EuroHOPE

Building register-based performance indicators for

hip fracture

using individual-level administrative health care data

Version of August 27, 2016

BRIDGEHEALTH WP11
Integrating data sources into a comprehensive EU Information System
for Health Health Care Monitoring and Reporting

1. Introduction and objectives

The principal aim of the BRIDGEHealth Work Package 11 "Integrating data sources into a comprehensive EU Information System for Health Health Care Monitoring and Reporting" is to create databases to enable comparison of performance in the care of specific patient groups between countries, within countries (regions and hospitals), and over time, using patient-level administrative health care data. The specific aims are updating protocols, data processing, reporting for selected diseases/condition included in the European Health Care Outcomes, Performance and Efficiency (EuroHOPE) project. This paper updates the earlier version the protocol for hip fracture, which has been applied in several articles (Medin et al. 2015, Häkkinen et al. 2015) as well as in the regional indicators available in http://eurohope.info.org.

In the earlier stage of EuroHOPE, the hip fracture data was gathered from Finland, Hungary, Italy, Netherlands, Scotland and Sweden for the years 2006-2008 and Norway for the year 2009. Now the data will be updated for Finland, Hungary, Italy and Sweden to cover more recent years. In addition data from Norway, Denmark and Spain (Madrid) will be collected and included in the comparison.

The main objective of the comparison database is to produce performance indicators at country, regional and hospital level for international benchmarking. The database enables to extend and deepen the international comparative research on the relationship between outcomes/quality and costs/resources as well as on the reasons behind the differences in outcomes and costs (Medin et al. 2015, Häkkinen et al. 2015).

This specific protocol for international comparisons for hip fracture describes how the EuroHOPE international comparison data is constructed is based on the data of hospital discharge registers, mortality registers, and other available administrative health care registers (such as medication use, specialty visits, etc.) (Figure 1). The protocol is used for preparing both the **national hip fracture databases for each country and for an international comparative hip fracture database,** which is produced using the national hip fracture databases.

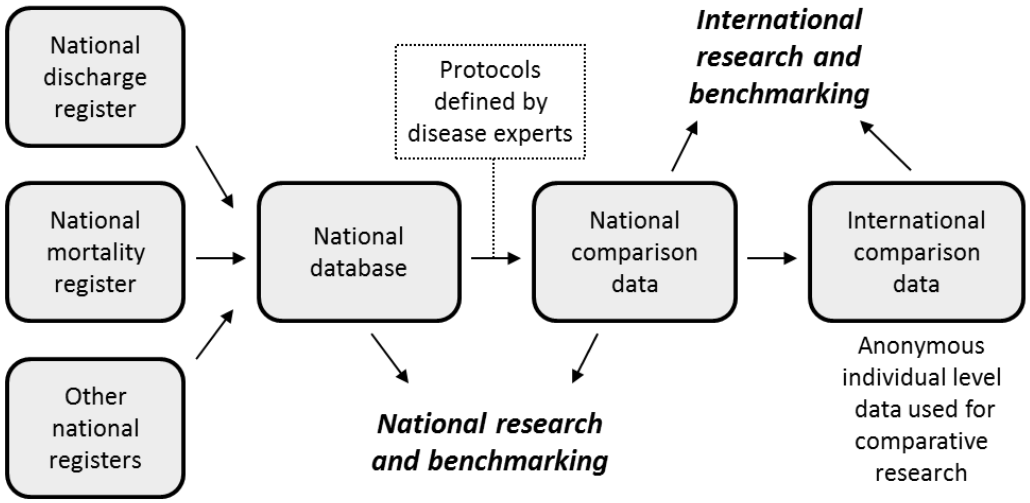

Figure 1. Schematic presentation of data flow in BridgeHEALTH WP11.

This protocol also defines how we have produced indicators on hip fracture at national and also on regional- and hospital-levels within countries. These include basic information on patients (number of patients, demographic characteristics, co-morbidity), indicators on the content of care (use of services and procedures, costs, treatment practices, process indicators), and outcomes.

The protocol, first introduced in EuroHOPE, has been updated to be applied in the present project. Participants of the present project are:

- University of Southern Denmark, Odense, Denmark
- National Institute for Health and Welfare, Helsinki, Finland
- Centre for Research on Health and Social Care Management, Università Commerciale Luigi Bocconi, Milan, Italy
- Health Services Management Training Centre, Semmelweis University, Budapest, Hungary
- Instituto de Salud Carlos III (ISCIII), Madrid, Spain
- Medical Management Centre, LIME, Karolinska Institutet, Stockholm, Sweden
- Department of Health Management and Health Economics, University of Oslo, Oslo, Norway.

