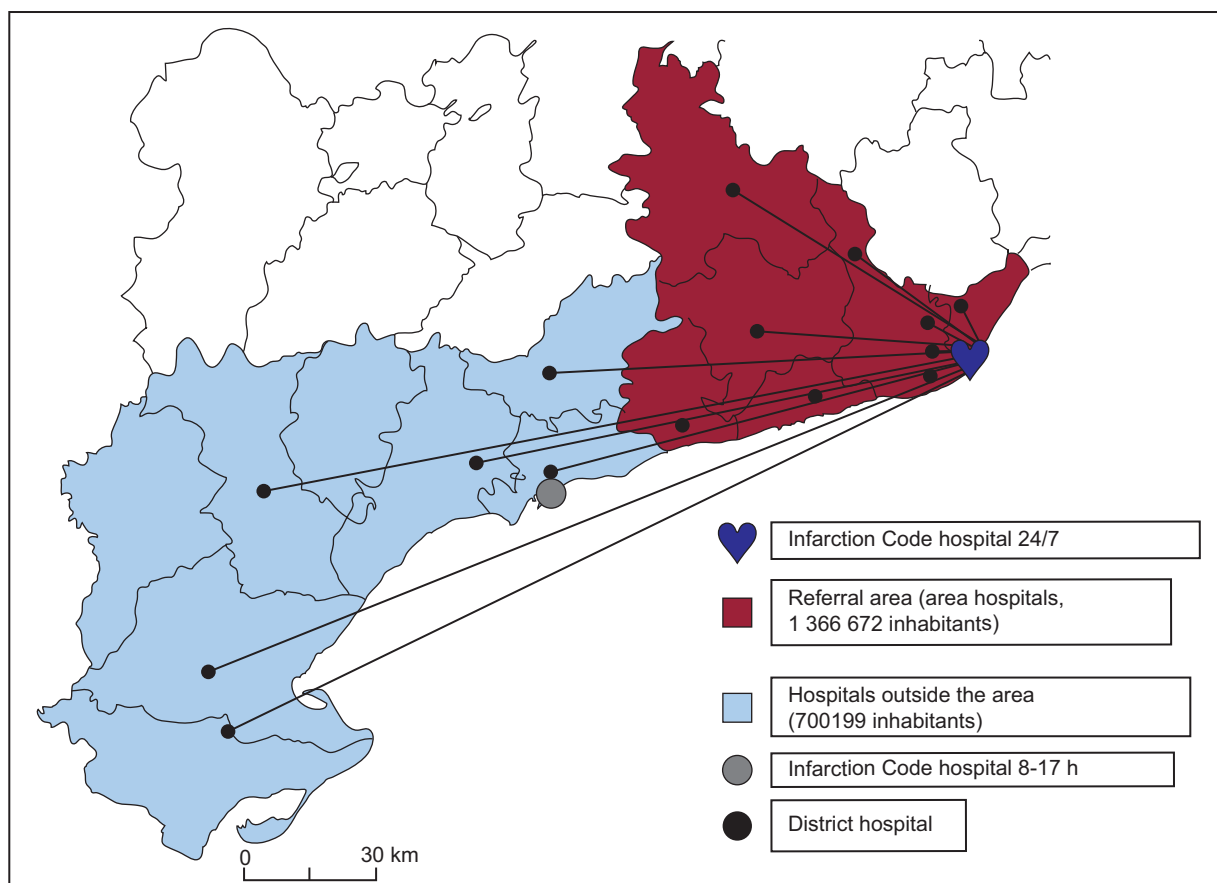
- All patients who attended the emergency room of our hospital.
- Patients transferred by the emergency medical services (EMS) from home or from primary care centers.
- Patients with contraindications for thrombolysis, referred from other hospitals.

