**Supplementary material**

# Quality Markers in Cardiology. Main Markers to Measure Quality of Results (Outcomes) and Quality Measures Related to Better Results in Clinical Practice (Performance Metrics). INCARDIO (Indicadores de Calidad en Unidades Asistenciales del Área del Corazón): A SEC/SECTCV Consensus Position Paper

INCARDIO Task Force. (Indicadores de Calidad en Unidades Asistenciales del Área del Corazón)

Joint task force between the Spanish Society of Cardiology (SEC) and the Spanish Society of Thoracic and Cardiovascular Surgery (SECTCV)

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## SUPPLEMENTARY MATERIAL

**Table 1. Population Selection and Adjustments Recommended to Compare Outcomes Between Different Hospitals**

| Metric | Relevance | Difficulty | Auditable | Comments |
|---|---|---|---|---|
| **MORTALITY,** number of days at any hospital during 30 days after index hospitalization | | | | |
| Classify hospitals in comparable clusters according to volume, technology and organization | 1 | 1 | 1 | Comparable clusters should be based on patient volume, technology, organization and transfer of patients |
| Recommended time measurements: 1 month after hospital admission | 1 | 2 | 2 | Corrects for early hospitals discharge. Simplifies measurements. Perceived by the task force as better than outcomes at different times (hospital discharge, 3 months, 6 months, 1 year) |
| Overall mortality | 1 | 1 | 1 | Quality metric dependent on too many different clusters of confounders (patient risk, transfers bias form other hospitals, proportion of very high risk and very low risk patients, other) |
| Cardiovascular mortality | 1 | 2 | 2 | Same comment as overall mortality. CV mortality very difficult to ascertain if not adjudicated |
| Exclusion of patients transferred from other hospitals, except when all patients are transfer from hospitals I and II to the same type III hospital | 1 | 2 | 2 | Corrects for higher mortality risk in patients only admitted to some hospitals. Some hospitals, because of attitude, local protocols or location may be more vulnerable than others. |
| Exclusion of patients with rare diseases and GRDs with very low intensity cases | 1 | 2 | 2 | These cases are considered as confounders. e.g., pre hospital cardiac arrest admitted unconscious, endocarditis. |
| Exclude patients with extreme high risk | 1 | 2 | 2 | This include unconscious at hospital arrival, cardiogenic shock at admission, terminal illness, etc. |
| Exclusion of patients with confusing diagnosis or no cardiac diagnosis as main reason for admission | 1 | 2 | 2 | These cases are considered as confounders; e.g., trauma, non-cardiac surgery |
| Cluster by GRDs<br>Select, well-defined, high-risk specific populations with prognosis known to be highly dependent on overall cardiologic treatment quality. | 1 | 2 | 2 | GRDs group relatively homogeneous diagnosis and procedures. Usually split into too many groups, sometimes arbitrarily. Only selected, well defined GRDs, representing challenging, complex procedures should be used. These include STEMI, heart failure, out of hospital cardiac arrest. TAVI, heart failure, Catheter ablation, pacemaker / CDI, CRT device implantation. With regard to surgery examples include, 1st time, staged, isolated CABG, aortic and mitral valve replacement, combined CABG and valvular surgery. Emergency surgery should be excluded. 1st time surgery preferred<br>Use of ICD9 codes should be a standard, but need clustering of related codes. *For some GRDs, ICD9 does not properly reflect some contemporary diagnosis such as ST elevation myocardial infarction.* |
| Adjustment for severity of illness | 1 | 2 | 2 | Severity of illness should be calculated using appropriate (validated) scales/scores, the same as used in clinical practice. Other options for correction of severity of illness could be considered if evidence based or lack of appropriate risk scores (e.g., heart failure) |
| Adjustment for risk of death | 1 | 2 | 2 | Risk of death should be calculated using the same appropriate scales/scores as used in clinical practice. Other options for correction could be considered if evidence based or lack of appropriate risk scores |

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| Describe outcomes in medical and surgical groups | 1 | 1 | 1 | Surgical and medical identify two different populations with different outcomes |
| For specified, prevalent, high-risk populations: Attribute GRDs to several specialties if different specialists may treat them | 1 | 1 | 1 | Helps to determine different outcomes according to staff expertise and unit organization. Differences will be minimized if teamwork and common protocols are used. These typically included heart failure patients. Describe outcomes for patients 1st admitted to cardiology units or to other hospital departments |

