

Original Investigation Reports

Delay to reperfusion in patients with myocardial infarction in Santa Fe. It is time to develop a reperfusion network

Hominal Miguel, Braida Antonela, López Lautaro, Constantin Nahuel, Etchetto Fabricio.

Coronary Unit. Cardiology Service. Sanatorio Diagnóstico. Santa Fe. Argentina.

ARTICLE INFORMATION

Received on November 10, 2024.

Accepted after review on February 4, 2025.

www.revistafac.org.ar

There are no conflicts of interest to disclose.

Keywords:

Acute myocardial infarction,
Reperfusion,
Networks of care for myocardial infarction.

ABSTRACT

Introduction: Time to reperfusion in myocardial infarction is crucial and can be optimized. The use of reperfusion networks has shown to be useful in improving delays.

Objectives: to evaluate in-hospital outcomes in subjects with MI according to the distance of referral and to identify barriers associated with delays.

Methods: all consecutive MI admitted between 2016 and 2023 were analyzed. The sample was divided into groups according to the referral distance: Zone 1 (Z1) Santa Fe, Zone 2 (Z2) ≤ 100 km, Zone 3 (Z3) >100 and ≤ 200 km and Zone 4 (Z4) >200 km. In-hospital outcomes were analyzed. All referral sites were contacted to identify challenges and causes of delays.

Results: a sample of 408 STEMI was selected: 54.6% were from Z1, 27.9% from Z2, 13.7% from Z3 and 3.6% from Z4. It was observed that there was a significant difference between the referral zones and the time until admission (Z1 4 h, Z2 6 h, Z3 9 h y Z4 16 h ($p < 0.004$). Reperfusion was performed at 70.1% and the most common cause of the lack of reperfusion was the delay (60.5%). Cardiogenic shock and mortality were higher according to the distance of the transfer ($p = 0.02$ y $p = 0.01$, respectively). Referral sites were contacted, and common causes of delay were identified.

Conclusions: In-hospital outcomes are related to the delay to transfer. The implementation of networking might be useful to minimize this problem.

INTRODUCTION

Acute myocardial infarction (AMI) constitutes the most important cause of mortality in Argentina. National reports reflect that approximately 30% of deaths in the country are due to cardiovascular cause.^{1,2,3}

The time elapsed between the patient contacting the system (patient's delay) and reperfusion (system's delay) constitutes an aspect modifiable by health policies. Once the diagnosis of ST elevation myocardial infarction (STEMI) has been established by the emergency service, the immediate activation of the hemodynamics service reduces delay to reperfusion, and thus, mortality.^{4,5,6,7} These times can be optimized in a simpler manner in centers having a hemodynamic service, where organization at institutional level becomes the foundation for success. It is more difficult in centers with no capacity for angioplasty (TCA), where a referral should be made to the nearest center. In such case, the system's delay considers the confirmation of the patient being received by the TCA center and the transfer logistics.

National registries report that between 15 and 30% of patients with reperfusion criteria do not receive a proper treatment, and that in less than 45% of cases reperfusion is

reached within the recommended times due to a lack of an adequately organized access to the health care system.^{8,9,10,11} The implementation of referral networks for reperfusion in AMI has proven to be an essential tool to decrease these delays. This tool allows patients to be treated in appropriate times and places, as their operation is based on two crucial foundations: making a correct pre-hospital diagnosis and carrying out a coordinated work between centers with different complexities to optimize reperfusion.^{12,13}

OBJECTIVES

The objective of our study was to evaluate the in-hospital outcomes in patients admitted due to STEMI to an institution according to their origin location, and to identify the current obstacles making their referral difficult.

MATERIALS AND METHODS

All patients admitted to the Coronary Unit of the Sanatorio Diagnóstico, since July 2016 until December 2023, due to AMI, were analyzed. Patients with NSTEMI were excluded.

