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EuroHOPE AMI: Material, Methods and Indicators

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Introduction and objectives

The main aim of the EuroHOPE AMI project is to compare performance in the care of AMI patients between countries, within countries (regions and hospitals), and over time. This comparison is made for various purposes. We will implement European-wide benchmarking of outcomes, quality and costs. This will enable decision-makers and health professionals to learn from the best practices. We will investigate the relationship between outcomes/quality and costs/resources between European countries, regions and providers, applying a multilevel approach. Finally, we will explore reasons behind the differences in outcomes and costs. In particular, our focus will be on policy driven factors such as treatment practices (PCI centres, CABG, use of medications), waiting times, organisation of services, and financing.

This paper defines specific protocols for international comparisons that are based on the data of hospital discharge registers, mortality registers, and other available registers (such as use of drugs etc.). The protocol has been used in preparing both **national AMI databases for each country and for an international comparative AMI database** which is produced from the national AMI databases. The comparative database has been used for basic reporting on care of AMI patients, and for research on reasons behind differences in performance.

This protocol defines how we have produced indicators at national and (within country) regional levels. The basic report includes basic information on patients (number of patients, age distribution, co-morbidity), indicators on content of care (use of services and procedures, costs, treatment practices, process indicators), and indicators of outcomes.

This paper is a joint work established (in alphabetical order) by Eva Belicza, Anne Douglas, Terje P. Hagen, Unto Häkkinen, Amber van der Heijden, Antti Malmivaara, Emma Medin, Dino Numerato, Mikko Peltola, Clas Rehnberg and Timo T. Seppälä.

Definition of AMI

Definition of AMI:

Detection or rise and/or fall cardiac biomarkers (preferably troponin) with at least one value above the 99th percentile of the upper reference limit (URL) together with evidence of myocardial ischaemia with at least one of the following:

- Symptoms of ischaemia;
- ECG changes indicative of new ischaemia (new ST-T changes or new left bundle branch block (LBBB));
- Development of pathological Q waves in the ECG;
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

(Circulation. 2007;116:2634-2653.)

AMI includes: ICD-9 code: 410, ICD 10-codes: I21, I22.

National Databases

Every country has established a **national AMI database**. From national discharge registers were included patients that had been admitted to hospital inpatient care because of AMI (ICD-9 code: 410 / ICD 10-codes I21, I22). We classified AMI cases into subgroups: 1: STE-MI or recurrent AMI (ICD 10 codes: I210, I211, I212, I213, I22, ICD 9 codes: 4100-4106, 4108, 41072, 41092); 2. Undefined AMI (ICD 10 –code I219, ICD 9-code: 4109 excluding if fifth digit is 2); 3. NonSTE-MI (ICD 10 code: I214, ICD 9-code: 4107 excluding if fifth digit is 2).

At present the database includes AMI patients for the year 2007 and is formed combining patient level data of each country's national registers.

Using personal identification number we have linked patients' information from the following registers:

- Hospital discharge registers
- Outpatient services in specialist care / hospitals
- Data from other institutions (e.g. nursing homes)
- Drug utilisation registers
- National mortality registers

International database used for calculating indicators

Data restrictions

At present database includes AMI patients (ICD-9 code 410 / ICD 10-codes I21, I22) admitted to hospital during the year 2007.

Following patients have been excluded:

- earlier diagnosis of AMI (ICD-9 code 410 / ICD 10-codes I21, I22) during the last 365 days in the hospital discharge registry
- length of stay during the first admission was more than 90 days
- patients under 18 years
- tourists and visitors (include those patients who have national social ID number and who are residents by nationality)

The main analysis will be done by using the patient data collected from National discharge registers. However, in the flow chart we will also give figures of those patients that were collected from mortality statistics and meet the same inclusion criteria in order to get information of total incidence of AMI. This information is necessary when we are estimating the proportion of total resources spent on AMI patients in the last year prior to death.

The specific information of registers in each country is provided in Appendix 1. Appendix 2 describes the definitions that have been used in preparing and analysing the data.

Definition of the first hospital episode

Total episode of care was defined as the entire treatment pathway from the beginning of the disease to the end of the treatment throughout any hospital admissions, other health service provisions or purchased medication in order to solve the health problem at hand in a specified time frame (Figure 1).

First hospital episode: hospital inpatient treatment beginning on the index day including also possible discharge to another hospital and terminating on the first discharge to home, one year of continuous inpatient care or death (Figure 1). If the patient is immediately transferred to inpatient rehabilitation center this is included in the first hospital episode (Häkkinen and Peltola 2012).