2. Construction of data

Definition of hip fracture

In the present study hip fracture data includes patients discharged with main diagnosis, in terms of the WHO International Classification of Diseases (ICD), of neck of femur fracture (ICD-9 codes

820.00-10/ICD-10 code S72.0), pertrochanteric fracture (ICD-9 codes 820.20-21/ICD-10 code S72.1), subtrochanteric fracture (ICD-9 codes 820.22, 820.32/ICD-10 code S72.2).

National database

In EuroHOPE, every country has established a **national hip fracture database** that includes patients treated in hospital due to hip fracture (prevalence of hip fracture in acute care). From national discharge registers patients that have been admitted to hospital inpatient care because of a main diagnosis of hip fracture were included in the national hip fracture database.

Using anonymised personal identification numbers we have linked patient information from the following sources:

- Hospital discharge registers
- Outpatient services in specialty care in hospitals
- Drug utilisation registers
- National mortality registers.

International database for calculating indicators

For an explanation regarding the approach used in this part of the study, please see Häkkinen et al. (2013).

Registry data on hospital discharges, prescription drugs and causes of death were acquired in the participating European countries. This chapter describes in detail how the 2013 cohort of the **national hip fracture comparison data** in EuroHOPE was created, starting from the prevalence of hip fracture in acute hospital care. Datasets covering other cohorts are created using the same logic. The steps in constructing the national comparison data are also shown in a flow chart in Appendix 4.

First, using hospital discharge data all patients admitted between 1st January 2013 and 31st December 2013 with a main diagnosis of one of the hip fracture subtypes of neck femure fracture, pertrochanteric fracture and subtrochanteric fracture (WHO International Classification of Diseases, 9th edition codes 820.0-9; 10th edition code S72.0-2) were identified. The hospital discharge records and all the identified patients' records in the other data sources mentioned above were gathered for the period between 1.1.2012 and 31.12.2014, i.e. for the preceding and following calendar years in addition to the cohort year data. The first hip fracture admission (index admission) of the year was identified as it starts the follow-up of the patient.

Patients with a hip fracture admission during the previous 365 days before the index admission were excluded from the 2013 cohort (hip fracture admission = hospital discharge record with a hip fracture diagnosis as the main diagnosis).

For each patient all continuous hospital treatment (the first hospital episode) starting from the first hip fracture admission (index admission) in 2013 was constructed by combining all

consecutive hospital stays for each patient. The consecutive hospital stays need not be in the same hospital, i.e. hospital transfers are taken into account when making the first hospital episode.

The included hip fracture patients were followed for up to 365 days from the first day (index day) of the index admission for inpatient and outpatient care in hospitals, medication purchases and vital status. In addition, the hospital discharges and use of prescribed medicines in the 365 days prior to the start of the index admission were used in assessing the presence of comorbid diseases among the patients.

The following patients were excluded from the cohort:

- Patients with a main diagnosis of hip fracture in the hospital discharge registry during the 365 days preceding a hip fracture admission (these patients will possibly be included in a preceding cohort).
- Patients under 50 years of age at the end of the first hospital episode
- Tourists, visitors, and patients who did not have a national patient identification number[1]
- Patients with incomplete look-back or follow-up data due to e.g. emigration[2]
- Patients not having a hip fracture operation with a procedure code shown in Appendix 2 during the first hospital episode.

3. Hospital and first hospital episode

Definition of a hospital

A hospital is a health care institution providing treatment for a number of medical conditions by specialized staff and equipment. In the present project, we speak of hospitals meaning institutions providing somatic (non-psychiatric) inpatient care for patients staying overnight (for at least one night, i.e. inpatients), and usually also health care services (diagnosis, treatment, or therapy) for patients without staying overnight (i.e. outpatients). A hospital may be a single building or a number of buildings on a campus. Also, in some countries a hospital can consist on many buildings in a certain geographical area. For example, in Finland after reorganization of Helsinki University Hospital in 2006, it includes several buildings in different municipalities in the capital area.