Patients treated with thrombolysis in other centers who did not show signs of reperfusion 90 min after administration of fibrinolytic treatment were transferred to our center for rescue angioplasty. In all cases, the patient was assessed directly by the cardiology team on call in our hospital. The team decided on the indication for reperfusion and contacted the interventional cardiology unit to perform the procedure. In the PreCode phase, the patients' referral area was the same as in the Infarction Code phase. The difference was that there was no protocol for STEMI: there was no standard strategy for prioritizing patient transfer or systematic prior contact with the EMS and the duty cardiologist.

## Infarction Code Procedure

The Infarction Code was implemented in Catalonia on June 1, 2009, in order to offer PA treatment to all patients diagnosed with STEMI and to guarantee shorter times between seeking medical assistance and opening of the artery. The autonomous community was divided into referral areas according to territorial sectors. The referral area of our hospital (Fig. 1)<sup>14</sup> includes 6 districts in the provinces of Barcelona and Tarragona,<sup>14</sup> which include 8 hospitals (area hospitals). Outside office hours (Monday to Friday from 17:00, and Saturdays and holidays), our hospital is also the referral hospital for other districts in the province of Tarragona,<sup>14</sup> which includes 7 hospitals (outside-area hospitals). When a healthcare team able to refer a patient for reperfusion therapy (primary healthcare centers, EMS, hospitals) diagnoses STEMI, they contact the EMS. When diagnosis is confirmed and transfer is decided, the Infarction Code is considered activated. The EMS contacts the duty cardiology team (single direct line) to report the patient's arrival, and the duty cardiologist directly alerts the interventional cardiology unit in the catheterization laboratory while the patient is in transfer. At the time of activation, double antiplatelet therapy is administered (acetylsalicylic acid and clopidogrel 600 mg) along with anticoagulation therapy (unfractionated heparin, 1 mg/kg as an intravenous bolus).

With patients who report directly to the emergency room of our hospital, the operation of the Infarction Code is no different to the previous period: a call is made to the duty cardiologist, who alerts the interventional cardiology unit.



**Figure 1.** Referral area of our center. Hospitals inside and outside the area.

In patients who need a transfer from other hospitals to perform PA, if the coordinating center of the EMS considers that the expected time between diagnosis and opening of the artery would clearly exceed 120 min, *in situ* fibrinolytic treatment is recommended; if this is ineffective, the patient is transferred for rescue angioplasty.

The Infarction Code was implemented at the extrahospital level by reorganizing ambulance flows, without increasing the resource needs of the transport system. Within the hospital, the increase in resources took the form of the availability of 2 intermediate care beds after interventions and hiring an additional nurse and a part-time interventional cardiologist.

Given the increase in the volume of work associated with implementing the program, and in order to offer appropriate care to all patients without overloading the interventional center, a protocol for return to the referring hospitals was drawn up. This protocol stipulates that after the procedure, hemodynamically stable patients with no complications are transferred to their referring hospital. Patients can be transferred to a hospital with an intensive care unit 8 h after reperfusion and can return to a hospital with conventional wards after 24 h have elapsed.

### Study Variables

Data on classification, origin, clinical characteristics, infarction, and procedure were collected.

For times, the following parameters were collected: time of symptom onset, time of first medical contact (time in which the first diagnostic electrocardiogram was performed and percutaneous reperfusion treatment was indicated),<sup>15</sup> time of arrival in the

catheterization laboratory, and time of opening of the artery (time when the first device is introduced).

From these times, the following delays were derived (Fig. 2): patient delay (time from the onset of symptoms to the first medical contact), delay in activation/transfer (time from first medical contact to arrival in the catheterization laboratory), and procedure delay (time from arrival in the catheterization laboratory until artery opening).

Finally, the following intervals were calculated: time from first medical contact to reperfusion (FMCToB, time from first medical contact to balloon), and total ischemia time (time from symptom onset until opening of the artery).

The success of the reperfusion procedure was defined as final TIMI (Thrombolysis in Myocardial Infarction) flow grade 3 and residual stenosis <20%.<sup>16</sup>

Clinical follow-up at 30 days and 1 year was performed. Data on mortality (overall and cardiovascular related), reinfarction, repeat revascularization of the “culprit” vessel, and stroke were collected. The composite outcome of all-cause mortality, reinfarction, and repeat revascularization of the culprit lesion at 30 days and 1 year was analyzed.