Acute myocardial infarction was defined as patients with clinical symptoms of ACS and cardiac biomarkers elevated, associated to the presence of some of the following

criteria: a) ST segment elevation ≥ 1 mm; b) motion or perfusion alteration in imaging study; c) evidence of intracoronary thrombus. Only type I AMIs, according to the fourth universal definition, were excluded.¹⁴

The sample was divided into zones according to distance in kilometers (km) until the institution in: Zone 1 (Z1) limited to the city of Santa Fe; Zone 2 (Z2) up to 100 km of distance; Zone 3 (Z3) between 100 and 200 km of distance; and Zone 4 (Z4) more than 200 km of distance. The estimation of distance was made by Google Maps, considering the fastest trajectory between the places where patients were assisted and the institution, going by land.

The variables of presentation were analyzed in patients at the time of hospital admission, as well as the treatment established and the following in-hospital events:

- **Heart failure:** presence of signs and/or symptoms of congestion upon admission and/or as they coursed.
- **Ventricular arrhythmias:** presence of tachycardia or sustained ventricular fibrillation or requirement for electrical cardioversion.
- **Kidney failure:** baseline value of serum creatinine > 2 mg/dl or its increase by 1.5 times the baseline value.
- **Cardiogenic shock:** defined as sustained systolic blood pressure of less than 90 mmHg, with no response to proper expansion and/or requiring vasopressor agents. It was considered both upon admission or during the patient's in-hospital course.
- **Mortality:** considered as all-cause death.
- **Composite events:** the addition of the abovementioned events.

Phone contact was made with all the locations included in the analysis, which corresponded to the center-north corridor of the province of Santa Fe. Locations in the south of the province were not included as referral is centralized in the city of Rosario. Data corresponding to the type of institution, availability of admission to ward or therapy, specialists, location of referral, hemodynamics and thrombolytic agents were surveyed.

For data analysis, the IBM SPSS Statistics 27 software was used. Quantitative variables are expressed as median and interquartile range; while qualitative variables are expressed as percentages and/or numbers. Chi-square test was applied to compare qualitative variables and Student's t-test for quantitative variables. In the cases of categorical variables, the ANOVA test and the chi-square test for trend were used, as it corresponded. A $p < 0.05$ value was considered significant.

RESULTS

During the analyzed period, a total of 693 patients were admitted to the Coronary Unit of the Sanatorio Diagnóstico due to AMI. From the total, those with NSTEMI ($n=278$) were excluded, constituting a final sample of 415 STEMI. From them, 53.9% ($n=227$) corresponded to Z1, 28.5% ($n=116$) to Z2, 13.9% ($n=57$) to Z3 and 3.7% ($n=15$) to Z4. The distance median of Z2 was 69.5 km (7 to 98 km), of Z3 119 km (101 to 186 km) and of Z4 248 km (213 to 366 km).

The referral locations for each zone were:

- **Zone 2:** Colastiné, Monte Vera, San José del Rincón, Santo Tomé, Arroyo Leyes, Empalme San Carlos, Recreo, Sauce Viejo, Franck, Laguna Paiva, Esperanza, Desvío Arjón, Nelson, San Jerónimo Norte, San Carlos Centro, Coronda, Humboldt, Llambi Campbell, Arocena, Gessler, Sa Pereira, San Fabián, Emilia, Pilar, Santo Domingo, Cayastá, Progreso, Barrancas, Videla, Gálvez, Nuevo Torino, Helvecia, Lopez, Bernardo de Irigoyen and Monje.

- **Zone 3:** Irigoyen, Felicia, San Justo, Maciel, Puerto Gaboto, Rafaela, María Juana, Colonia Macias, Marcelino Escalada, San Genaro, Sastre, Sunchales, Cañada Rosquín, Centeno, Soledad, San Javier, Gobernador Crespo, Colonia Dolores, La Lucila, La Criolla, San Cristóbal, Vera y Pintado, La Brava, El Trébol, Colonia Teresa and Pedro Gomez Cello.

- **Zone 4:** Calchaqui, Alejandra, Margarita, San Guillermo, La Gallareta, Vera, Malabrigo, Tostado, Reconquista, Avellaneda, Golondrina and Las Toscas.

The age median of the sample was 69 years (range from 30 to 95 years). The male gender was the most prevalent (64.4%) and the most frequent risk factor was hypertension (67.7%); 31.8% were diabetic and 17.1% presented history of ischemic heart disease (angina, AMI or previous PTCA). The rest of the basal characteristics of the population and the comparison between the different groups can be observed in [Table 1](#).