At hospital level analysis we have specified the definition of a hospital in order to be sure that we are comparing units with a similar structure and scope. For this end, we have formulated a definition of hospital, and a corresponding classification of different types of hospitals. We have used these definitions of hospitals in a specific variable depicting the type of care that the patient has received for each day of the follow-up daily information (during one year follow-up). In addition, we will gather more detailed information on the hospitals that have the main

[1] In Italy for 2006-2008, the patients whereby of the first index admission started outside their regions of residence (the Lazio region for the Provinces of Roma, Rieti, Latina, Frosinone, and Viterbo and the Piedmont region for the city of Turin), were excluded.

[2] In Hungary, patients being imprisoned are excluded as their use of health care services is not included in the hospital discharge register.

responsibility for the care. The more specific hospital-level information collection is to be gathered for the hospitals acting as the first hospitals in the care chain, and for the hospitals taking the responsibility of the patient in the first hospital episode (in the individual level data the hospitals are given variables named FSTHOSP and HEPHOSP, respectively). Thus, FSTHOSP is the hospital where the patient was initially admitted in. HEPHOSP is defined as the hospital that was highest in the hierarchy of hospitals which treated the patient during the first week.

Definition of the first hospital episode

The total episode of care is 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 2).

The first hospital episode covers all care given to patients as an inpatient in a hospital. Consecutive hospital discharges are included in the same hospital episode if the preceding hospital stay's discharge date is the same as the following discharge's admission date or the admission date is the next date after the preceding discharge date. If the patient is immediately transferred to a rehabilitation centre at the hospital this is included in the first hospital episode (Häkkinen et al. 2013). The first hospital episode ends when the patient is discharged to home (and is at home for at least one day), to a nursing home or to a long-term care institution, or the patient dies. The total episode of care was defined as the entire treatment pathway from the beginning of the disease (i.e. acute stage of the disease) to the end of the episode (predefined follow-up time, see below), irrespective of any organizational boundaries (Figure 2).

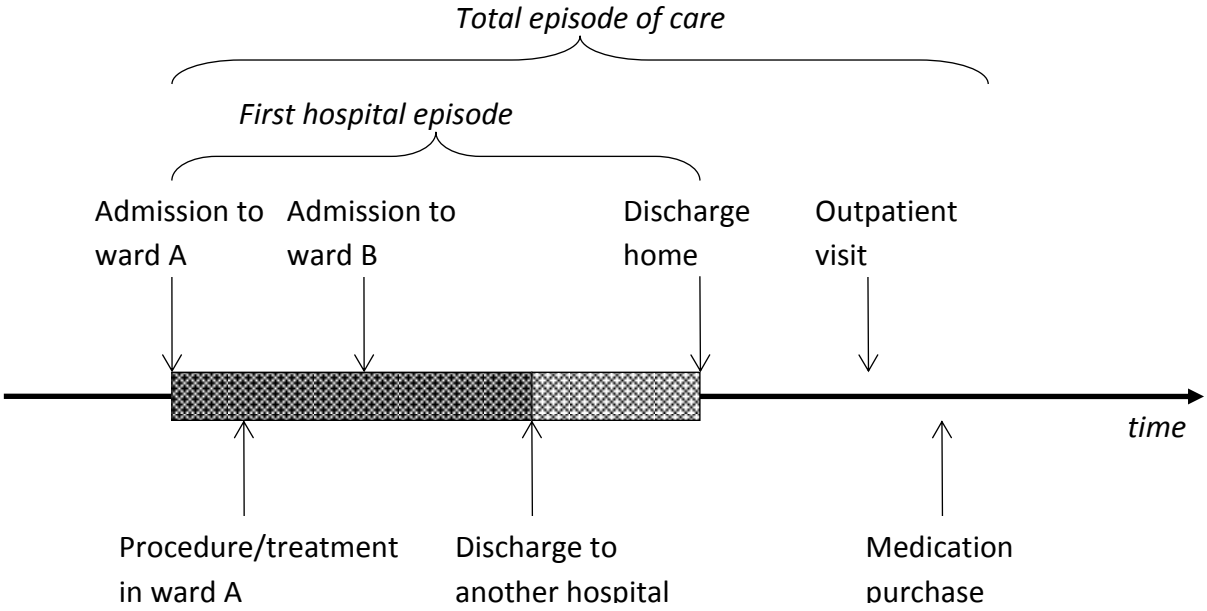

Figure 2. A schematic presentation of the follow-up of patients throughout the treatment pathway demonstrating the definitions of first hospital episode and the total episode of care

Rehabilitation

In some countries (e.g. in Finland) it is difficult to separate rehabilitation given in a hospital from acute care as well as to separate rehabilitation from long-term care. Some countries (e.g. Hungary) may have data on all inpatient rehabilitation. Other countries usually have data on inpatient rehabilitation given in hospitals but no data on rehabilitation given in a specialized rehabilitation centre.