### Statistical Analysis

Quantitative variables are shown as means (standard deviation) and were compared using the Student *t* test; if they did not follow a normal distribution, they were reported as medians [interquartile range] and compared using the Mann-Whitney rank test. Categorical variables were compared using the Pearson  $\chi^2$  test and described using absolute numbers and percentages.

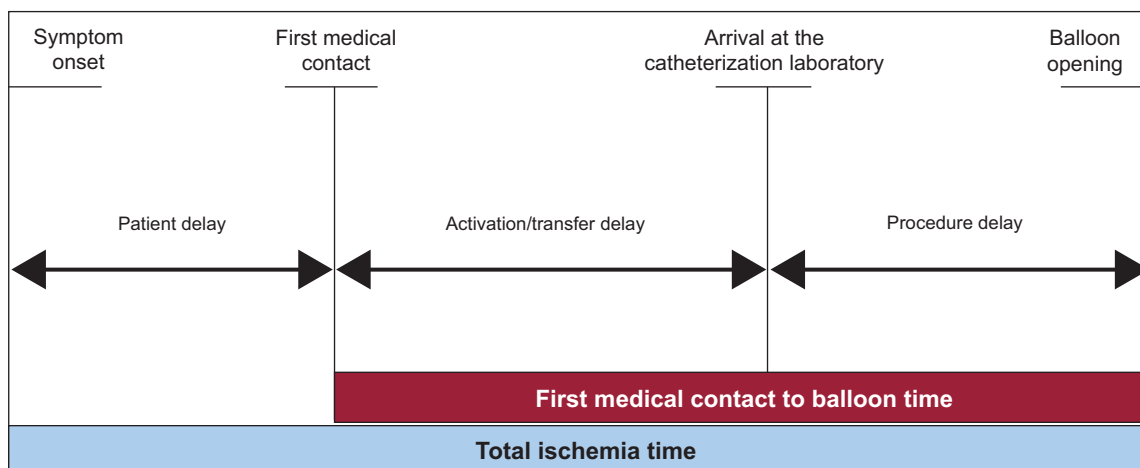


Figure 2. Periods of time analyzed.

The survival analysis was performed using the Cox proportional risks analysis with stepwise regression. The multivariate analysis included variables that were significant in the univariate comparison ( $P < .1$ ) and clinically relevant variables according to previous publications. The assumption of proportionality was checked by introducing interactions between the study variables and survival time into the model. Survival curves were constructed from the Cox model. Significance was set at a bilateral  $P$  value  $< .05$ . SPSS (version 18.3) software was used for the statistical analysis (SPSS Inc., Chicago, Illinois, United States).

## RESULTS

### Clinical Characteristics

In the PreCode phase (June 1, 2008 to May 31, 2009), percutaneous reperfusion was performed in our center in the first 12 h of infarction in 241 patients, whereas during the Infarction Code phase (June 1, 2009, to May 31, 2010), 514 reperfusion procedures were performed, representing an increase of 112%.

During the Infarction Code period, 566 emerging catheterization procedures were performed (PA indication or rescue angioplasty), of which 52 (9.2%) were considered false alarms, and were not included in the analysis. The patients' clinical characteristics are summarized in Table 1; no significant differences between groups were found. A significant increase in the percentage of PA compared to rescue angioplasty was observed. An increase in the rate of use of bivalirudin as an anticoagulant was identified in the Infarction Code phase.

No significant differences were observed for successful outcome of the procedure. Of note was a greater trend toward greater severity in the PreCode phase. The variables of hypotension, cardiogenic shock, advanced Killip class, and intraaortic balloon counter pulsation occurred more frequently in the PreCode phase.