In regard to the time elapsed between the onset of symptoms and arrival to the institution, a statistically significant difference was evident between the different zones (median in h): Z1 4 h, Z2 6 h, Z3 9 h and Z4 16 h ($p < 0.005$). Also, it was observed that the presence of angina at the time of admission was less as the distance increased: Z1 85.5%, Z2 85.3%, Z3 77.2% and Z4 40% ($p < 0.005$). Likewise, at the time of admission, 64.9% did not present signs of heart failure (HF), 22.4% were in Killip Kimball II/III and 8.2% in cardiogenic shock ([Table 2](#)).

Reperfusion was carried out in 70.1% of cases by primary TCA. Between non-reperused individuals ($n=124$), the most frequent cause was being outside the therapeutic window (60.5%), followed by the presence of inappropriate anatomy (21.8%). A difference was observed in the reason not to reperfuse according to the different areas where the patients came from, with an increase being significant in late arrival to the reperfusion center according to the different areas of origin, as reflected in [Table 3](#).

An estimation was made of left ventricular ejection fraction (LVEF) in 95% of cases by echocardiogram, with a 50% median. It was observed that it was reduced as distance increased: Z1 50%, Z2 50%, Z3 46% and Z4 34% ($p < 0.005$).

In regard to in-hospital course, the most frequent complication was HF (34.6%), cardiogenic shock (16.3%), kidney failure (14.5%) and the presence of ventricular arrhythmias (VT/VF) (9.1%). Total mortality was 13%. A trend of increase was observed in the incidence of complications as referral distance increased: HF (Z1 36.6%, Z2 35.5%, Z3 45.6% and Z4 46.7%; $p=0.4$), kidney failure (Z1 12.3%, Z2 14.7%,

TABLE 1.
Basal characteristics of the population

	Total	Zone 1	Zone 2	Zone 3	Zone 4	P
Age (years)	69 ± 12	69 ± 12	69 ± 12	68 ± 11	67 ± 11	0,9
Male gender	64,6%	64,8%	67,2%	59,6%	60%	0,7
Risk factors						
Hypertension	67,7%	67,8%	65,5%	70,2%	100%	0,4
Diabetes Mellitus	31,8%	31,7%	29,3%	35,2%	40%	0,7
CV history						
Infarction	11,1%	12,8%	7,8%	8,8%	20%	0,3
Angioplasty	12,3%	12,8%	12,9%	8,8%	13,3%	0,8
Ischemic heart disease	17,1%	16,7%	17,2%	17,5%	20%	0,9
Vascular disease	10,6%	10,1%	12,1%	8,8%	13,3%	0,8
Heart failure	5,8%	6,2%	6%	3,5%	6,7%	0,8
Stroke	7%	7%	5,2%	10,5%	6,7%	0,6

TABLE 2.
Presentation variables upon admission to the center

	Total	Zone 1	Zone 2	Zone 3	Zone 4	P
Angina upon admission	82,7%	85,5%	85,3%	77,2%	40%	0,006
Onset of symptoms (h)	5 ± 8	4 ± 6	6 ± 8	9 ± 9	16 ± 9	0,004
Killip Kimball						
I	64,9%	70,9%	70,7%	59,6%	53%	0,09
II	18,8%	18,1%	18,1%	24,6%	26,6%	0,2
III	3,6%	3,1%	5,2%	3,5%	6,6%	0,3
IV	8,2%	7,9%	6%	12,3%	13,3%	0,01

TABLE 3.
Variables associated to a lack of reperfusion

	Total	Zone 1	Zone 2	Zone 3	Zone 4	P
Non-reperfused cases	29,9% (124)	26,9% (61)	28,4% (33)	36,8% (21)	60% (9)	0,03
Outside therapeutic window	60,5% (75)	52,5% (32)	69,7% (23)	71,4% (15)	77,8% (7)	0,04
Inappropriate anatomy	21,8% (27)	27,8% (17)	18,8% (6)	14,3% (3)	11,1% (1)	0,06
MINOCA	40,8% (11)	47% (8)	33,3% (2)	33,3% (1)	0% (0)	0,07
Failed primary TCA	22,2% (6)	17,6% (3)	11,1% (1)	33,3% (1)	100% (1)	0,22
Small vessel disease	18,5% (5)	23,6% (4)	11,1% (1)	0% (0)	0% (0)	0,32
LMCA and/or 3-vessel lesion	18,5% (5)	11,8% (2)	33,3% (2)	33,3% (1)	0% (0)	0,4
Hemodynamic instability	10,5% (13)	11,5% (7)	12,1% (4)	9,5% (2)	0% (0)	0,08
Without clinical and/or ECG criteria	7,2% (9)	8,2% (5)	6% (2)	4,8% (1)	11,1% (1)	0,41

