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CLINICAL RESEARCH

# Prognosis and management of myocardial infarction: Comparisons between the French FAST-MI 2010 registry and the French public health database<sup>☆</sup>



*Infarctus du myocarde en France : comparaison du registre FAST-MI 2010 à l'échantillon généraliste des bénéficiaires de l'assurance maladie*

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**Abbreviations:** CI, Confidence interval; CICU, Cardiac intensive care unit; EGB, *Échantillon généraliste des bénéficiaires*; FAST-MI, French registry of acute ST-elevation or non ST-elevation myocardial infarction; ICD-10, International classification of diseases 10th edition; INSEE, *Institut national de la statistique et des études économiques*; OR, Odds ratio; PMSI, *Programme de médicalisation des systèmes d'information*; STEMI, STSegment elevation myocardial infarction.

<sup>☆</sup> This work was performed in the cardiology department of Clermont-Ferrand university hospital. Grégoire Massoulié and Jérôme Wintzer-Wehekind are co-first authors.

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## KEYWORDS

STEMI;  
Epidemiology;  
Management;  
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## Summary

**Background.** – Multicentre registries of myocardial infarction management show a steady improvement in prognosis and greater access to myocardial revascularization in a more timely manner. While French registries are the standard references, the question arises: are data stemming solely from the activity of French cardiac intensive care units (ICUs) a true reflection of the entire French population with ST-segment elevation myocardial infarction (STEMI)?

**Aim.** – To compare data on patients hospitalized for STEMI from two French registries: the French registry of acute ST-elevation or non-ST-elevation myocardial infarction (FAST-MI) and the *Échantillon généraliste des bénéficiaires* (EGB) database.

**Methods.** – We compared patients treated for STEMI listed in the FAST-MI 2010 registry ( $n = 1716$ ) with those listed in the EGB database, which comprises a sample of 1/97th of the French population, also from 2010 ( $n = 403$ ).

**Results.** – Compared with the FAST-MI 2010 registry, the EGB database population were older ( $67.2 \pm 15.3$  vs  $63.3 \pm 14.5$  years;  $P < 0.001$ ), had a higher percentage of women (36.0% vs 24.7%;  $P < 0.001$ ), were less likely to undergo emergency coronary angiography (75.2% vs 96.3%;  $P < 0.001$ ) and were less often treated in university hospitals (27.1% vs 37.0%;  $P = 0.001$ ). There were no significant differences between the two registries in terms of cardiovascular risk factors, comorbidities and drug treatment at admission. Thirty-day mortality was higher in the EGB database (10.2% vs 4.4%;  $P < 0.001$ ).

**Conclusions.** – Registries such as FAST-MI are indispensable, not only for assessing epidemiological changes over time, but also for evaluating the prognostic effect of modern STEMI management. Meanwhile, exploitation of data from general databases, such as EGB, provides additional relevant information, as they include a broader population not routinely admitted to cardiac ICUs.

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## MOTS CLÉS

STEMI ;  
Épidémiologie ;  
Prise en charge ;  
Thérapeutique ;  
Pronostique

## Résumé

**Contexte.** – Les registres multicentriques de prise en charge de l'infarctus du myocarde (MI) mettent en évidence une constante amélioration du pronostic ainsi qu'un plus large accès à la revascularisation myocardique dans des délais plus courts. Les registres français (USIK, FAST-MI) font référence, mais les données uniquement issues de l'activité des USIC français sont-elles le reflet de l'ensemble de la population française souffrant d'un syndrome coronarien aigu avec élévation du segment ST (STEMI) ?

**Objectif.** – Comparaison du registre « *French registry of acute ST-elevation or non-ST-elevation myocardial infarction 2010* » (FAST-MI 2010) à ceux répertoriés dans l'Échantillon généraliste des bénéficiaires (EGB).

**Méthodes.** – Nous comparons, dans ce travail, les patients pris en charge pour STEMI répertoriés dans le registre « *French registry of acute ST-elevation or non-ST-elevation myocardial infarction 2010* » (FAST-MI 2010) ( $n = 1716$ ) à ceux répertoriés dans l'Échantillon généraliste des bénéficiaires (EGB), échantillon de 1/97<sup>e</sup> de la population française sur la même période ( $n = 403$ ).