### Patient Origin and Site of Code Activation

During the Infarction Code phase, the number of patients transferred by EMS from home or the primary care center (116 vs 190) and from hospitals in the referral area (35 vs 191) increased, whereas the number of patients who spontaneously attended the emergency room in our center remained the same (Table 2).

Overall, the number of patients referred from a noninterventional center increased from 24% ( $n=57$ ) to 49% ( $n=252$ ). The decision to activate the PA system in the PreCode period was taken almost exclusively in our hospital on the arrival of the patient. In contrast, after implementing the Infarction Code, 86% of the activations occurred outside our center (Fig. 3). As a result of this modification, the percentage of patients who entered the catheterization laboratory directly without referral from the emergency room was 11% ( $n=26$ ) in the PreCode phase and 67% ( $n=327$ ) in the Infarction Code phase. The number of procedures performed outside office hours significantly increased (Table 1).

### Delay Times

Table 3 details the changes observed in delay times. A significant reduction in the median total ischemia time of 30 min (12.2% reduction) was observed. A more marked median reduction in FMctoB of 32 min (26.7% reduction) was also observed. In the detailed analysis of the delays, a decrease in the activation/transfer time of 29 min was observed, whereas the in-hospital delay was reduced by a median of 3 min. No significant changes in patient delay were observed.

The percentage of patients with FMctoB  $< 120$  min was significantly higher in the Infarction Code group (81% vs 51%;  $P < .001$ ).

Given the greater percentage of patients treated with rescue angioplasty in the PreCode phase, the delay times in the subgroup of patients treated with PA were analyzed, and the same differences as those observed for the overall population were maintained (Table 3B).

Analysis according to referral site showed a decrease in delay times for all sites where the Infarction Code was activated (Table 2). This result was maintained when only patients who underwent PA were analyzed, and a significant decrease in FMctoB was observed, even in the cases of transfers over larger distances (from outside-area hospitals).

### Clinical Outcomes

#### Mortality

The overall mortality of the patients with STEMI treated by angioplasty in the first 12 h of the infarction was 6.5% at 30 days and 9.8% at 1 year of follow-up. The crude all-cause mortality rates at 30 days and 1 year were lower in the Infarction Code group (Table 4A). Table 4B expresses the data pertaining to patients who

**Table 1**  
Baseline Characteristics of the Event and the Procedure

	PreCode (n=241)	Infarction Code (n=514)	P
<i>Demographic Data</i>			
Age	61.5±12.6	61.8±13.4	.75
Women	44 (18.3)	103 (20)	.6
<i>History</i>			
Smoker	119 (49.4)	228 (44.4)	.2
Dyslipidemia	138 (57.3)	266 (51.8)	.16
Hypertension	138 (57.3)	294 (57.2)	.99
Diabetes mellitus	57 (23.7)	137 (26.7)	.4
Renal failure	11 (4.6)	31 (6)	.4
Peripheral vascular disease	26 (10.8)	32 (6.2)	.03
Prior AMI	26 (10.8)	63 (12.3)	.6
Prior PCI	18 (7.5)	39 (7.6)	.95
Prior coronary artery surgery	6 (2.5)	7 (1.4)	.21
<i>Infarction data</i>			
Anterior AMI	100 (41.5)	238 (46.3)	.22
Inferior AMI	133 (55)	252 (49)	.12
Killip≥III	24 (10)	31 (6)	.081
Cardiogenic shock	11 (4.6)	17 (3.3)	.4
OTI	17 (7.1)	23 (4.5)	.14
<i>Treatment</i>			
ASA	238 (98.7)	507 (98.6)	.5
Clopidogrel	229 (95)	488 (94.9)	.99
Heparin	230 (95)	492 (96)	.98
Abciximab	45 (18.7)	109 (21.2)	.44
Bivalirudin	31 (12.9)	125 (24.3)	<.001
<i>Data on the Procedure</i>			
Primary angioplasty	195 (80.9)	486 (94.6)	<.001
Rescue angioplasty	46 (19.1)	28 (5.4)	<.001
Out of office hours	113 (47)	286 (64)	<.001
IAoBCP	13 (5.4)	9 (1.8)	.009
Initial TIMI flow 0-1	177 (73.6)	396 (77.4)	.32
Three-vessel disease	43 (17.8)	97 (18.9)	.77
Thrombus aspiration	167 (69)	365 (71)	.67
Coronary stenting	223 (92.5)	476 (92.6)	.97
Final TIMI flow 3	229 (95)	488 (94.9)	.99
Angiographic success	227 (94.2)	480 (93.2)	.75
Zwolle score	3.6 [1-4]	3.2 [1-4]	.12

