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**Quality Indicators for Acute Myocardial Infarction: Rate of implementation and Association with 3-Year Survival. Results from the Nationwide FAST-MI 2005 and FAST-MI 2010 Registries**

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## Abstract

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## Introduction

Evaluation of the quality of care is an integral part of modern health care, and has become an indispensable tool for health authorities, the public, the press and patients. However, measuring quality of care in patients admitted for acute myocardial infarction (AMI) is difficult, because it is a multifactorial and multidimensional concept that cannot be estimated solely on the basis of patients' clinical outcomes. Thus, measuring the process of care through quality indicators (QIs) has become a widely used practice in this context. The Acute Cardiovascular Care Association of the European Society of Cardiology (ACCA) has defined a set of QIs for the management of AMI (ref to be added) comprising 20 QI (12 "main" and 8 "secondary" QIs). These QIs are in line with current ESC guidelines [1-2] and have been selected according to their feasibility and reliability of assessment, with a view to developing programmes to improve quality of care for the management of AMI across Europe. The 20 QIs defined by ACCA cover 7 domains reflecting the full spectrum of care, including centre organisation, reperfusion-invasive strategy, in-hospital risk assessment, antithrombotic treatment during hospitalisation, secondary prevention discharge treatments, patient satisfaction, as well as two composite quality indicators (CQI) and 30-day mortality adjusted for the GRACE risk score (Figure 1).

The new compilation of QIs developed by ACCA require validation as benchmaking tools for evaluating centre performance and in their associate with clinical outcomes. To address this need, we assessed the rates of implementation of the ACCA QIs in the French Registry of Acute ST-Elevation

or non- ST-elevation Myocardial Infarction (FAST-MI) 2005 and 2010, and investigated the association between the QIs and 30-day and 3-year mortality.

## Methods

### Setting and design

Data for this population-based cohort study were extracted from two nationwide French registries, conducted 5 years apart, namely FAST-MI 2005 (NCT00673036) [3], and FAST-MI 2010 (NCT01237418) [4]. Briefly, the primary objectives of the FAST-MI registries were to evaluate the characteristics, management, and outcomes of AMI patients, as seen in routine clinical practice, on a country-wide scale. Both registries consecutively included patients with AMI admitted to a coronary or intensive care unit (ICU) within 48 hours of symptom onset, over a one-month period (October-November 2005 and 2010). Data on baseline characteristics, including demographics, risk and medical history, previous, use of cardiac procedures (including timing of percutaneous coronary intervention), use of medications (including previous, acute, and discharge treatments), and biological variables were collected, as previously described [3-7]. For both surveys, centralized follow-up was performed by the French Society of Cardiology. Dedicated research technicians contacted both physicians and patients, after checking the patients' vital status in municipal registers. All institutions admitting patients for AMI were invited to participate, including university teaching hospitals, community hospitals, and private clinics. The study was conducted in accordance with the guidelines on good clinical practice and French legislation. The 2005 registry was approved by the Committee for the

Protection of Human Subjects in Biomedical Research of Saint Antoine University Hospital, and the protocol of the 2010 registry was approved by the Committee for the Protection of Human Subjects of Saint Louis University Hospital, Paris. All patients provided written informed consent.

Assessment of variables and QIs

We calculated each patient's GRACE risk score for 6-month mortality from existing data, according to the initial description of the GRACE risk score [8]. To estimate the adjusted mortality risk, we used categories of the GRACE risk score defined by deciles of the score. The number of patients included in the registry during the month of recruitment was used as proxy for the volume of activity of each center. For each patient in the FAST-MI registries, data fields were identified that would enable the calculation of the 20 QIs. Each QI was calculated using the most appropriate variables and classified into one of four categories, namely: (1) QIs that could be assessed directly from existing variables; (2) QIs calculated from two or more variables; (3) QIs estimated after extrapolation or use of the proxy; and (4) QIs that could not be assessed using existing data.

For each patient, the opportunity-based CQI was based on the number of times particular care processes were performed (numerator) divided by the number of opportunities the patient had to receive that process or the number of opportunities the hospital had to provide the process, as appropriate (denominator). The all-or-none CQI was calculated as follows:

- In patients with a left ventricular ejection fraction (LVEF) >40%, and no evidence of heart failure: as the proportion of patients fulfilling all three

score elements, namely: low dose aspirin, $P2Y_{12}$ inhibitor and high intensity statins.

- In patients with a LVEF ≤40% and/or clinical evidence of heart failure: as the proportion of patients fulfilling all 5 score elements, namely low dose aspirin, $P2Y_{12}$ inhibitor, high intensity statins, angiotensin-converting enzyme inhibitor (ACEi) (or angiotensin-receptor blocker (ARB)) and β-blockers.

Statistical analysis

Baseline characteristics for the study population are reported as number (percentage) for categorical data, and medians [interquartile range (IQR)] or mean± standard deviation (SD) for continuous non-normally and normally distributed data respectively. QIs are presented as numerator (number of patients who presented the QI criterion) and denominator (patients eligible for the QI). The CQI is presented as mean±SD. The opportunity-based CQI was split into 4 categories, in keeping with recognised cut offs, namely 0, 0-40%, 40-80% and > 80% [9-10].