**Résultats.** – La population EGB comparée au registre FAST-MI 2010 est plus âgée ( $67,2 \pm 15,3$  vs  $63,3 \pm 14,5$  ans ;  $p < 0,001$ ), plus féminine (36,0% vs 24,7% ;  $p < 0,001$ ) et bénéficie de moins d'angiographies coronaires en urgence (75,2% vs 96,3% ;  $p < 0,001$ ). Elle est également moins souvent hospitalisée dans les centres hospitaliers universitaires (27,1% vs 37,0% ;  $p = 0,001$ ).

Aucune différence significative n'est observée dans les deux registres en termes de facteurs de risques cardiovasculaires, de comorbidités (exceptés diabète [ $p=0,008$ ] et insuffisance rénale chronique [ $p < 0,001$ ] plus présents dans l'EGB) et de traitement médicamenteux à l'admission. Enfin, la mortalité à 30 jours est plus importante dans l'EGB (10,2% vs 4,4%;  $p < 0,001$ ).

**Conclusions.** — Les registres comme FAST-MI sont indispensables pour apprécier au fil du temps les changements épidémiologiques, mais aussi l'impact pronostic de la prise en charge moderne du STEMI. L'exploitation de datas issues d'une base de données généralistes apporte un complément d'information pertinent puisqu'incluant une population plus large non systématiquement admise en USIC.

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## Background

Over the past 20 years, acute coronary syndrome with ST-segment elevation (ST-segment elevation myocardial infarction [STEMI]) has seen a remarkable transformation in its prognosis. A net decrease in the mortality of patients with STEMI has been observed in French registries conducted every 5 years, namely USIK in 1995 [1] and USIC in 2000 [2], followed by the French registry of acute ST-elevation or non-ST-elevation myocardial infarction (FAST-MI) in 2005 [3] and 2010 [4]. Accordingly, the 30-day mortality has decreased drastically from 13.7% in 1995 to 4.4% in 2010 [3,4].

Such a reduction in mortality is correlated with better management of STEMI not only as a result of greater access to coronary angioplasty, drug optimization and enhancements in both technology and angioplasty equipment, but also as a result of patient population characteristics (younger, more likely to be women) [5]. These results are extremely encouraging for the acute management of STEMI. However, clinical studies, as well as other American and European [6–8] registries, report more subtle results [9,10]. This difference is possibly explained by the fact that the patients enrolled in FAST-MI are those hospitalized exclusively in cardiac intensive care units (CICUs). It would thus appear both useful and important to compare these selected data with a population obtained from the *Échantillon généraliste des bénéficiaires* (EGB; general sample of beneficiaries). Indeed, this database, the validity of which we have shown previously in the field of heart failure, allows for a more tailored approach to daily clinical practice [11,12] (indexing of all managed STEMI patients even if not hospitalized in CICUs).

The objective of this study was to compare data on patients hospitalized for STEMI obtained from these two French registries (FAST-MI and EGB).

## Methods

### FAST-MI 2010 registry

The FAST-MI 2010 registry encompassed 213/279 (76.3%) CICUs distributed in 149 public hospitals (including 38 university hospital centres [17.8%]), 62 private centres and two military centres.

Inclusion criteria for the FAST-MI 2010 registry were as follows: patients aged  $\geq 18$  years who agreed to participate in the study and were admitted to the CICU for acute coronary syndrome within 48 hours after the onset of symptoms over a period of 1 month (October 2010). Exclusion criteria were: any symptoms lasting  $> 48$  hours after the first call; and iatrogenic infarctions.

### EGB database

Data were extracted from the EGB database, which comprises a representative 1/97th random sample of the population covered by the French national health insurance system (approximately 80% of the French population) [13,14]. The EGB database currently includes more than 600,000 beneficiaries, and has been used widely for public health and pharmacoepidemiological purposes for more than 5 years [15–19].