**Table 2. Recommended ICD-9-MC Codes**[113]

| Clinical setting Related Diagnosis Groups (GRDs) | ICD-9-MC codes | Comments |
|---|---|---|
| **STEMI** | 410.71 | Does not guarantee the inclusion of selective STEMI cases<br>Correct for GRACE risk score wenever possible<br>Excluding patients unconscious at hospital arrival is highly recommended in dedicated databases (e.g., STEMI code programs and similar) |
| **Non-STEMI** | 410.72 | Correct for GRACE risk score |
| **Out of hospital cardiac arrest** | V12.53 | ICD9 dos not allow the identification of patients arriving to hospital unconscious after an episodio of cardiac arrest. Mortality in this setting is much higher and reference hospitals with a hypothermia program will be penalized if these patients are not excluded |
| **Staged PCI** | 00.66 (PCI)<br>+00.40/00.41/00.42/00.45/<br>00.46/00.47/36.06/36.07<br>36.06 Bare stent<br>36.07 DE stent<br>00.41 One vessel<br>00.42 Two vessel<br>00.47 Three vessel | Risk correction using Syntax score desirable but impossible except in dedicated databases/registries<br>Corrections for GRACE risk score desirable in dedicated databases<br>Mortality is very low; crude data can be considered as a good meassure |
| **Transfemoral TAVI** | 35.05 | Correct for EuroSCORE 2 |
| **ABLATION** | 37.33 / 37.34 | Suggestion: no correction, Very low mortality |
| **Pacemarker** | 37.80 | Suggestion: no correction |
| **ICD** | 37.94 | Suggestion: no correction |
| **RCT** | 00.50 | Suggestion: no correction |
| **Heart Failure** | 428.0 Congestive heart failure, unspecified<br>428.1 left heart failure<br>428.20 HF Systolic<br>428.21 Systolic acute<br>428.22 Systolic chronic<br>428.23 Acute on chronic systolic<br>428.3 HF diastolic<br>428.31 Acute diastolic<br>428.32 Chronic diastolic<br>428.33 acute on chronic diastolic<br>428.4 HF systolic and diastolic<br>428.41 Systolic and diastolic acute<br>428.42 Systolic and diastolic chronic<br>428.43 Acute on chronic sys. & diast<br>428.9 HF unspecified | Perceived as one of the main parameters for quality results metrics.<br><br>Complex to codify. Detailed diagnoses/codes probably will not be reliable in the CMBD or other databases<br><br>No risk score validated and universally used.<br><br>One solution could be the selection of a well-defined subgroups e.g.,<br>Systolic heart failure, first episode (428:21) |

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| | 429.4 HF post surgery<br>785.51.cardiogenic shock<br>402.01, 402.11, 402.91 Hypertension with HF | |
| **1st surgery Aortic valve** | 395 Rheumatic<br>424.1 No Rheumatic<br>35.21 biological prosthesis<br>35.22 mechanical prosthesis | No specific code for 1st time surgery. CMBD database can identify previous surgery |
| **1st surgery Mitral valve** | 394.1 Rheumatic<br>424 No rheumatic<br>35.23 Bbiological prosthesis or repair<br>35.24 Mechanical prosthesis | No specific code for 1st time surgery. CMBD database can identify previous surgery |
| **1st surgery CABG** | 36.10 One vessel<br>36.12 Two vessel<br>36.13 Three vessel<br>36.14 Four vessel | No specific code for 1st time surgery. CMBD database can identify previous surgery |
| **Stroke** | 434.9 y 434.91 Primary TIA or stroke<br>997.0 stroke complicating procedures | |
| Transfusions | 99.03 | |

**Table 3. Quality Measures Related With Better Results in Clinical Practice. Performance Measures. General, Hospital Related. Clinical Cardiology**

| **Clinical cardiology** | |
|---|---|
| **Metric** | **Recommendations** |
| **Structure. Resources directly related to patient care** | |
| **Hospital volumes** | • Nº cardiology beds |
| | • Nº dedicated ICCU beds (recommended 4-5 beds / 100.000 inhabitants) |
| | • Nº patients discharged from type II hospitals > 500; from type III > 1000 |
| **Desired technology** | • Dedicated cardiac unit: Recommended in type II and III hospitals covering a population > 300.000 |
| | • Dedicated ICCU. Recommended in type III hospitals |
| | • Echocardiographs. TTE, all hospitals. TEE and stress echo in type II and III hospitals; 3D echo in type III hospitals |
| | • Interventional cardiology labs. 1 in type II, at least 2 in type III hospitals |
| | • MS-CT, type II and III hospitals |
| | • PET-CT Scanner, type II and III hospitals |
| | • NMR, type II and III hospitals |
| | • Heart protected hospital. Defibrillators in all floors of all hospital buildings. |
| | • Telemetry ECG monitoring in non-intensive care cardiology wards |
| | • Holter monitoring systems. Recommended in all hospitals |
| **Staffing** | • Certified cardiologist responsible for cardiac unit in hospitals > 300.000 |
| | • Certified cardiologists, recommended in all hospitals |
| | • Cardiologist certified in echocardiography (at least 2 years training) (at least 1 recommended in type III hospitals, or hospitals performing over 1000 studies / year or performing stress echo or TEE) |
| | • Cardiologist certified in interventional cardiology (at least 2 years training) (at least 1 recommended in type II and III hospitals) |
| | • Cardiologist certified in electrophysiology and complex arrhythmias (at least 2 years training) (at least 1 recommended in type II and III hospitals) |
| | • Nurses with > 1-year cardiology experience. Recommended in type II and III hospitals |
| | • Other: secretaries, paramedics, social workers, etc. |
| **Organization** | • Dedicated cardiac unit: Recommended in type II and III; or hospitals covering a population > 300.000 |
| | • Dedicated ICCU. Recommended in type III hospitals |
| | • Cardiac imaging unit. Recommended in type III hospitals |
| | • Cardiologist 24 h in hospital, recommended in type II and III hospitals |
| | • Cath Lab unit: recommended in type II and III hospitals |
| | • Electrophysiology Unit. Recommended in type III hospitals |
| | • Cardiology outpatient clinics. Recommended in all hospitals |
| | • Day hospital. Recommended in all hospitals |