We have divided the first hospital episode to acute and non-acute care. In countries where rehabilitation is included in hospital inpatient data and can be separated from acute care this is coded in a STATE variable[3]. In addition, an own class in the hospital hierarchy is given for geriatric wards of hospitals.
We will include inpatient rehabilitation and thus keep our definition of the end of an episode. In addition, in countries where rehabilitation is included in hospital inpatient data and can be separated from acute care this will be coded like mentioned earlier. In addition, an own class in the hospital hierarchy will be given for geriatric wards in hospitals.

Length of stay, acute and non-acute care

We measured the length of stay (LoS) in acute care during the first hospital episode from the index day at the start of the initial admission to the last day of acute hospital care during the period of continuous acute hospital treatment (LoS = last date in acute treatment – index date +1).

We defined acute hospital care as treatment given in a hospital's intensive care unit, trauma/orthopaedic ward, or in other acute care settings (all other medical and surgical specialties). In addition, we calculated several other LoS measures including the length of the first admission, the total length of the continuous episode of care, the number of days in rehabilitation during the first continuous episode of care, and the number of days in hospital during the entire follow-up year. All LoS measures were truncated at 365 days if the length of stay was longer.

Hospital hierarchy

The daily STATE variable describes in which place or state the patient is. It is based on the idea that a patient can only be in one place in each day and that with hospital discharge data the days in institutions can be located in time. In case of overlapping admissions, the STATE variable is marked

[3] The daily STATE variable conveys information on if a patient was, in a given day, in a hospital or not, about the type of hospital where the patient was that date, whether the main diagnosis was related to a certain disease, information about the intensity of the treatment (i.e. acute care, non-acute etc. based on information known about the ward giving the treatment). Thus, the state variables give a possibility to extract and pinpoint the days the patient spent in rehabilitation, even within the first hospital episode or any other hospital stay during the follow-up. The codes for state variables are given in a separate excel-file.

with the hospital being in the highest step of hospital hierarchy (defined by each country). In descending order, the hospitals, institutions or units in the hierarchy are university hospitals, specialist hospitals, central or regional hospitals and general or local hospitals, rehabilitation, geriatric and general care, psychiatric care, and long term care.

1. University hospital

A university hospital (teaching hospital) combines hospital treatment to patients with teaching to medical students and nurses and usually it is linked to a medical school, or university. University hospital has an extensive array of specialties and services, and university hospitals are able to provide treatment to the most demanding medical conditions and are responsible for the treatment of rare and severe medical conditions in their region. University hospitals are usually tertiary referral hospitals: Tertiary care is specialized consultative health care, usually for inpatients and on referral from a primary or secondary health professional, in a facility that has personnel and facilities for advanced medical investigation and treatment, such as a tertiary referral hospital (Healy, Mckee 2002). Examples of tertiary care services are cancer management, neurosurgery, cardiac surgery, plastic surgery, treatment for severe burns, advanced neonatology services, palliative, and other complex medical and surgical interventions.

2. Specialized hospital

Types of specialized hospitals treat certain disease categories such as cardiac, oncology, or orthopedic problems, and so forth. A specialized hospital may have smaller volumes, but they are considered to have an excellent know-how in their field.

3. Central or regional hospital

A central hospital is typically the major health care facility in its region, with a fairly large numbers of beds for intensive care and many specialized facilities (for example surgery, plastic surgery, childbirth, bioassay laboratories, and so forth).

4. General/local hospital

General hospital is set up to deal with many kinds of disease and injury, and it has an emergency department to deal with immediate and urgent threats to health. These hospitals have usually only the basic specialties such as surgery, internal medicine, deliveries and gynecology, ear, nose and throat disease etc.

5. Rehabilitation

Here we include all rehabilitation given in special rehabilitation hospitals/clinics as well as all other hospitals if this can be separated from the acute care using diagnoses, procedures, DRGs, or the department level information. Thus if rehabilitation is given e.g. in a university hospital and it can be separated from the acute care, the state variable is coded to give information about this.