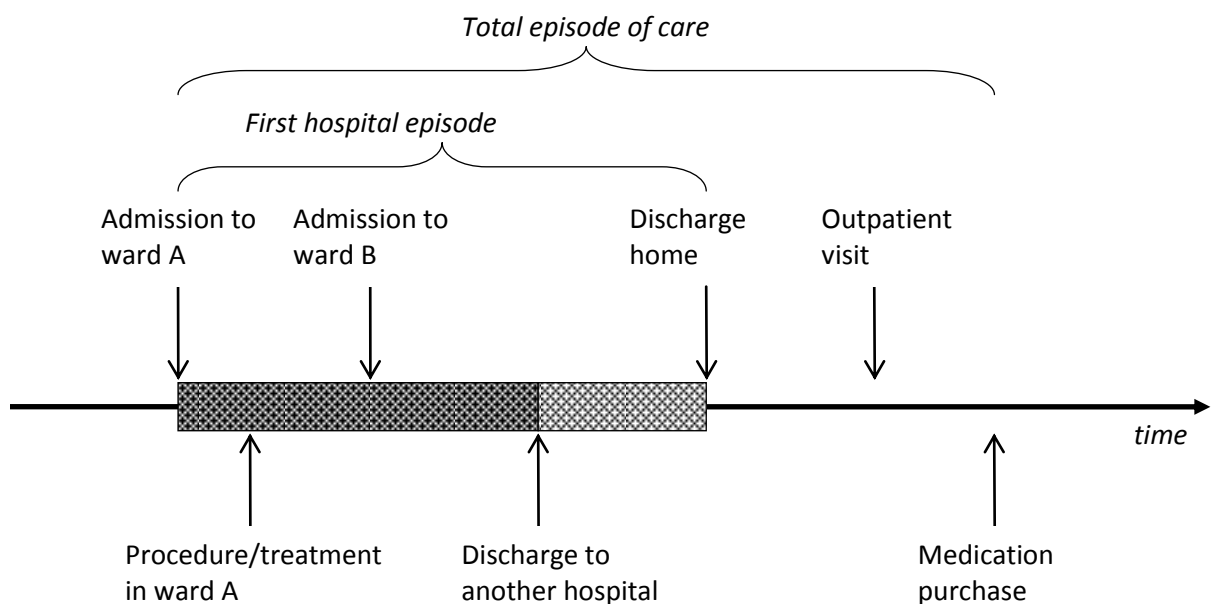


Figure 1. A schematic presentation of the follow-up of patients throughout the treatment pathway demonstrating the definitions of first hospital episode and the total episode of care.

Description of indicators

Baseline indicators of patients:

- age and gender
- co-morbidities (see Appendix 2);
 - Hypertension
 - Coronary artery disease
 - Atrial fibrillation
 - Cardiac insufficiency (heart failure)
 - Diabetes mellitus
 - Atherosclerosis

- Cancer
- COPD and asthma
- Dementia
- Depression
- Parkinson's disease
- Mental disorders
- Renal insufficiency (failure)
- Alcoholism
- Stroke

Co-morbidities are calculated in two ways

- 1) based on medicine purchase, or main or secondary diagnosis during the previous 365 days hospital inpatient utilisation (total and separately for genders)
 - 2) based on main and secondary diagnoses during the previous 365 days hospital utilisation
- Number and share of patients that have used drugs (outside hospitals) during 365 days prior to the index date (including index date) based on ATC (anatomic therapeutic classification) -classification one year before admission (see below: the process indicators)
 - in-patient hospital stay days one year prior to AMI in acute care

Process indicators:

- Length of stay of first hospital admission, days per patient
- Length of stay of first hospital episode, days per patient
 - total
 - days per patient due to AMI
- Total inpatient days per patient over the first year after AMI
 - total
 - days per patient due to any AMI
- Number and share of patients having with length of stay of the first hospital episode of 90 days or more
- Number and share of patients treated during the first hospital episode in different type of AMI/cardiology centre (cardiology center with PCI availability, hospital with cardiological special treatments, general hospital)
- Number and share of patients received during the first hospital episode percutan cardiological intervention (PCI)
- Number and share of patients received during the first hospital episode cardiological bypass surgery (CABG)
- Number and share of patients that have used drugs (outside hospitals) during 365 days after based on ATC (anatomic therapeutic classification) classification one year before and one year after hospitalisation.