Patient-level analysis: To estimate the strength of association between QIs and long-term mortality, we fitted a Kaplan-Meier survival curve for the 4 categories of the opportunity-based CQI. Multivariate survival analysis was performed using Cox's proportional hazards model for 3-year survival, adjusted for deciles of the GRACE score, period (2005 or 2010 cohort), volume of activity (<20 vs. ≥20 patients included), type of center (with or without PCI facilities on site) and type of MI (STEMI vs. NSTEMI). Results are presented as hazard ratios (HR) with 95% confidence intervals (CI).

Center level analysis: The correlation between volume of activity and the value of the CQI was determined using linear regression and Spearman's correlation coefficient; a coefficient <0.50 indicates very low or no correlation. To estimate the variability of the QIs across centers, we calculated the mean (95% confidence interval [CI]) of the opportunity-based CQI in all centers that included more than 20 MI patients in the registry. To classify these centers as "low", "intermediate" or "high" quality, we compared the CI of the CQI of each center with the mean of the cohort (2005 or 2010).

Analyses were performed using SAS software, version 9.4 (SAS Institute Inc., Cary, NC, USA). All tests were two sided, and a p value <0.05 was considered significant.

## Results

Patient characteristics, acute management and mortality

A total of 7,839 patients were included: n=3,670 patients from 223 centers in FAST-MI 2005, and n=4,169 patients from 213 centers in FAST-MI 2010. The median number of patients included per center was 23 [IQR 14; 40] in 2005 and 31 [IQR 17; 48] in 2010. The baseline characteristics of the patients from both cohorts are presented in Table 1. Previous medication, acute and discharge treatments, and mortality rates are presented in Table 2. Compared to patients from 2005, those admitted in 2010 less often had diabetes, a history of heart failure or previous MI, and had a lower GRACE risk score. There was no difference in previous medication, but patients from the 2010 cohort received more reperfusion, were more often submitted to invasive procedures and revascularization, and had higher rate of dual antiplatelet

therapy, beta-blockers, ACEI (or ARB) and statins at discharge. The crude mortality rate was lower in the 2010 cohort as compared with 2005, both at 30 day and at 3 years.

Assessment of QIs from FAST-MI 2005 and 2010 (Table 3)

Domain 1: Centre organisation.

Despite prospective data collection regarding the type of center (academic, public non-academic, or private for-profit), equipment, staff and volume of activity, no information was prospectively recorded regarding the existence of a network organization, or regarding pre-hospital interpretation of ECG or cath lab activation. Time to reperfusion was available in around 85% of STEMI patients. Lastly, since participation in the FAST-MI registry is based on a voluntary basis, all FAST-MI centers fulfilled the QI pertaining to voluntary participation in registries to assess quality of care.

Domain 2: Reperfusion / invasive strategy.

The specific times between onset of pain and reperfusion were available in >80% of the cases [11]. Eligibility for reperfusion was determined according to the time between symptoms (<12 hours) and first medical contact in STEMI patients. The proportion of patients with timely reperfusion was directly recorded for patients treated with fibrinolysis and for patients admitted in PCI-capable centers. Conversely, the door-in-door-out times for transferred patients were not recorded. The time to “balloon” was used as a proxy for the time to “arterial access”. Specifically, we were able to determine eligibility for

reperfusion in all patients, and the rates of reperfusion were 63% and 79% in 2005 and 2010 respectively. The time from first medical contact to reperfusion was available in all patients treated with fibrinolysis (FMC to needle) and in 41% and 64% of patients treated by primary PCI in 2005 and 2010 respectively. The rate of NSTEMI patients submitted to invasive strategy within 72 hours of presentation was 79% in 2005 and 92% in 2010.

Domain 3: In hospital risk assessment.

The numerical value of the GRACE and CRUSADE scores was not prospectively recorded in the FAST-MI registries. Conversely, the value of the LVEF was directly available in 76% and 85% in 2005 and 2010 respectively.

Domain 4: Antithrombotic treatment during hospitalisation.

Neither prasugrel nor fondaparinux was available in 2005, thus the 2 QI were not applicable in the 2005 cohort. The proportion of patients with adequate $P2Y_{12}$ inhibition was calculated from existing data in patients alive at discharge for the 2010 registry. Adequate prescription of P2Y12 inhibitors was observed in 57% in 2010. Only 14% of the NSTEMI patients not submitted to immediate angiography received at least one injection of fondaparinux.

Domain 5: Secondary prevention.

Prescription of statins, beta-blockers and ACEI/ARB, as well as the type and dose were recorded in both the 2005 and 2010 registries, but the potential contra-indications or intolerance were not documented. Statins were prescribed in 2,717 (74%) in 2005 and in 3,710 (92%) in 2010, and at high intensity in 1,183 (37%) and 2,022 (63%) respectively. The rate of patients with LVEF ≤0.40 or heart failure during hospitalization was comparable in 2005 (17%) and 2010 (16%); the rate of prescription of beta-blockers and ACEI (or ARB) in these patients was 71% and 77% in 2005, and 63% and 84% in 2010, respectively. Since potential contra-indications (such as hypotension or worsening renal dysfunction) were not recorded, it is possible that non-prescription may have been justified in practice.

Domain 6: Patient Satisfaction.