AMI, acute myocardial infarction; ASA, acetylsalicylic acid; AVB, atrioventricular block; IAoBCP, intraaortic balloon counter pulsation; OTI, orotracheal intubation; PCI, percutaneous coronary intervention; TIMI, Thrombolysis in Myocardial Infarction.

The results are expressed as mean±standard deviation, no. (%), or median [interquartile range].

underwent PA and shows similar results to those of the overall population.

The multivariate analysis (Fig. 4) showed that the variables predictive of mortality at 1 year were age, anterior infarction site, Killip class≥III on arrival at the catheterization laboratory, and multivessel disease. The variable of study period showed a trend to lower mortality in the Infarction Code group, although the differences were not statistically significant. The survival curves constructed from the multivariate analysis are shown in Figure 5. The multivariate analysis limited to patients who underwent PA showed that the variables predictive of 1-year mortality were the same as those for the overall population and confirmed that the variable of study period was associated with lower mortality in the Infarction Code group, although the differences

**Table 2**  
Delay Between First Medical Contact and Reperfusion According to Period, Origin, and Indication for Reperfusion

	PreCode	Infarction Code	P
<i>A. Overall population</i>			
Home/PCC (n=116/190)	125 [90-160]	80 [63-105]	<.001
Emergency room (n=68/72)	82 [60-125]	70 [50-84]	.03
In-area hospital (n=35/191)	135 [106-200]	90 [75-110]	<.001
Outside-area hospital (n=22/61)	218 [168-300]	132 [105-155]	<.001
<i>B. Only primary angioplasty</i>			
Home/PCC (n=104/189)	123 [89-160]	80 [63-105]	<.001
Emergency room (n=68/72)	82 [60-125]	70 [50-84]	.03
In-area hospital (n=16/191)	130 [105-165]	90 [75-110]	.001
Outside-area hospital (n=7/34)	215 [160-235]	119 [95-148]	<.001

PCC, primary care center.

Times (minutes) as median [interquartile range].

**Table 3**  
Delay Times

	PreCode	Infarction Code	P
<i>A. Overall population, no.</i>			
FMCToB	120 [85-165]	88 [68-114]	<.001
Total ischemia time	246 [180-390]	216 [166-330]	.001
Patient delay	110 [75-215]	115[60-184]	.2
Activation/transfer delay	85 [53-130]	56 [40-85]	<.001
In-hospital delay	30 [25-40]	27 [20-35]	<.001
<i>B. Primary angioplasty, no.</i>			
FMCToB	115 [80-160]	85 [66-110]	<.001
Total ischemia time	225 [170-360]	210 [165-310]	.02
Patient delay	107 [70-203]	111 [57-175]	.3
Activation/transfer delay	80 [45-120]	55 [39-80]	<.001
In-hospital delay	30 [25-40]	27 [20-35]	<.001

FMCToB, first medical contact to balloon time.

Times (minutes) as median [interquartile range].

were not statistically significant (hazard ratio=1.67; 95% confidence interval, 0.98-2.9; P=.06).

### Reinfarction, Revascularization, Stroke

The reinfarction rates at 30 days and 1 year showed no significant differences between the 2 groups; a greater trend toward a higher incidence of reinfarction at 1 year of follow-up was observed in the PreCode group.

The revascularization rate of “culprit” lesions at 30 days and 1 year showed no significant differences.