Diuretics (C03*, C07BB*, C09BA*, C09DA*)

Beta blockers (C07*)

ACE inhibitors (C09A*, C09B*)

Angiotensin receptor blockers (AT II antagonists) (C09C*, C09D*)

Calcium channel blockers (C08*, C07FB*, C09BB*)

Insulin (A10A*)
Blood glucose lowering drugs, excluding insulins (oral diabetes medication) (A10B*)
Statins (C10AA*)
ADP receptor inhibitors (clopidogrel, prasugrel, ticagralor) (B01AC04, B01AC22, B01AC24)
Dipyridamole (B01AC07, B01AC30)
Warfarin (B01AA03)
Antidepressants (N06A*)
Anti-dementia drugs (N06D*)
Antiepileptics (N03A*)

Outcome indicators

- Mortality at 30, 90, and 365 days from the index admission day.
- Readmission (due to recurrence of AMI) to hospital within 30, 90 days and 365 days from the index admission.
- Complications during the first hospital episode:
 - pulmonary embolism
 - stroke

Risk adjustment

One of the challenges when comparing health outcomes between countries is to adjust for differences in the patient mix. One country may have older, more ill patients than another country. This is further complicated by the fact that detailed information on the patients may not be available, or variables being very differently defined across countries. In order to have comparable performance indicators the indicators have to be adjusted for confounding factors. EuroHOPE aims to solve this problem by using register data available for everyone with a specified health problem, which contains detailed information on variables with effect on the health outcomes. Examples are disease specific co-morbidities, length of stay and medication use prior to the occurrence of the health problem studied.

For each outcome, three different risk adjusted outputs are produced: 1. adjusted for sex and age only, 2. adjusted for sex, age, disease specific co-morbidities based on primary and secondary diagnosis, LOS the year prior to index admission, and 3. identical to 2 except co-morbidities are based on both primary and secondary diagnosis and medication purchase. **For detailed instructions, see Appendix 3.**

Based on the experiences in the PERFECT project (Peltola *et al.*, 2011), the observed/expected approach described in Ash *et al.* (2003) is used, which roughly corresponds to indirect standardization. Specifically, the method uses regression modelling for the risk adjustment. For mortality outcomes up to one year logistic regression is used, while for the LOS outcomes negative binomial regression is used. The method is described more detail in Mogren, Peltola *et al* 2012. The STATA CODES for calculating indicators are given in Appendix 4.

Case-mix standardisation will be used when comparing countries, regions, hospitals, or years. Variables which are considered potential prognostic factors (and thus confounders) are used

for adjustment. These will be derived from primary and secondary diagnoses of previous discharge data and from data on previously prescribed medicines. We will use

- age (in years, classified)
- gender
- co-morbidity as defined in (Appendix 2)
- in-patient hospital stay days during one year prior to AMI in acute care.

Levels of analysis

Indicators are produced at national and within countries also regional level and later at hospital level. Regional information is based on patients' place of residence. The definitions for regions have been made in each country according to the local preferences.

Remarks on interpretation of indicators

Here text describes what should be taken into account in comparisons of indicators. The most important caveats related to differences in coding practices, availability of data and differences in classifications should be discussed. This chapter will be finalized after indicators of all are available

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Appendix 1. Particular characteristics of national registers and data bases

Hospital discharges register for inpatient care

Finland	(1987-) 2000-
Hungary	2004-
Italy	since 2003 for all the regions/provinces involved
the Netherlands	(1995-) 2000- (from 2005 incomplete) patient ID is questionable (age, sex, address, etc.)
Norway	1999-2007 without patient ID, 2007.Febr.- with ID
Scotland	1980- (no private producers)
Sweden	(1987-) 2000-

Register on use of outpatient services in hospitals and/or other specialist units

Finland	(1998-) 2000-, data on diagnosis is not complete?
Hungary	2004-
Italy	since 2004 for all the regions/provinces involved
the Netherlands	2005- (incomplete personal identifiers)
Norway	1999-2007 without patient ID, 2007.Febr.- with ID (same as inpatient)
Scotland	Only Lothian county available
Sweden	2001-

Register on use of outpatient services in primary care

Finland	2006- (in Helsinki metropolitan area)
Hungary	NA (2008-, but availability questionable)
Italy	NA
the Netherlands	2000- (a nationally representative sample)
Norway	NA
Scotland	2000
Sweden	2006- (for a few county councils)