Z3 22.8% and Z4 13.3%; $p=0.2$), ventricular arrhythmias (Z1 10.1%, Z2 15.5%, Z3 10.5% and Z4 26.7%; $p=0.1$); ACS (Z1 15.4%, Z2 21.6%, Z3 22.8% and Z4 33.3%; $p=0.02$) and death (Z1 11%, Z2 21.6%, Z3 22.8% and Z4 26.7%; $p=0.01$) (*Figure 1*).

Finally, a survey contact was made by phone about most institutions that make up the center-north corridor of the province. In it, we asked about the type of institution, availability of admission in ward or therapy, specialists, location of referral, hemodynamics and thrombolytic agents. From all surveyed centers ($n=73$), the following was observed:

- 34.2% were primary care centers and had no specialists available (cardiologists).
- 50.7% were medical care centers with scarce capacity for transient admission (in the general ward). From them, 30.1% had a specialist available for consultation.
- Only 15.1% of the centers included in the analysis had polyvalent units.
- 9.6% reported having thrombolytic agents available. From them, nearly half (42.8%) belong to centers with hemodynamic laboratory available and just a third (28.6%) reported having used them in the last 3 years.
- There are 14 centers with availability of hemodynamic laboratory (24/7). There is an additional center that only performs procedures in a scheduled manner (Mondays through Fridays at a specific time). From them, we should highlight:
 - 3 centers located in the north of the province (department General Obligado) have a distance to each other of less than 10 km. From them, 2 are in the same location (Reconquista).
 - 2 institutions located in the center of the province (department Castellanos) have a distance to each other of approximately 60 km. In turn, these are located at 121 km and 41 km respectively from the city of Santa Fe.
 - 1 center is located in a location close to Santa Fe (department La Capital), at 14 km of distance.
 - The city of Santa Fe has 8 institutions (7 private and 1 public) with hemodynamic laboratory available.
- 24.6% ($n=18$) of the locations refer to a center with higher complexity, which do not have thrombolytic agents or hemodynamic laboratory available either.
- 38.3% ($n=28$) of the locations included in the analysis referred patients to this institution, having closer centers with hemodynamic laboratory.

DISCUSSION

In this study, we observed there is a clear association between adverse in-hospital events and the area of referral of patients, which is due to delay to reperfusion and its complications (pump failure, less LVEF, ventricular arrhythmias, etc.)

The current recommendation by guidelines suggest, if possible, PTCA in cases of STEMI as long as it can be carried out within the first 120 minutes.¹⁵ Anyway, the real situation at world level is far from said recommendation, as between 20-60% of patients referred to centers with hemo-