As for the “centre organization-Network” domain, no information about patient satisfaction was recorded in either registry, although some individual components of this QI, such as participation in a rehabilitation programme or smoking cessation counselling, were recorded in 2010.

Domain 7: CQI and adjusted mortality.

The mean value of the opportunity-based CQI was 0.52±0.30, calculated for 1,004 (39%) patients in 2005, and 0.72±0.31 from 2,042 (51%) patients in 2010. The all or none CQI was targeted (calculated at “1”) in 2,307 (64%) of the patients (49% in 2005 and 75% in 2010). Among patients with impaired LV

function, the all or none based CQI was at one in 72 (20%) patients in 2005 and in 251 (53%) in 2010.

Patient-level analysis**:** The Kaplan Meier survival curves show differences according to the categories of the opportunity-based CQI (Figure 2). Multivariable analysis showed a significant relationship between categories of the CQI and survival. Using the Cox model, adjusted for deciles of the GRACE risk score, type of myocardial infarction, PCI-capability and cohort, there was a decrease in mortality with increasing quartiles of the CQI; HR = 0.82 (95% CI 0.64; 1.04) for quartile 2 vs. quartile 1, 0.69 (0.54; 0.88) for quartile 3 vs. quartile 1; and 0.68 (0.53; 0.89) for quartile 4 vs. quartile 1 (Figure 3).

Center level analysis: The correlation between the number of patients included in the registry (a proxy for volume of activity of each centre) and the value of the CQI was no tsignificant in 2005 and very low in 2010 (supplementary online figure). Among centers that included more than 20 patients (n=58 in 2005 and n=69 in 2010), the mean (95% CI) of the CQI was used to perform center benchmarking (Figure 4). Compared to the national average for the cohort, 12 centers performed better than average in 2005, and 22 in 2010. Conversely, a substantial number had a significantly lower mean CQI: 16 centers in 2005 and 17 in 2010.

## Discussion

This study shows that QIs developed by the ACCA for the treatment of AMI may be extracted from existing registries. In addition, the opportunity-based CQI is related to survival and makes it possible to distinguish quality levels between centers. These results could have an impact on the use and diffusion of these QIs, influence the design of future registries, as well as influence any future upgrades of the QIs.

The significant link between long-term survival and the opportunity-based CQI is an important finding, since firm evidence of the impact of quality of care on mortality is sparse. In our study, this relation is significant, even after adjustment for deciles of the GRACE risk score, year of admission, type of AMI and PCI capability of the admitting center. We cannot exclude the possibility that other potential confounders may exist, but, from our data, the reality of the impact of quality on survival appears plausible. This impact on survival is an additional argument in favour of more widespread assessment of the quality of care. Furthermore, wider use of QIs for assessment and benchmarking of quality of care could encourage better compliance with these specific processes of care.

The composite CQI also made it possible to perform center benchmaking. While this method seems adequate, it suffers from some limitations, mainly related to the number of patients included in the registry. In particular, a large proportion of centers could not be evaluated, since they included less than 20 patients in the registry. Although we did not observe a strong relation between the number of patients included and the value of the CQI, the relation between volume of activity and quality of care is documented [12], and the assessment of quality in low-volume centers is important. The All or None CQI

seems more difficult to interpret since it was calculated from only 3 items in patients without LV dysfunction and would need large cohorts to be measured among patients with impaired LVEF.

Our findings have also the potential to impact on future registries. Indeed, the QIs developed by the ACCA were defined with the primary aim of improving quality, but also with a view to multinational assessment. Ideally, this would require a specific and dedicated survey, but considering the cost and complexity of such a survey at a European level, and the number of existing high-quality national databases in Europe, the idea of using existing databases is appealing. Our results show that several QIs were measured directly, whereas certain others could only be assessed after transformation or extrapolation of existing variables. Lastly, some QIs could not be measured at all, either because the necessary variables (or even a proxy thereof) were lacking, or because of the drugs or strategies under evaluation were not available at the time of data recording.

It is probably feasible to improve the possibility to assess QIs from existing registries, depending on the specific QIs. For QIs like center organization, numerical GRACE or CRUSADE scores, or statin intensity, for example, the required variables could easily be captured with a simple data field update. The delivery of timely reperfusion is a widely used metric for assessing quality of care. Nevertheless, as shown in our study, assessing the different times and pathways is complex, and suffers from many limitations. Since an accurate time of onset of symptoms or time of first medical contact is often either lacking or unreliable, a precise definition and standardization how these times are measured is mandatory, as proposed in the ACC/AHA statement on

performance measures and reperfusion therapy [13]. Since QIs are based on the application of recent guidelines, including the use of new drugs or strategies, they cannot be applied in ongoing or old registries, unless only recently admitted are selected. Thus, the FAST-MI 2005 database cannot be used in the same way as the FAST-MI 2010 database, resulting in a debatable and maybe artificial improvement in quality, partially explained by the changes in guidelines and the availability of drug and strategies. Lastly, recording exceptions in QI [14] in regular registries, such as medical reasons (e.g. contra-indications, non indications, intolerance), patient-related reasons (e.g. patient preference, social or economic reasons) and system-related reasons (e.g. insurance coverage or availability of drugs) would be more difficult to obtain.