Since 2005, the EGB database has included basic demographic data and has prospectively collected all claims for visits to physicians and exhaustive claims for all reimbursed drugs dispensed in retail pharmacies (including dates of prescription and dispensing, and quantities delivered). Medications are identified by their Anatomical therapeutic chemical class codes, which are included in the EGB database. The EGB database also contains data collected by the *Programme de médicalisation des systèmes d'information* (PMSI; programme for medicalization of information systems) in healthcare institutions (medical and surgical departments); thus, during the patient's stay, principal diagnoses and associated diagnoses are available, coded according to the International classification of diseases 10th edition (ICD-10). Associated diagnoses represent a proxy for comorbidity assessment and identification of triggering factors. All medical procedures performed during each stay are identified with their specific codes from the Common classification of medical procedures. The EGB database also includes registration of the date of death, recorded automatically from the *Institut national de la statistique et des études économiques* (INSEE; National institute for statistics and economic studies), independent of the use or not of health care resources.

Only hospitalized patients with an ICD-10 code of STEMI are included (codes I21.0× to I21.9×, except for code I21.4, which is defined as subendocardial infarction).

## Patient inclusion in the present study

Only those patients treated for STEMI stemming from the initial publication of FAST-MI 2010 [5] were included in the present study. Patients included from the EGB database were hospitalized patients, with a discharge date during the year 2010 and at least one ICD-10 code of STEMI as principal diagnosis.

Patients with a non-STEMI in the EGB database or the FAST-MI 2010 registry, as well as those who died before hospital admission, were not included. Information regarding death was directly accessible, whether indicated in the INSEE or via the PMSI and recorded by the French public administration. Treatment data included drugs dispensed in pharmacies, within 60 days after hospitalization for STEMI, that had been the subject of a reimbursement claim.

## Statistical analysis

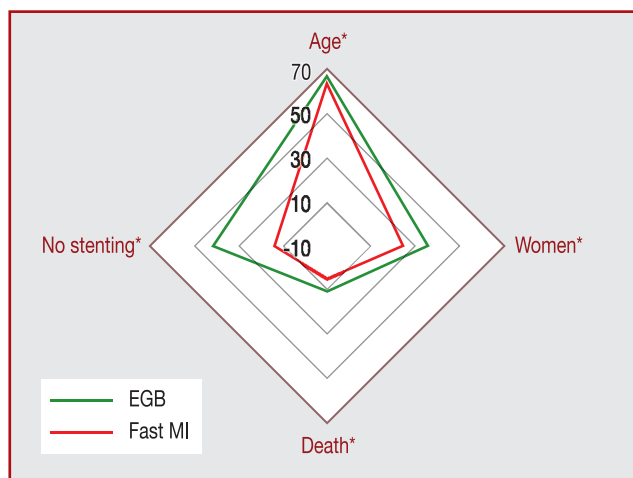
All analyses were performed using Stata software, version 12 (StataCorp, College Station, TX, USA). All analyses were done for a two-sided type I error of  $\alpha = 5\%$ . Population data are described as frequencies and associated percentages for categorical variables and as means  $\pm$  standard deviations for quantitative variables (age). Quantitative data were compared between groups (EGB 2010 and FAST-MI 2010) using Student's *t*-test, according to their assumptions (normality studied by the Shapiro-Wilk test and homoscedasticity by the Fisher-Snedecor test). Comparisons concerning categorical data were performed using the  $\chi^2$  test or, when appropriate, Fisher's exact test. Then, a univariate analysis of 30-day mortality was performed using logistic regression, followed by a multivariable logistic regression model to determine predictive factors of 30-day mortality, by backward and forward stepwise selection of factors considered significant in the univariate analysis and according to clinical relevance variables [20,21]. Results are presented as odds ratios (ORs; for univariate analysis) and adjusted ORs (for multivariable analysis) with associated 95% confidence intervals (CIs).

## Results

### Baseline characteristics

During the year 2010, 403 patients with a diagnosis of STEMI were listed in the EGB database. In the FAST-MI 2010 registry, 56% of patients ( $n = 1716/3079$ ) were included with the same diagnosis. Patients in the EGB database were older ( $67.2 \pm 15.3$  vs  $63.3 \pm 14.5$  years;  $P < 0.001$ ), were more often women ( $36.0\%$  vs  $24.7\%$ ;  $P < 0.001$ ) and were less frequently treated in university hospital centres ( $27.1\%$  vs  $37.0\%$ ;  $P = 0.001$ ) (Table 1).