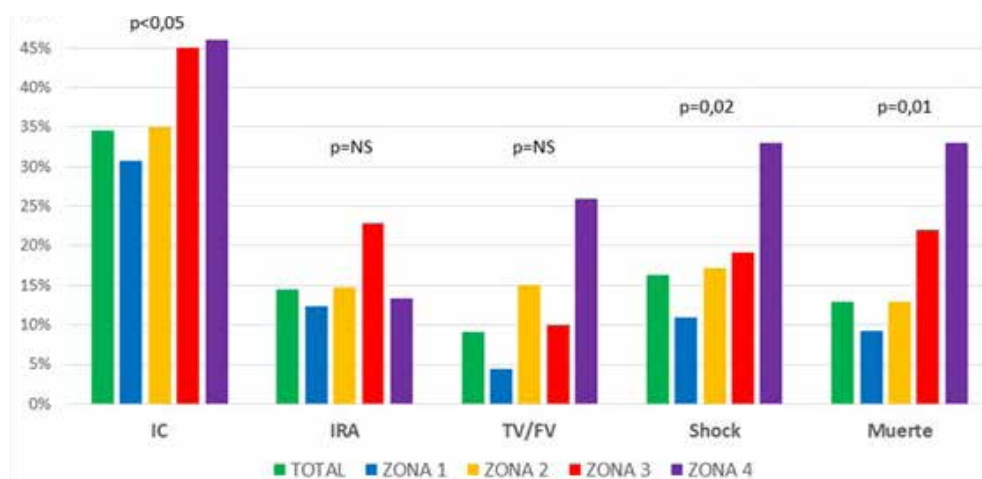


FIGURE 1.
In-hospital events

dynamic laboratory available arrive outside this time window.¹⁶ Thus, as these times extend, the benefits of mechanical reperfusion decrease, with a negative effect on mortality in the short and long terms.^{17,18,19}

National data from the third report on the ARGEN-IAM-ST registry point out to delayed presentation as the main cause for no reperfusion, being in most cases due to delay by the patient to consult (61%), followed by delays in transfer (35%).²⁰ This study plainly shows the real life obstacles for STEMI patients referral in the region. Clearly, a delay in diagnosis and referral of patients to a more complex center has a significant impact on in-hospital prognosis, reflecting on the rate of cardiovascular events.

It is important to highlight that, although this analysis is not based on timing, but on distance, it is possible to observe there is a directly proportional relationship between referral zones and the time between the onset of symptoms and arrival to a more complex center (ours). Previous publications based on distance also showed results similar to ours, with less reperfusion rate and increase in composite in-hospital events (recurrent ischemia, stroke and death).²¹

It has been proven that this delay in the system has a negative impact on clinical presentation and course: lower rate of reperfusion, larger AMI extension, less LVEF, higher incidence of HF upon admission, higher rate of complications during in-hospital course, with the subsequent cost that this represents for the health care system.

We should highlight that, as with national registries, the most frequent reason for a lack of reperfusion was being outside the time window, which significantly increased as the referral distance increased.

In regard to the survey of the centers from the different zones in the interior of the province, it was observed that in many small locations that only have primary care centers and with no specialists available, referral of patients (occasionally already with diagnosis of STEMI) is made to a nearby location, which does not have the necessary resour-

ces for reperfusion (with no thrombolytics or hemodynamic laboratory available). Once patients are received in these centers, diagnosis is made or confirmed, and then they are referred to a center of more complexity for reperfusion. It was also observed that many patients are referred to more distant locations solely due to medical insurance issues, as there are no agreements with closer centers. The same situation happens between the public and private sectors. These situations entail a delay related with the system (admission of patient, evaluation by specialist and transfer logistics, among others), which increases the total time of ischemia, with the subsequent adverse result in morbimortality.

In *Figure 2*, we show the geographical distribution of all the locations from where patients were received in this registry and the centers with hemodynamic laboratory available currently. Patients were received from the locations indicated by blue dots, showing an evident lack of logistics, as in many cases there were closer centers, capable of providing a proper reperfusion.

The implementation of an infarction network could improve this situation, providing support in locations receiving patients by telemedicine, for a proper analysis of ECGs and a joint decision on the most appropriate reperfusion therapy for each case. Data published by Silberstein et al. in regard to the AMI network of the El Cruce Hospital, proved to reduce the no-reperfusion rate from 39.3% to 20% with the implementation of telemedicine, shortening referral times and increasing reperfusion by fibrinolytics in a guided manner.²²

Recently, the infarction code of the Argentine Federation of Cardiology published in 2023 by Zapata makes evident the need to regionalize AMI treatment by the implementation of networks.²³ The mortality rate in Argentina is stable in spite of the effort to increase reperfusion strategies.²⁴ This reflects the need to implement measures to achieve patients having access to appropriate reperfusion therapies, in adequate times.