The stroke rates at 30 days were low in both groups. Although the incidence was 2-fold higher in the PreCode group, this difference was not statistically significant.

Analysis of the composite endpoint of death, reinfarction, and new revascularization showed a significant difference between the 2 groups at 1 year of follow-up (Table 4); this difference was not maintained in the multivariate analysis of survival.

## DISCUSSION

Implementation of the Infarction Code has radically changed the care of patients with STEMI in our population. In line with

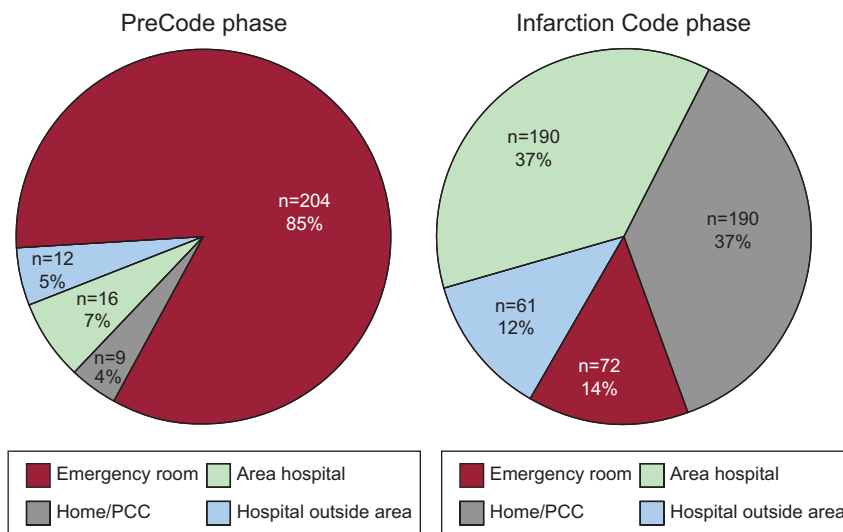


Figure 3. Site of indication of reperfusion. Differences between PreCode and Infarction Code phases. PCC, primary care center.

previously studies, we observed an almost 2-fold increase in the number of patients who received percutaneous reperfusion treatment in the acute phase of acute myocardial infarction and a significant decrease in rescue angioplasty<sup>13</sup> in our catheterization laboratory.

Table 4  
Descriptive Analysis of Clinical Outcomes

	PreCode	Infarction Code	P
<b>A. Overall population</b>	241	514	
<i>Events at 30 days</i>			
Total mortality	22 (9.1)	27 (5.3)	.044
Cardiac mortality	21 (8.7)	23 (4.5)	.02
Reinfarction	5 (2.1)	7 (1.4)	.54
RRCV	4 (1.7)	6 (1.2)	.74
IS	3 (1.2)	3 (0.6)	.39
MCVE	26 (10.8)	34 (6.8)	.063
<i>Events at 1 year</i>			
Total mortality	33 (13.7)	41 (8)	.018
Cardiac mortality	27 (11.2)	30 (5.8)	.012
Reinfarction	13 (5.4)	13 (2.6)	.06
RRCV	11 (4.6)	16 (3.2)	.4
MCVE	45 (18.8)	57 (11.5)	.007
<b>B. Primary angioplasty</b>	195	486	
<i>Events at 30 days</i>			
Total mortality	15 (7.7)	25 (5.1)	.21
Cardiac mortality	14 (7.2)	21 (4.3)	.13
Reinfarction	5 (2.6)	6 (1.3)	.31
RRCV	4 (2.1)	5 (1.1)	.46
IS	1 (0.5)	2 (0.4)	1
MCVE	19 (9.7)	31 (6.6)	.19
<i>Events at 1 year</i>			
Total mortality	26 (13.3)	37 (7.6)	.016
Cardiac mortality	20 (10.3)	26 (5.3)	.027
Reinfarction	10 (5.1)	11 (2.3)	.08
RRCV	8 (4.1)	15 (3.2)	.6
MCVE	34 (17.4)	52 (10.9)	.03

IS, ischemic stroke; MCVE, major cardiovascular events (death, reinfarction, or repeat revascularization); RRCV, repeat revascularization of "culprit" vessel. Data are presented as no. (%).