Finally, our results have the potential to impact on the update of the definition of QIs. Future revisions of the QI set will take into account not only changes necessary to remain aligned with current guidelines, but also the challenges of assessing QIs as seen in our study. From our results, no QI had a rate of measurement above 90%, showing that there is still room for improvement and, therefore, no need for withdrawal. Conversely, the rate of several QIs was very low, such as the use of fondaparinux, suggesting there may be bias in its assessment in addition to lack of compliance with guidelines. The two QIs for patients with impaired LVEF also have several limitations, such as the low proportion of cases concerned (19-23% of the patients), and the need to record all potential contra-indications, which cannot be extracted from current registries.

**Conclusion**

The application of the QI set developed by the ACCA to the FAST-MI 2005 and 2010 registries was possible for 12/20 indicators, covering different domains such as reperfusion and invasive strategy, risk assessment, anti-thrombotic treatment, and secondary prevention. The opportunity-based composite QI calculated from existing variables was found to be significantly related to adjusted mortality, and had the capacity to distinguish centres with high, average and low quality of care. These results may have an impact on the design of future registries, and on the update of the ACCA QIs.

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## Figure Legends

**Figure 1:** Description of the 20 Quality indicators defined by the Acute Cardiovascular Care Association of the European Society of Cardiology, covering seven domains of care.

**Figure 2:** Kaplan-Meier survival curves according to categories of the opportunity-based composite quality indicator.

**Figure 3:** Factors associated with survival by Cox proportional hazards regression.

**Figure 4:** Benchmarking of the performance of each centre as compared to the national average value of the composite quality indicator, in 2005 and 2010, among centres that included >20 patients. Arrows: centers with performance lower (in red) or better (in green) than the national mean.

**Supplementary online figure:** Correlation between the number of patients included in the registry (used as a proxy for volume of activity) and the value of the opportunity-based composite quality indicator.

R value = Spearman’s correlation coefficient.

**Table 1 :** Baseline characteristics and conditions at admission in the FAST-MI 2005 and 2010 cohorts

| **Variable** | **FAST-MI 2005 N= 3670** | **FAST-MI 2010 N= 4169** | P value |
|---|---|---|---|
| Male | 2515 (69%) | 3030 (73%) | <0.001 |
| Age (years) | 67±13 | 65±14 | <0.001 |
| Age >75 years | 1271 (35%) | 1246 (30%) | <0.001 |
| STEMI | 1872 (51%) | 2314 (55%) | <0.001 |
| STEMI with first medical contact <12 hours | 1618 (87%) | 1801 (78%) | <0.001 |
| Admission to center with cathlab on site | 2756 (75%) | 3813 (71%) | <0.001 |
| Hypertension | 2187 (60%) | 2226 (53%) | <0.001 |
| Hypercholesterolemia | 1774 (48%) | 1806 (43%) | <0.001 |
| Current smokers | 1065 (29%) | 1462 (35%) | <0.001 |
| Diabetes mellitus | 1316 (36%) | 835 (20%) | <0.001 |
| Body weight (kg) | 77±16 | 77±15 | 0.35 |
| History of stroke | 199 (5%) | 144 (3%) | <0.001 |
| History of MI | 666 (18%) | 642 (15%) | 0.001 |
| History of heart failure | 214 (6%) | 175 (4%) | 0.008 |
| History of PCI | 518 (14%) | 622 (15%) | 0.31 |
| History of surgical revascularization | 210 (6%) | 248 (6%) | 0.99 |

| | | | |
|---|---|---|---|
| Peripheral artery disease | 368 (10%) | 324 (8%) | 0.004 |
| COPD | 179 (5%) | 271(6%) | 0.002 |
| Admission systolic blood pressure (mmHg) | 140±29 | 144±28 | <0.001 |
| Admission heart rate (bpm) | 80±20 | 79±20 | 0.03 |
| GRACE risk score, mean±SD | 149±37 | 141±36 | <0.001 |
| LVEF (%), mean±SD | 52±13 | 52±11 | 0.68 |
| LVEF ≤ 0.40 | 639 (23%) | 669 (19%) | 0.001 |
| Haemoglobin at admission (mg/dL) | 13.7±1.9 | 14.1±1.8 | <0.001 |
| Creatinine at admission (mmol/L) | 117±41 | 119±44 | 0.35 |
| Glycaemia at admission (mg/dL) | 159±80 | 145±73 | <0.001 |
| LDL-cholesterol (mg/dL) | 117±41 | 119±43 | 0.55 |
| GFR (Cockcroft, mL/min) | 77±138 | 76±33 | <0.001 |
| GFR (MDRD) >60 mL/min | 2133 (64%) | 2582 (65%) | 0.16 |
| GFR (MDRD) 30-60 mL/min | 974 (29%) | 1112 (28%) | |
| GRF (MDRD) <30 mL/min | 242 (7%) | 249 (6%) | |

STEMI, ST elevation myocardial infarction ; cathlab, catheterization laboratory ; PCI, percutaneous coronary intervention ; COPD, chronic obstructive pulmonary disease ; LVEF, left ventricular ejection fraction ; GFR, glomerular filtration rate ; MDRD, Modification of Diet in Renal Disease.