The majority of cardiovascular risk factors and comorbidities were similar. However, patients in the EGB database more often had diabetes ( $22.1\%$  vs  $16.5\%$ ;  $P = 0.008$ ), chronic renal failure ( $6.4\%$  vs  $2.1\%$ ;  $P < 0.001$ ), peripheral artery disease ( $9.4\%$  vs  $4.8\%$ ;  $P < 0.001$ ) and a history of coronary stent angioplasty ( $15.6\%$  vs  $10.2\%$ ;  $P = 0.002$ ), while fewer underwent coronary artery bypass graft surgery ( $2.5\%$  vs  $5.6\%$ ;  $P = 0.01$ ). The estimated incidence of STEMI in the



**Figure 1.** Comparison between the *Échantillon généraliste des bénéficiaires* (EGB) database and the French registry of acute ST-elevation or non ST-elevation myocardial infarction (FAST-MI) with regard to mean age, female sex, 30-day mortality and the absence of stenting, represented as a spider chart.

French population derived from the EGB population was 75/100,000.

### Acute phase angiography and coronary angioplasty

Compared with patients in the EGB database, patients in the FAST-MI 2010 registry more frequently underwent coronary angiography ( $96.3\%$  vs  $75.2\%$ ;  $P < 0.001$ ) and coronary stenting during hospitalization ( $86.7\%$  vs  $58.8\%$ ;  $P < 0.001$ ) (Fig. 1).

### Drug treatment

Treatments at inclusion were similar in the EGB and FAST-MI 2010 populations (Table 2). Upon hospital discharge, patients in the EGB database less frequently received dual antiplatelet therapy ( $P < 0.001$ ), beta-blockers ( $P < 0.001$ ), statins ( $P < 0.001$ ) and angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers ( $P < 0.001$ ).

### Mortality

Mortality at 30 days was higher in the EGB database ( $10.2\%$  vs  $4.4\%$ ;  $P < 0.001$ ). Multivariable analysis revealed that chronic kidney disease (OR: 6.08; 95% CI: 1.72–21.49;  $P = 0.005$ ), age  $> 75$  years (OR: 4.41; 95% CI: 1.18–16.49;  $P = 0.03$ ) and history of heart failure (OR: 4.50; 95% CI: 1.12–18.09;  $P = 0.04$ ) were associated with higher mortality (Table 3).

### Evolution of the EGB database between 2005 and 2013

Unlike in the FAST-MI registry, the clinical picture of STEMI-treated patients did not change between the 2005–2007, 2008–2010 and 2011–2013 periods: there were no differences in terms of age ( $P = 0.87$ ), female sex ( $P = 0.48$ ) or 30-day mortality ( $P = 0.87$ ) (Fig. 2). In contrast, the EGB