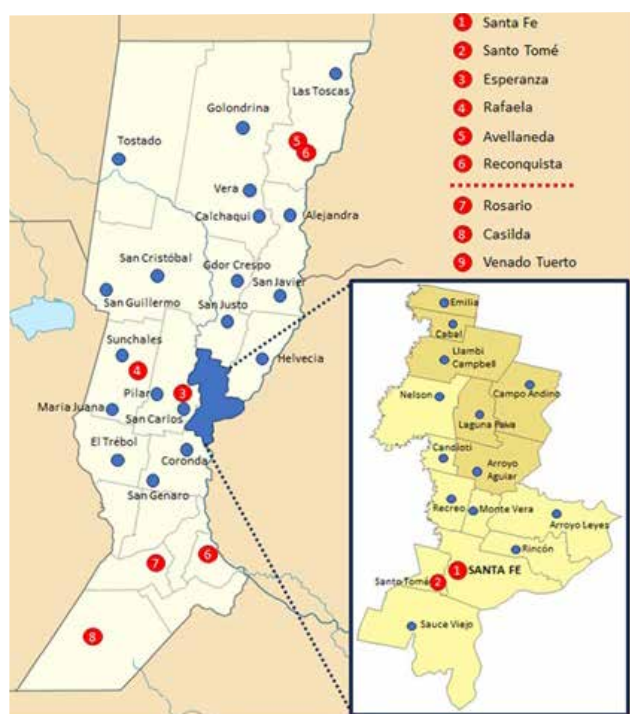


FIGURE 1.

Distribution of locations of referral and centers with hemodynamic laboratory.

Blue dots: referral locations. **Red dots:** locations with hemodynamic centers available (24/7 capacity).

LIMITATIONS

The small size of the sample and the descriptive character of the study are a limitation for the interpretation of results. On the other hand, the single-center design makes generalization difficult, as it corresponds to a private institution, where patients with medical insurance and/or pre-established agreements are admitted, which probably results in a more optimistic view of reality, not considering patients with difficulties for access to care.

We should highlight that, although in the survey multiple locations were included, always contemplating the most important ones in each department, we should consider a bias as we could not have all of them.

CONCLUSIONS

The delay in referral of patients with AMI has a clear negative impact on in-hospital evolution, representing a higher rate of complications and mortality.

Multiple obstacles were identified in the region, which may generate delays at the time of applying the most appropriate strategy for each patient, such as no availability of a specialist to confirm the diagnosis, the scarcity of thrombolytic agents, and a lack of logistics at the time of referral to more complex centers.

The implementation of networks for the reperfusion of AMI according to the geographical needs of each region may constitute a potential solution for a proper use of re-

sources. To fulfil such goals, it is crucial to have an adequate infrastructure with an efficient organization and governmental support. Public health policies are essential, integrating both the public and private health care areas.