**Table 2 :** Medications prior to admission; procedures and times during hospitalization; discharge prescriptions and mortality in the FAST-MI 2005 and 2010 registries

| Variables | FAST-MI 2005<br>N= 3670 | FAST-MI 2010<br>N= 4169 | P value |
|---|---|---|---|
| Prior aspirin use | 934 (25%) | 910 (22%) | 0.002 |
| Prior clopidogrel use | 479 (13%) | 515 (12%) | 0.35 |
| Prior beta blocker use | 921 (25%) | 989 (24%) | 0.16 |
| Prior ACEI/ARB use | 1293 (35%) | 1365 (33%) | 0.02 |
| Prior statin use | 1031 (28%) | 1151 (28%) | 0.63 |
| Fondaparinux in-hospital | 0 | 717 (17%) | |
| Information re time from onset to FMC<br>Reperfusion among STEMI pts<br>Information re time to reperfusion | 1861/1872 (99%)<br>1175/1872 (63%)<br>1170 (99%) | 2193/2314 (95%)<br>1843/2235 (81%)<br>1409 (77%) | <0.001 |
| Reperfusion with lysis:<br>No. with time information (FMC to needle)<br>Time (minutes) (median [IQR]) | 516 (27%)<br>512 (99%)<br>35 (20; 70) | 341 (15%)<br>324 (96%)<br>55 (40; 90) | <0.001 |
| Reperfusion with primary PCI:<br>No. with time information (ECG to balloon)<br>Time (minutes) (median [IQR]) | 659 (35%)<br>602 (100%)<br>127 (60;260) | 1474 (66%)<br>1024 (91%)<br>105 (77; 174) | <0.001 |
| Coronary angiography<br>No. with time to coronary angiography | 3098 (84%)<br>3070 (99%) | 3941 (94%)<br>3393 (86%) | <0.001 |
| Aspirin at discharge | 3170 (86%) | 3878 (93%) | <0.001 |
| Clopidogrel at discharge | 2613 (71%) | 2486 (60%) | <0.001 |
| Prasugrel at discharge | 0 | 1134 (27%) | |
| Dual antiplatelet therapy at discharge | 2459 (67%) | 3529 (85%) | <0.001 |
| ACEI/ARB discharge | 2387 (65%) | 3212 (77%) | <0.001 |
| Beta blockers at discharge | 2654 (72%) | 3496 (84%) | <0.001 |

| | | | |
|---|---|---|---|
| Statins at discharge | 2717 (74%) | 3710 (89%) | <0.001 |
| High intensity statins at discharge | 1183 (37%) | 2022 (63%) | <0.001 |
| Ezetimibe at discharge | 32 (1%) | 114 (3%) | <0.001 |
| 30-day mortality | 241 (6.6%) | 136 (3.3%) | <0.001 |
| 3-year mortality | 813 (22.1%) | 555 (13.3%) | <0.0001 |
| 3-year MACE | 1021 (27.8%) | 709 (17.0%) | <0.001 |

ACEI, angiotensin-converting enzyme inhibitors ; ARB, angiotensin receptor blockers ; FMC, first medical contact ; STEMI, ST elevation myocardial infarction ; No., number; IQR, interquartile range; MACE, major adverse cardiac events (.

**Table 3:** Rates of eligibility for and implementation of Quality Indicators in the FAST-MI 2005 and 2010 cohorts

| Quality Indicators | **FAST-MI 2005 N= 3670** | **FAST-MI 2010 N= 4169** |
|---|---|---|
| **Domain 1: center organization** | | |
| Q1_1: written network | | |
| Numerator | not recorded | not recorded |
| Denominator | 3670 (100%) | 4169 (100%) |
| Q1_2: routine assessment of times for reperfusion | | |
| Numerator | 1573 (87%) | 1864 (81%) |
| Denominator | 1798 (93%) | 2314 (78%) |
| Q1_3: participation to a registry/quality program | | |
| Numerator | 3670 (100%) | 4169 (100%) |
| Denominator | 3670 (100%) | 4169 (100%) |
| **Domain 2: reperfusion (among STEMI pts)** | | |
| Q2_1: rate of reperfusion (STEMI) | | |
| Numerator (STEMI eligible for reperfusion)) | 1090 (71%) | 1454 (81%) |
| Denominator (reperfusion among those eligible) | 1544 (82%) | 1796 (77%) |
| Q2_2: timely reperfusion | | |
| Numerator (STEMI with reperfusion) | 508 (35%) | 784 (52%) |
| Denominator (timely reperfusion among those eligible) | 1415 (xx%) | 1492 (xx%) |
| Q2_3: invasive strategy | 1415 (79%) | 1708 (92%) |
| Numerator(NSTEMI pts without immediate PCI) | 1798 (xx%) | 1855 (xx%) |
| Denominator | | |
| **Domain 3: risk assessment** | | |
| Q3_1: value of the GRACE score recorded | | |
| Numerator | not recorded | not recorded |
| Denominator | 3670 (100%) | 4169 (100%) |
| Q3_2: value of the CRUSADE score recorded | | |
| Numerator | not recorded | not recorded |
| Denominator | 3670 (100%) | 4169 (100%) |