**Table 1** Baseline patient characteristics and complications.

	EGB 2010 (n = 403)	FAST-MI 2010 (n = 1716)	P
<i>Age (years)</i>	67.2 ± 15.3	63.3 ± 14.5	< 0.001
< 60 years	133 (33.0)	742 (43.3)	
60–74 years	111 (27.5)	537 (31.3)	
≥ 75 years	146 (39.5)	437 (25.4)	
<i>Women</i>	145 (36.0)	423 (24.7)	< 0.001
<i>Centre</i>			
University medical centre	105 (27.1)	634 (37.0)	0.001
Community/military	201 (51.8)	755 (44.0)	
Private, for profit	82 (21.1)	327 (19.0)	
<i>Cardiovascular risk factors</i>			
Hypertension	193 (47.9)	806 (47.0)	0.74
Dyslipidaemia	167 (41.4)	675 (39.3)	0.44
Diabetes mellitus	89 (22.1)	283 (16.5)	0.008
Tobacco use	102 (25.3)	701 (40.9)	< 0.001
Obesity (BMI > 30 kg/m <sup>2</sup> )	53 (13.2)	324 (20.1)	0.007
Coronary heredity	23 (5.7)	450 (25.0)	< 0.001
<i>Cardiovascular history</i>			
Myocardial infarction	55 (13.6)	187 (10.9)	0.12
Stroke/TIA	18 (4.5)	68 (4.0)	0.64
Heart failure	12 (3.0)	41 (2.4)	0.50
PAD/peripheral vasculopathies	38 (9.4)	83 (4.8)	< 0.001
CABG	10 (2.5)	95 (5.6)	0.01
Stenting/dilatation (PCI)	63 (15.6)	175 (10.2)	0.002
<i>Comorbidities</i>			
Atrial fibrillation	50 (12.4)	100 (5.6)	< 0.001
Chronic respiratory failure	23 (5.7)	85 (5.0)	0.54
Chronic renal failure	26 (6.4)	42 (2.1)	< 0.001
Neoplasia	43 (10.7)	147 (8.6)	0.18
<i>Complications</i>			
Cardiogenic shock	26 (6.5)	87 (4.9)	0.19
Complete AV block	31 (7.7)	46 (2.6)	< 0.001
Ventricular fibrillation/CPA	8 (2.0)	49 (2.8)	0.37

Data are expressed as mean ± standard deviation or number (%). AV: atrioventricular; BMI: body mass index; CABG: coronary artery bypass graft; CPA: cardiopulmonary arrest; EGB: *échantillon généraliste des bénéficiaires*; FAST-MI: French registry of acute ST-elevation or non ST-elevation myocardial infarction; PAD: peripheral artery disease; PCI: percutaneous coronary intervention; TIA: transient ischaemic attack.

database confirmed the increase in the rate of angioplasty ( $P < 0.001$ ).

## Discussion

This study enabled us to compare data from patients hospitalized for STEMI obtained from a validated registry stemming from clinical practice (FAST-MI 2010) and from the French national health insurance system (EGB database).

The EGB database appears valid in depicting this STEMI population, as shown previously by our group for heart failure [12]. Indeed, patients exhibited similar characteristics (comorbidities, cardiovascular risk factors, prevalence of young women), the effect of estimated STEMI was similar to that described in France (75/100,000 vs 78/100,000) [22], and there was overlapping evolution of angiograms between the two registries over the past decade [23]. However, there

were several differences between these two databases with regard to epidemiology (higher cardiovascular risk, older and greater proportion of women in the EGB database), initial management (less stenting in the EGB database), medical management (fewer prescriptions for STEMI drugs in the EGB database), as well as prognostic differences. Indeed, 30-day mortality was more than two-fold higher in the EGB database (10.5% vs 4.4%;  $P < 0.001$ ). Both epidemiological and management differences may partly account for this poorer prognosis. The EGB database population – older, with a higher female:male ratio – was associated with a greater number of severe comorbidities (chronic kidney disease [+305%], peripheral artery disease [+195%], diabetes [+133%] and atrial fibrillation [+221%]). Accordingly, the FAST-MI 2010 registry revealed that women were found to have much later and less frequent recourse to angioplasty, and thus had a poorer prognosis, despite management in the CICU [24].

**Table 2** Treatments.

	EGB 2010	FAST-MI 2010	P
<i>Treatment at entry (30 days)</i>	(n = 403)	(n = 1716)	
Beta-blocker	75 (18.6)	313 (18.2)	0.86
Antiplatelet agent	87 (21.6)	335 (19.5)	0.35
ACE/ARB	106 (26.3)	478 (27.9)	0.53
Statin	84 (20.8)	374 (21.8)	0.67
Anticoagulant	12 (3.0)		
<i>Treatment at discharge (60 days; hospital survivors)</i>	(n = 368)	(n = 1687)	
Beta-blocker	249 (67.7)	1502 (89.0)	< 0.001
Aspirin	260 (70.7)	1638 (97.1)	< 0.001
Clopidogrel	206 (56.0)	980 (58.1)	0.46
Prasugrel	53 (14.4)	592 (35.1)	< 0.001
Dual antiplatelet therapy	230 (62.5)	1537 (91.1)	< 0.001
ACE/ARB	234 (63.6)	1412 (83.7)	< 0.001
Statin	262 (71.2)	1565 (92.8)	< 0.001

Data are expressed as number (%). ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; EGB: *échantillon généraliste des bénéficiaires*; FAST-MI: French registry of acute ST-elevation or non ST-elevation myocardial infarction.