Register data from other institutions

Finland	nursing homes (from Social Insurance Institution 1995-) 2000-
Hungary	2004- Hospital discharge data includes long term care, inpatient rehabilitation
Italy	<u>Medial emergency</u> - since 2004 for all the regions/provinces involved, <u>Rehabilitation</u> - only province of Rome since 2005
the Netherlands	nursing home care 2004-
Norway	2007.Febr.- with ID
Scotland	Lothian data from long stay hospitals
Sweden	NA

Appendix 2. Variable definitions

Co-morbidity codes

Co-morbidity	ICD-9	ICD-10	ATC-code
Hypertension	40*	I10*-I15*	C03*, C07* (with neither coronary artery disease nor atrial fibrillation indicates hypertension), C08*, C09*
Coronary artery disease	410*-414*	I20*-I25*	N/A
Atrial fibrillation	4273*	I48*	N/A
Cardiac insufficiency (heart failure)	428*	I50*	N/A
Diabetes mellitus	250*	E10*-E14*	A10A*, A10B*
Atherosclerosis	440*	I70*	N/A
Cancer	140*-208*	C00*-C99*, D00*-D09*	L01* except L01BA01
COPD and asthma	4912*, 496*, 493*	J44*-J46*	R03*
Dementia	290*, 3310*	F00*-F03*, G30*	N06D*
Depression	2960*, 2961*	F32*-F34*	N06A*
Parkinson's disease	332*	G20*	N04B*
Mental disorders	295*-298* expect 2960* and 2961*	F20*-F31*	N05A* except N05AB01 and N05AB04, and no dementia
Renal insufficiency (failure)	585*	N18*	N/A
Alcoholism	291*, 304*, 305*	F10*-F19*	N/A
Stroke	430*-438*	I60*, I61*, I63*, I64*, G45*	N/A

Complication codes

Pulmonary embolism: ICD 10: I26, ICD 9: 415

Stroke: ICD10: I60-I69, G45, G46; ICD9: 430-438

Procedure codes (varies by countries)

Appendix 3. Instructions for adjustment for confounding (apply for between and within country comparisons)

The point estimates and confidence intervals for incidence, process variables and treatment outcomes are produced as follows:

1. Unadjusted data

- a. Incidence of AMI
- b. Age and gender
- c. PCI, CABG and angiography during the first hospital episode
- d. Co-morbidities based on main diagnosis or medicine purchase during the previous 365 days
- e. Medication purchases 365 days prior the index date
- f. Medication purchases 365 days after the index date
- g. Proportions treated at cardiological center with PCI availability, hospital with cardiological special treatments, general hospital

2. Data adjusted for age and gender only

- a. Complications (pulmonary embolism and stroke)
- b. Length of stay at hospital: first admission, hospital episode, total during one year after index admission due to AMI
- c. AMI recurrence at 30, 90 and 365 days after index admission
- d. Mortality at 30, 90 and 365 days after index admission of AMI patients

3. Adjusted for age, gender, number of hospital days during previous 365 days (LOS) prior to index admission, disease specific co-morbidities based on primary and secondary diagnosis¹

- a. Complications (pulmonary embolism and stroke)
- b. Length of stay at hospital: first admission, hospital episode, total during one year after index admission due to AMI
- c. AMI recurrence at 30, 90 and 365 days after index admission
- d. Mortality at 30, 90 and 365 days after index admission of AMI patients

4. Adjusted for age, gender, LOS the year prior to index admission, disease specific co-morbidities based on primary and secondary diagnosis¹ & medication purchase².

- a. Complications (pulmonary embolism and stroke)
- b. Length of stay at hospital: first admission, hospital episode, total during one year after index admission due to AMI
- c. AMI recurrence at 30, 90 and 365 days after index admission
- d. Mortality at 30, 90 and 365 days after index admission of AMI patients

¹hypertension, coronary artery disease, atrial fibrillation, cardiac insufficiency (heart failure), diabetes mellitus, atherosclerosis, cancer, COPD and asthma, dementia, depression, Parkinson's disease, mental disorders, renal insufficiency (failure), alcoholism, stroke

²medication purchase (prescription and special reimbursement data): diuretics, beta blockers, ACE inhibitors, angiotensin receptor blockers (AT II antagonists), calcium channel blockers, insulin, blood glucose lowering drugs, excluding insulins (oral diabetes medication), statins, ADP receptor inhibitors (clopidogrel, prasugrel, ticagralor), dipyridamole, warfarin, antidepressants, anti-dementia drugs, antiepileptics