| | | |
|---|---|---|
| Q3_3: value of the LVEF recorded | | |
| Numerator | 2806 (76%) | 3544 (85%) |
| Denominator | 3670 (100%) | 4169 (100%) |
| **Domain 4 : antithrombotics during acute stay** | | |
| Q4_1 : adequate P2Y12 | Not applicable | |
| Numerator (patients discharged) | | 2160 (57%) |
| Denominator (clopidogrel vs. prasugrel) | | 3794 (93%) |
| Q4_2: fondaparinux among NSTEMI | Not applicable | |
| Numerator | | 266 (14%) |
| Denominator | | 1855 (51%) |
| QI4_3: DAPT at discharge | | |
| Numerator | 2459 (67%) | 3529 (87%) |
| Denominator | 3463 (100%) | 4048 (100%) |
| **Domain 5 : discharge secondary prevention** | | |
| Q5_1 : high intensity statins | | |
| Numerator | 1183 (41%) | 2022 (56%) |
| Denominator | 2857 (xx%) | 3614 (xx%) |
| Q5_2: ACEI/ARB among pts with LVEF<.40 | | |
| Numerator | 291 (77%) | 430 (84%) |
| Denominator | 376 (xx%) | 511 (xx%) |
| Q5_3: bb among pts with LVEF<.40 | | |
| Numerator | 376 (xx%) | 511 (xx%) |
| Denominator | 268 (71%) | 455 (63%) |
| **Domain 6 patient's satisfaction** | | |
| Q6_1: patient's feedback | | |
| Numerator | not recorded | not recorded |
| Denominator | 3670 (100%) | 4169 (100%) |
| **Domain 7: CQI** | | |
| Q7_1: opportunity CQI | | |
| Applicable (among patients discharged alive) | 1004 (35%) | 2042 (50%) |
| Mean (SD) | 0.52 (0.30) | 0.72 (0.31) |

| | | |
|---|---|---|
| Q7_2: all or none CQI (among patients discharged alive): | 1333 (38%) | 2051 (51%) |
| 5 items (pts with LVEF≤.40 or heart failure) | 364 | 454 |
| Numerator | 72 (20%) | 251 (53%) |
| Denominator | | |
| 3 items (pts with LVEF≤.40 without heart failure) | | |
| Numerator | 969 | 1597 |
| Denominator | 659 (68%) | 1373 (77%) |

**Figure 1**

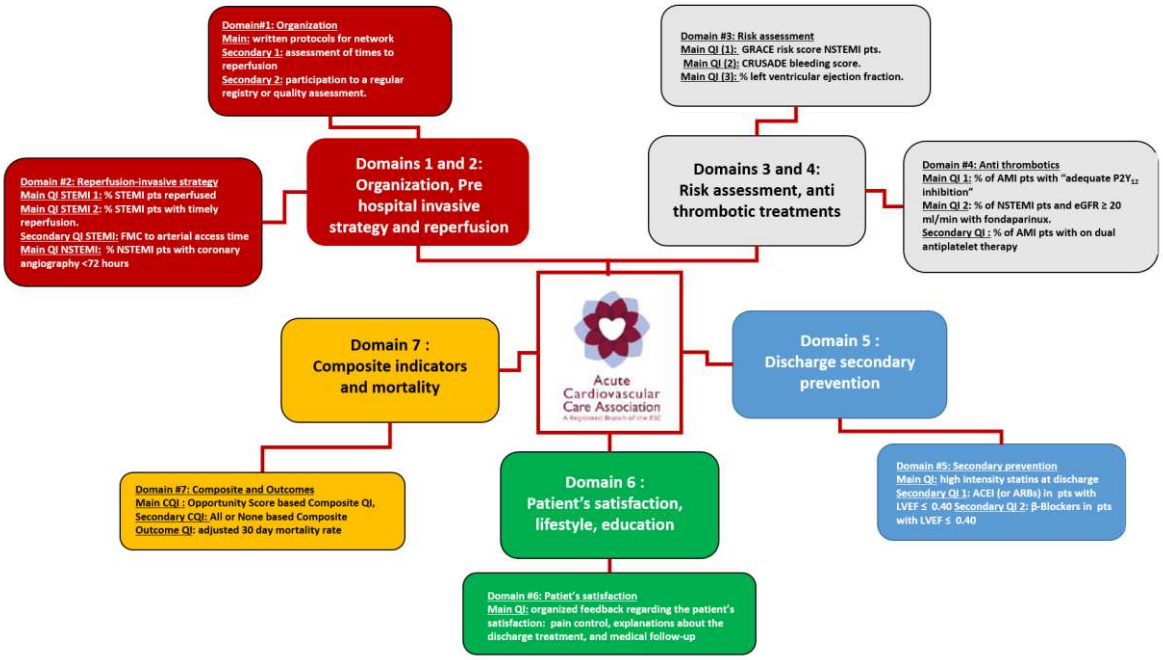
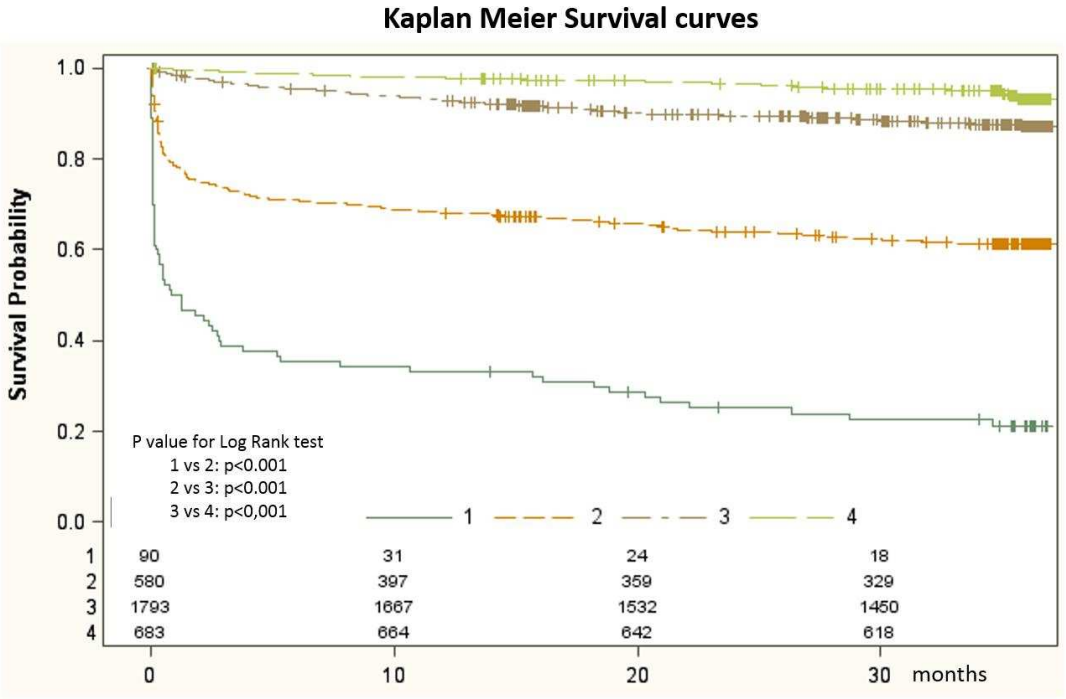