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| | • Established and hospital approved protocols for derivation to other hospitals in case of need for other services: Transplant, cath lab, electrophysiology, adult congenital heart diseases, cardiac surgery, rehabilitation program. Recommended in all hospitals without the required technology. |
| **Patient services** | • Cardiologist on call / 24 hours Recommended in hospitals II and III hospitals |
| | • Rehabilitation program. Recommended in all hospitals, in house or in a reference hospital |
| | • Palliative Care / Hospice program |
| | • Wound management services |
| | • Pain management program |
| | • Translators |
| | • Social workers |
| | • Home care |
| **Accreditation** Certification of qualification conferred by external organizations | • ISO certified units<br>• Accreditation of Cath Lab (ESC)<br>• Accreditation of ECHO Lab (ESC)<br>• Accreditation of Electrophysiology Lab (ESC)<br>• Accredited continuous medical accreditation programs, for cardiologists, residents and nurses<br>• Other accreditations<br>• Honours, awards<br>• Reputation<br>• Impact factor |
| **Process of delivery care for diagnosis, treatment, prevention and patient education** | |
| **Local protocols** for diagnosis and treatment based on ESC /AHA.ACC guidelines | • Local protocols based on guidelines recommendations for prevalent GRDs: IHD, AF, valvular, HF. Recommended in all hospitals Appropriate use of limited resource technologies |
| **Multidisciplinary protocols** | • With, but no only: emergency department, internal medicine, anaesthesiology, general intensive care unit, nephrology, radiology, central lab, primary care physicians.<br>• Use of common, approved protocols in prevalent GRDs. Recommended in all hospitals.<br>• Avoid duplicity of units in the same hospital (e.g., heart failure) |
| | • STEMI: SUMA / SAMUR, cardiac unit, emergency department. Regional STEMI protocol |
| | • Cardio toxicity. Recommended in type II and III hospitals |
| | • Adult congenital heart diseases (selected hospitals) |
| | • Endocarditis recommended in type II and III hospitals |
| | • Nursing programs. Recommended in all hospitals |
| | • Primary care programs. Recommended in all hospitals |
| | • Quality control programs on yearly basis (e.g. door to balloon time in STEMI). Recommended in hospitals II and III hospitals |
| | • Primary and secondary prevention program. Recommended in all hospitals |
| | • Patient and population education program. Recommended in all hospitals |
| | • Established and hospital approved protocols for derivation to other hospitals in case of need for other services: Transplant, cath lab, electrophysiology, cardiac surgery, rehabilitation program, adult congenital heart diseases, complex pulmonary hypertension. Recommended |

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| | in all hospitals without the required technology |
| **Waiting list for 1st medical outpatient visit** | • < 40 days. Recommended in all hospitals.<br>• < 1,7 / 1000 population covered by hospital |
| **Safety. Quality control programs focussed on safety** | • Including, but not only: Infections, transfusions, medical errors, malpractice, patient complains<br>• All hospitals should identify possible safety problems and organized local quality programs in a yearly basis |
| **Patient education** | • Medical report at discharge, including diagnosis, process of care in hospital, treatment, recommendations life style, primary and secondary prevention and scheduled visit if necessary. Recommended for all patients in all hospitals |
| | • Educational deliverables e.g., booklets, charts for recording symptoms. Control of adherence to treatment and recommendations |
| | • Patient web page |
| | • Teaching sessions disease oriented for patients and relatives |
| | • Rehabilitation programs including education in primary and secondary cardiovascular prevention |
| | • Control of adherence to treatment and recommendations programs |
| **Results. Outcomes in selected populations** | • As described in text and table # 5 |
| **Adherence to local protocols** based on ESC / AHA-ACC guidelines | • Recommended > 90% in all hospitals |
| **Heart-team.** Indications for elective interventional cardiology (coronary, structural and electrophysiology) | • Recommended > 90% in all hospitals |