**Table 3** Thirty-day survival and effect of population characteristics and care management (univariate and multivariable analyses).

Characteristics	Univariate analysis			Multivariable analysis		
	OR	95% CI	P	Adjusted OR	95% CI	P
<i>Age (ref. is &lt; 60 years)</i>						
60–74 years	2.26	0.73–6.95	0.16	3.86	0.84–17.7	0.08
≥ 75 years	5.24	1.96–14.02	0.001	4.41	1.18–16.49	0.03
<i>History of dyslipidaemia</i>	0.21	0.09–0.52	0.001	0.19	0.06–0.65	0.008
<i>Cardiogenic shock</i>	43.8	16.6–115.3	< 0.001	92.2	23.6–359.9	< 0.001
<i>Ischaemic heart disease</i>	0.42	0.19–0.91	0.03	0.34	0.11–1.07	0.07
<i>Congestive heart failure</i>	5.24	2.09–13.16	< 0.001	4.50	1.12–18.09	0.03
<i>Coronary angiography</i>	0.19	0.10–0.37	< 0.001	0.30	0.11–0.78	0.01
<i>Stroke + LTI cereb</i>	3.73	1.26–11.06	0.02	2.71	0.62–11.81	0.19
<i>Chronic renal failure</i>	4.63	1.87–11.47	0.001	6.08	1.72–21.49	0.005

CI: confidence interval; LTI cereb: long-term illness for cerebrovascular disease; OR: odds ratio; ref.: referent; TIA: transient ischaemic attack.

The design of the FAST-MI 2010 registry imposes inclusions secondary to hospitalization in the CICU, and therefore with optimal management of the STEMI. A segment of the more frail population, with a more uncertain diagnosis or poorer prognosis, is excluded from the registry (i.e. the population receiving medical treatment without hospitalization in the CICU). The EGB database, on the other hand, allows the study of this particular population.

Initial management also differs between the two registries. Revascularization after STEMI is less systematic in the EGB database (fewer coronary angiographies, less stenting). Participating centres in FAST-MI 2010 are typically university hospitals or centres equipped with an interventional cardiology platform, while EGB database patients can be hospitalized in centres with no CICU or coronary angiography room.

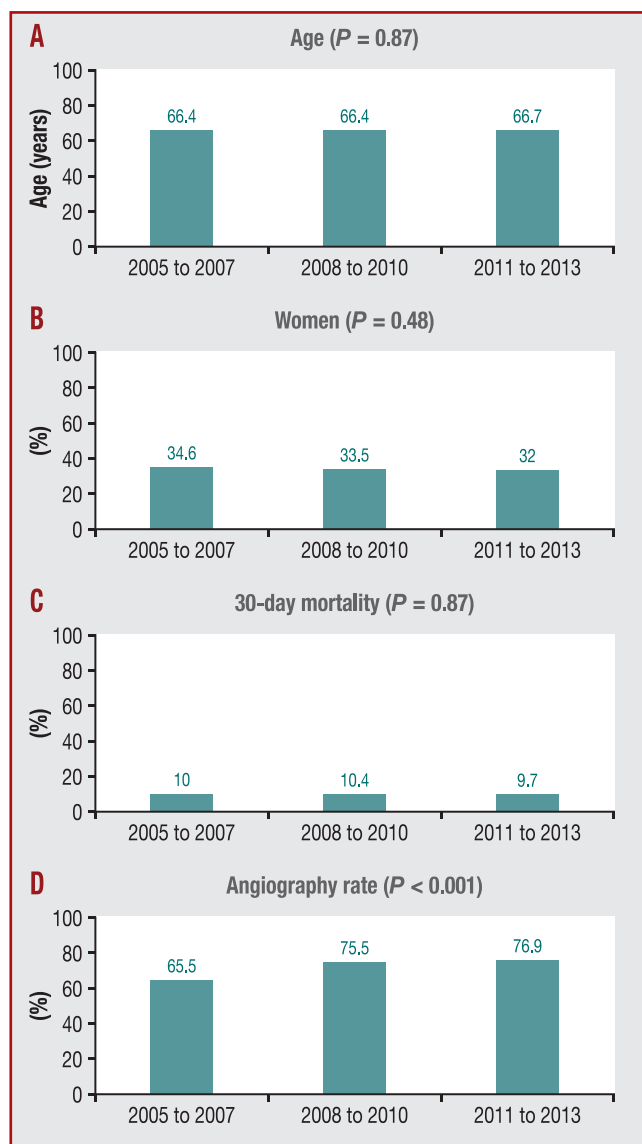
Finally, the study of the EGB database does not allow us to confirm the evolving patterns observed in the