Domain#1: Organization
Main: written protocols for network
Secondary 1: assessment of times to reperfusion
Secondary 2: participation to a regular registry or quality assessment.
Domain #3: Risk assessment
Main QI (1): GRACE risk score NSTEMI pts.
Main QI (2): CRUSADE bleeding score.
Main QI (3): % left ventricular ejection fraction.
Domain #2: Reperfusion-invasive strategy
Main QI STEMI 1: % STEMI pts reperfused
Main QI STEMI 2: % STEMI pts with timely reperfusion.
Secondary QI STEMI: FMC to arterial access time
Main QI NSTEMI: % NSTEMI pts with coronary angiography <72 hours
Domains 1 and 2: Organization, Pre hospital invasive strategy and reperfusion
Domains 3 and 4: Risk assessment, anti thrombotic treatments
Domain #4: Anti thrombotics
Main QI 1: % of AMI pts with "adequate P2Y12 inhibition"
Main QI 2: % of NSTEMI pts and eGFR ≥ 20 ml/min with fondaparinux.
Secondary QI : % of AMI pts with on dual antiplatelet therapy
Acute Cardiovascular Care Association
Domain 7 : Composite indicators and mortality
Domain 5 : Discharge secondary prevention
Domain #7: Composite and Outcomes
Main CQI : Opportunity Score based Composite QI,
Secondary CQI: All or None based Composite
Outcome QI: adjusted 30 day mortality rate
Domain 6 : Patient's satisfaction, lifestyle, education
Domain #5: Secondary prevention
Main QI: high intensity statins at discharge
Secondary QI 1: ACEI (or ARBs) in pts with LVEF ≤ 0.40 Secondary QI 2: β-Blockers in pts with LVEF ≤ 0.40
Domain #6: Patiet's satisfaction
Main QI: organized feedback regarding the patient's satisfaction: pain control, explanations about the discharge treatment, and medical follow-up