BIBLIOGRAPHY

1. Secretaría de Políticas, Regulación e Institutos. Dirección de Estadísticas e Información de Salud Estadísticas Vitales. Información Básica - Año 2009; Serie 5. Nro 53 (nov. 2010). Disponible en <https://www.argentina.gob.ar/sites/default/files/serie5nro53.pdf> Acceso 28 de Mayo de 2025.
2. Ferrante D, Tajer C. ¿Cuántos infartos hay en la Argentina? Rev Argent Cardiol 2007; 75: 161 - 163.
3. Amini M, Zayeri F, Salehi M. Trend analysis of cardiovascular disease mortality, incidence, and mortality-to-incidence ratio: results from global burden of disease study 2017. BMC Public Health 2021; 21: 401.
4. Fordyce CB, Al-Khalidi HR, Jollis JG, et al. Association of rapid care process implementation on reperfusion times across multiple ST-segment-elevation myocardial infarction networks. Circ Cardiovasc Interv 2017; 10: e004061.
5. Stowens JC, Sonnad SS, Rosenbaum RA. Using EMS dispatch to trigger STEMI alerts decreases door-to-balloon times. West J Emerg Med 2015; 16: 472 - 480.
6. Shavadia JS, Roe MT, Chen AY, et al. Association between cardiac catheterization laboratory pre-activation and reperfusion timing metrics and outcomes in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention: a report from the ACTION registry. JACC Cardiovasc Interv 2018; 11: 1837 - 1847.
7. Kontos MC, Gunderson MR, Zegre-Hemsey JK, et al. Prehospital activation of hospital resources (PreAct) ST-segment-elevation myocardial infarction (STEMI): a standardized approach to prehospital activation and direct to the catheterization laboratory for STEMI recommendations from the American Heart Association's mission: lifeline program. J Am Heart Assoc 2020; 9: e011963.
8. Gagliardi J, Charask A, Perna E, et al. Encuesta Nacional de infarto agudo de miocardio con elevación del ST en la República Argentina (ARGEN-IAM-ST). Rev Argent Cardiol 2016; 84: 548 - 557.
9. Gagliardi J, Charask A, Higa C, et al. Infarto agudo de miocardio en la República Argentina. Análisis comparativo en los últimos 18 años. Resultados de las Encuestas SAC. Rev Argent Cardiol 2007; 75: 171 - 178.
10. Blanco F, Riccitelli MA, García Escudero A, et al. La demora en la realización de la angioplastia primaria, ¿una causa relacionada con el paciente o con el sistema médico-asistencial? Rev Argent Cardiol 2009; 77: 14 - 20.
11. García Escudero A, Riccitelli M, Gaito M, et al. Demoras en la realización de la angioplastia primaria en los pacientes trasladados con infarto agudo de miocardio: un problema médico-asistencial. Rev Argent Cardiol 2009; 77: 88 - 95.
12. Alexander T, Mulasari AS, Joseph G, et al. A system of care for patients with ST-elevation myocardial infarction in India. The Tamil Nadu-ST-Segment Elevation Myocardial Infarction Program. JAMA Cardiol 2017; 2: 498 - 505.
13. Ibanez B, James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018; 39: 119 - 177.
14. Thygesen K, Alpert J, Jaffe A, et al. Consenso ESC 2018 sobre la cuarta definición universal del infarto de miocardio. Rev Esp Cardiol 2019; 72: 1 - 27.
15. Byrne R, Rossello X, Coughlan J, et al. 2023 ESC Guidelines for the management of acute coronary syndromes: Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC). Eur Heart J 2023; 44: 3720 - 3826.
16. Nallamothu B, Bates E, Herrin J, et al for NRMI Investigators. Times to treatment in transfer patients undergoing primary percutaneous coronary intervention in the United States: National Registry of Myocardial Infarction (NRMI)-3/4 analysis. Circulation 2005; 111: 761 - 767.

17. Rathore S, Curtis J, Chen J, et al for the National Cardiovascular Data Registry. Association of door-to-balloon time and mortality in patients admitted to hospital with ST elevation myocardial infarction: national cohort study. *BMJ* **2009**; 338: 1807.
18. McNamara R, Wang Y, Herrin J, et al for the NRM Investigators. Effect of Door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. *J Am Coll Cardiol* **2006**; 47: 2180 – 2186.
19. Lambert L, Brown K, Segal E, et al. Association between timeliness of reperfusion therapy and clinical outcomes in ST-elevation myocardial infarction. *JAMA* **2010**; 303: 2148 - 2155.
20. D'Imperio H, Charask A, Castillo Costa Y, et al. Infarto de miocardio en Argentina. Tercer reporte del registro ARGEN-IAM-ST y comportamiento de la mortalidad en 8 años. *Rev Argent Cardiol* **2023**; 91: 435 - 442.
21. Hominal M, Bagnera F, Zapata G, et al. Impacto de la distancia del traslado a la reperusión en el infarto agudo de miocardio. *Rev Fed Arg Cardiol* **2016**; 45: 125 - 129.
22. Silberstein A, De Abreu M, Mariani J, et al. Programa en red para la reperusión del infarto con telemedicina. *Rev Argent Cardiol* **2015**; 83: 187 - 193.
23. Zapata G. Código Infarto de la Federación Argentina de Cardiología - CI FAC Programa Nacional sobre educación y prevención, manejo e investigación del ataque agudo al corazón de la Federación Argentina de Cardiología. *Rev Fed Arg Cardiol* **2023**; 52: 65 - 67.
24. Castillo Costa Y, Delfino F, Mauro V, et al. SCA con elevación del segmento ST: impacto del tiempo al diagnóstico en el tiempo puerta-balón en el mundo real. Datos del Registro ARGEN-IAM-ST. *Rev Argent Cardiol* **2020**; 88: 530 - 537.