### Delay Times

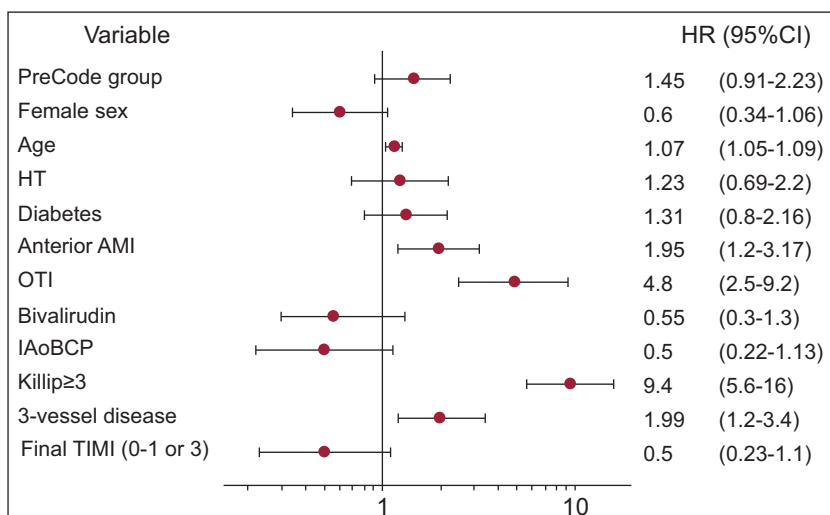
The present study showed a clear improvement in delay times compared with the period prior to the Infarction Code in patients treated with angioplasty in the first 12 h. Currently, the vast majority of patients have FMctoB that meet the recommendations of the European Guidelines.<sup>2</sup> Among the modifications provided by the new protocol, we wish to emphasize the effectiveness of extrahospital activation of PA, which, along with direct transfer to the catheterization laboratory, has been shown to have a significant impact on reducing delay times.<sup>17</sup> We should highlight that in our study, we refer to the time of first medical contact as the time in which reperfusion treatment was indicated, whether in our center, extrahospital care, or in another hospital unable to perform PA. This distinction is important because some recent publications on delay times in the United States<sup>6,18</sup> exclude patients transferred from other centers (up to a third of the total), and the delay was calculated relative to the arrival of the patient at the hospital with PA facilities. Measurement of the times from therapeutic indication seems to be a more appropriate strategy, as it allows the overall functioning of the health system to be assessed.<sup>15</sup> Our results are comparable to those published in this journal by Rodríguez-Leor et al.,<sup>19</sup> who reported very similar total ischemia and FMctoB times. In our series, compared with that study, the patients transferred from other centers, despite a larger and more populated referral area, showed shorter delay times, in line with those recommended in the guidelines. Implementation of the Infarction Code has allowed a greater reduction in FMctoB compared with the previous period in this group in particular.

With regard to patients from centers outside the referral area, despite a decrease in times compared with the PreCode phase, FMctoB still has values above those recommended by the guidelines; further efforts are needed to optimize the transfer strategy and comply with recommendations in order to maintain the clinical benefit of PA and guarantee homogenous care for the entire population.

Nevertheless, given that some transfers are up to 200 km, the times obtained do not differ from those of other registries in the "real world" that have assessed similar situations.<sup>8,10,20</sup>

### Clinical Events

The mortality results were similar to those obtained in care programs for STEMI at a national level<sup>21</sup> and were also in line with



**Figure 4.** Multivariate analysis of predictors for mortality at 1 year of follow-up. 95%CI, 95% confidence interval; AMI, acute myocardial infarction; HR, hazard ratio; HT, hypertension; IAoBCP, intraaortic balloon counter pulsation; OTI, orotracheal intubation; TIMI, Thrombolysis in Myocardial Infarction.