**Figure 2**




**Opportunity score Composite QI: (1) =0; (2) =0-40%; (3) =40-80%; (4) >80%**

## Figure 3

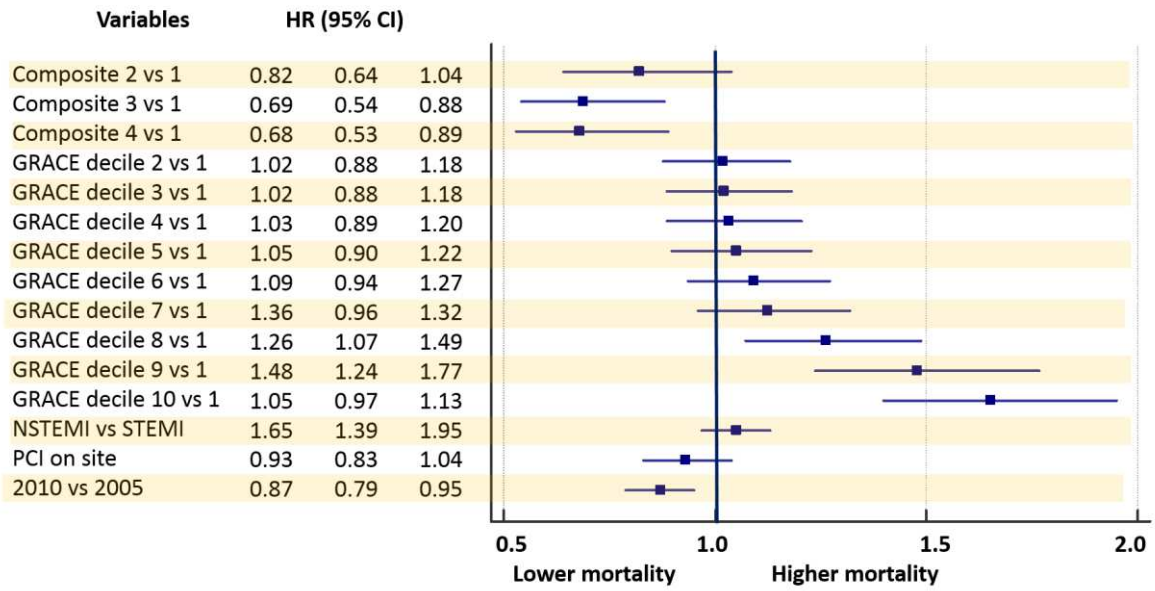
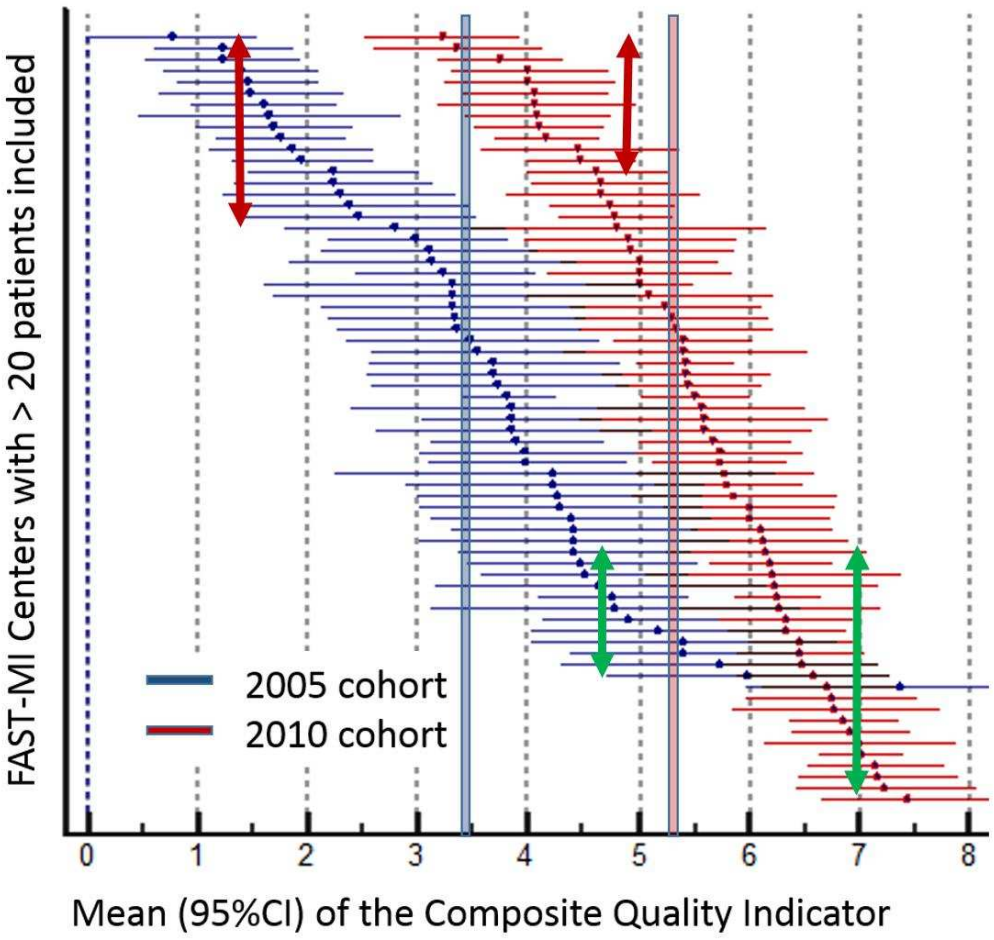

Variables
HR (95% CI)
Composite 2 vs 1 0.82 0.64 1.04
Composite 3 vs 1 0.69 0.54 0.88
Composite 4 vs 1 0.68 0.53 0.89
GRACE decile 2 vs 1 1.02 0.88 1.18
GRACE decile 3 vs 1 1.02 0.88 1.18
GRACE decile 4 vs 1 1.03 0.89 1.20
GRACE decile 5 vs 1 1.05 0.90 1.22
GRACE decile 6 vs 1 1.09 0.94 1.27
GRACE decile 7 vs 1 1.36 0.96 1.32
GRACE decile 8 vs 1 1.26 1.07 1.49
GRACE decile 9 vs 1 1.48 1.24 1.77
GRACE decile 10 vs 1 1.05 0.97 1.13
NSTEMI vs STEMI 1.65 1.39 1.95
PCI on site 0.93 0.83 1.04
2010 vs 2005 0.87 0.79 0.95
0.5
1.0
1.5
2.0
Lower mortality
Higher mortality

**Figure 4**


FAST-MI Centers with > 20 patients included
2005 cohort
2010 cohort
0
1
2
3
4
5
6
7
8
Mean (95%CI) of the Composite Quality Indicator

**Supplementary online figure**