FAST-MI registry and other European registries [8,9]. Unlike the FAST-MI registry, the included population may not necessarily receive CICU management [5]. Patients included in the CICU are younger and with fewer comorbidities. An analysis of the total population of the health insurance database appears to confirm these trends. Such a discrepancy may result from the limited sample size [22].

## Comparisons between the FAST-MI 2010 registry and the EGB database

### FAST-MI 2010 registry

The FAST-MI 2010 registry is a 1-month (October 2010) cross-sectional snapshot of the CICU management of patients hospitalized for STEMI in France. Conducted every 5 years, this collection of data allows the identification of major epidemiological trends as well as the effect of invasive



**Figure 2.** Evolution of patient characteristics within the *Échantillon généraliste des bénéficiaires* (EGB) database from 2005 to 2013. A. Age. B. Female sex. C. 30-day mortality. D. Angiography rates.

STEMI management strategies [23]. However, conducting such a registry is expensive and requires the active and comprehensive participation of coronary emergency unit personnel. These registries also have certain limitations: the FAST-MI 2010 registry only included 62% of patients admitted to CICUs (3079/4970 patients), with a low participation refusal rate of 5.6%; they are dependent on the voluntary participation of each centre; the exclusion criteria allow homogenization of the studied sample, but exclude a non-negligible subpopulation of patients (acute coronary syndromes persisting for > 48 hours or not hospitalized in the CICU); not all patients admitted for STEMI are managed in CICUs (elderly population, rural regions).

The comparison of patients hospitalized for STEMI from the Global registry of acute coronary events (GRACE) registry [25] revealed a lower mortality rate in patients enrolled in a randomized clinical trial (3.7%) compared with eligible non-enrolled patients included in a registry (7.1%). This

difference was also observed among patients not participating in a randomized trial and ineligible for enrolment (11.4%;  $P < 0.001$ ). These latter patients had the same characteristics as the EGB database patients (older, more often women, higher cardiovascular risk, longer history of surgical revascularization).

### EGB database

The EGB database is a representative sample of beneficiaries covered by the health insurance system; it has already enabled assessment of medication adherence in coronary patients [13] and its effect on outcomes [26]. The EGB database has certain limitations. The collection of data is based on PMSI coding and, as such, certain clinical data (e.g. body mass index, tobacco use) and therapeutic data (e.g. prehospital fibrinolysis non-coded by Emergency medical services) are entered incorrectly or not entered at all. In addition, the EGB database does not contain any test results or paraclinical data (e.g. left ventricular ejection fraction, biological results). By contrast, it does contain all of the information regarding reimbursed care, albeit limited to the French metropolitan area [27]. Treatment at CICU discharge is extrapolated from filled prescriptions dispensed at 60 days, although this corresponds to that already described in the long-term study on medication adherence in patients with STEMI [27]. However, the EGB database may be more representative of patients managed for STEMI in France in different centres, including those with or without a CICU.

### Conclusion

The FAST-MI registry is the gold standard for the epidemiological assessment of the management of patients hospitalized in CICUs for STEMI. However, the EGB database allows longitudinal follow-up, through passive and annual data collection. Although these two registries are different, their designs and the populations included provide complementary information, and offer a comprehensive and interesting view of patients treated for STEMI in France.

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### Disclosure of interest

The authors declare that they have no competing interest.

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