data published from international trials and clinical registries.<sup>9,22-24</sup> Of note is the tendency to improved clinical profile on admission, with a lower incidence of severe heart failure among patients of the Infarction Code group. This difference in fundamental clinical variables that impact on prognosis has several explanations. Firstly, it could be explained, in part, by a decrease in the percentage of patients undergoing rescue angioplasty, a subgroup with a worse severity profile and a tendency for poorer outcomes.<sup>25,26</sup> Secondly, the decrease in delay times has helped improve the severity profile on arrival in the catheterization laboratory. Finally, we cannot rule out a selection bias in our study during the PreCode period, which may have had an impact on clinical outcomes.

In comparison with other series published, we found no differences in factors predictive of mortality in our population.<sup>6,21,27</sup> A larger number of patients are required to determine

whether there is a significant impact on mortality on implementation of the Infarction Code. However, the reductions observed in terms of delay times and more favorable initial clinical profile on arrival at the catheterization laboratory undoubtedly had an impact on the trends observed.

The differences in mortality and clinical events observed in the 2 groups were maintained in the subgroup of patients who underwent PA. This observation underlines the importance of reducing delays after activating the Infarction Code.

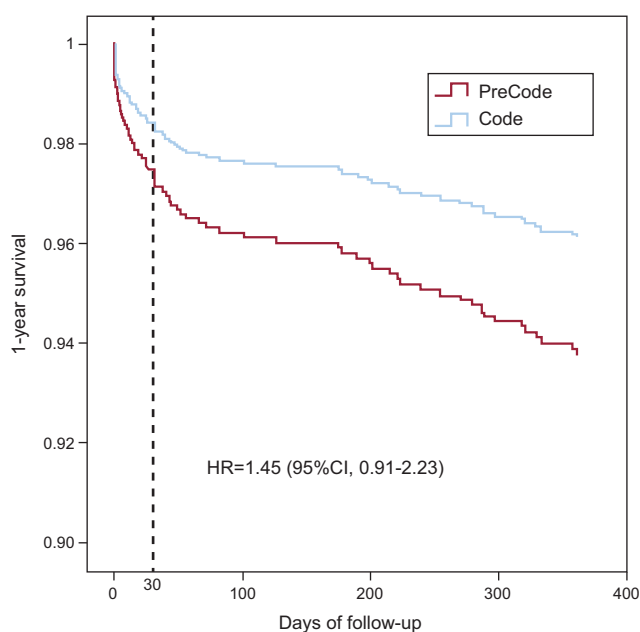
An aspect of note is that, given the characteristics of our referral area, the population attended by our hospital has little inter-sectorial mobility, and therefore the Infarction Code program can serve to identify the real incidence at a population level of myocardial infarction treatable by reperfusion in a referral area.

**Limitations**

This was a single-center, observational study and, although data were collected prospectively, some differences might not have been detected, which might have had an impact on the findings. Furthermore, as already mentioned, although all patients referred to our hospital during the study period were included, thereby ensuring good representation of the functioning of PA in the “real world”, a selection bias in the PreCode period cannot be ruled out. Indeed, we do not know the real incidence and characteristics of the infarctions treated by effective fibrinolysis or not treated with any reperfusion therapy in this period. Consequently, clinical outcomes should be interpreted with caution, although implementation of the Infarction Code is one of the largest differences between the 2 periods and is probably the main factor behind the improvements observed in the outcomes of our patients.

**CONCLUSIONS**

It has been shown that implementation of the Infarction Code improves delay times for care of patients with STEMI treated in our center with PA, leading to an efficient care network, even for long-distance transfers. The effectiveness of the protocol was confirmed by the short and long-term results, with an improvement in the clinical profile of the patients on arrival at the catheterization laboratory and low mortality rates during follow-up.



**Figure 5.** Survival curves at 1 year. 95%CI, 95% confidence interval; HR, hazard ratio.

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## CONFLICTS OF INTEREST

None declared.

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