6. Geriatric and general care

Care given in geriatric wards and care given in general medicine departments, independent of the hospital type (any of the above accepted care).

7. Psychiatric care

Care given in psychiatric specialties, or having ICD-10 code F* as main diagnosis.

8. Long term care

All inpatient care given in nursing homes and other long-term institutions.

4. Description of indicators

The EuroHOPE project aims at constructing a number of indicators describing the performance of the health care system in treatment of hip fracture. With the national comparison data a number of national-, regional- and hospital-level indicators are produced. The calculation of indicators and the reporting of the data is based on a common script, executed in Stata on the national comparison data. Below in Table 1, the indicators that are published on the national- and regional-level in the EuroHOPE website in the ATLAS tool are described. The name of the indicator, a short description of the indicator, and the factors used in risk-adjustment are given in the Table.

Table 1. EuroHOPE indicators on hip fracture publicly available on www.eurohope.info.

Indicator	**Description**	**Risk-adjustment**
Number of patients	Number of patients included in the national comparison data.	
Number of patients per 100 000 inhabitants	Number of patients included in the national comparison data per 100 000 inhabitants.	
Age	Average and median age of the patients. Age in years at the start of the hospital care for hip fracture.	
Males	Share of males.	

Length of stay, first hospital episode	The number of days in acute hospital treatment during the first hospital episode. Consecutive hospital stays are taken into account when constructing the first hospital episode.	Age[4], sex
Length of stay, first year	The number of days in hospital treatment during 365 days after the start of the acute hospital treatment due to hip fracture.	Age[4], sex
7-, 30-, 90-day and 1-year mortality	The share of hip fracture patients who died within the given period of time after the start of the first hospital admission because of hip fracture.	Age[4], sex
Readmission in 30 days	Readmission to acute hospital care within 30 days after the end of acute care in the first hospital episode.	Age[4], sex

Baseline patient characteristics

In addition to the publicly reported indicators given in Table 1, a number of other indicators are produced in EuroHOPE. The indicators can be classified as indicators related to the baseline patient characteristics, process, and outcome.

As baseline patient characteristics the following information is gathered:

- Age and gender
- Comorbidities (see separate file for definitions)
    - Hypertension
    - Coronary artery disease
    - Atrial fibrillation
    - Cardiac insufficiency (heart failure)

[4] Classified: 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-.

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

Co-morbidities are defined from various register sources according to two different approaches:

1. Based on the main and secondary diagnoses of all hospital inpatient and outpatient records during the 365 days preceding the index admission
2. Based on medicine purchases and the main or secondary diagnoses of all hospital inpatient and outpatient records during the 365 days preceding the index admission.

Process indicators

The patients' first hospital episode and the whole follow-up of one year are tracked for a number of aspects that convey information about the care given to the patient. The process indicators produced in the project are the following:

- Length of stay (LoS) of the index (surgery) admission, days per patient
- Length of stay of the first hospital episode, days per patient, in four categories
    - Total LoS
    - Days in acute care
    - Days in non-acute care
    - Days due to hip fracture (days with main diagnosis of hip fracture)

- The number of inpatient days per patient over the first year after hip fracture
    - Total LoS
    - Days in acute care
    - Days in non-acute care
    - Days due to hip fracture (days with main diagnosis of hip fracture)

- Number and share of patients having length of stay of the first hospital episode of 90 days or more
- Number and share of patients with the different subdiagnoses (femoral neck, subtrochanteric, pertrochanteric) treated with the different surgical procedures (partial prosthetic replacement, total prostehic replacement, internal fixation neck, internal fixation other, and repositions)

- 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 hospitalization:

    - Vitamins (A11*, A12A, A12AA)
    - Calcium + D (A12AX*)
    - Drugs for treatment of bone diseases (H05AA*, H05BA*, G03DC05, G03XC*)
    - Biphosphonates (M05B*)
    - Estrogens (G03C*
    - Glucocorticoids (H02AB*)
    - Fenantoin (N03AB02, N03AB04, N03AB05)
    - Levothyroxin (H03AA01)
    - Proton pump inhibitor (A02BC).

Outcome indicators

The project aims at constructing measures to be used for performance monitoring and assessing the outcomes of care given to the patients. As outcome indicators, the following measures are included:

- Mortality at 7, 30, 90, 120, and 365 days from the index admission day
- Hip fracture recurrence
- Share of patients operated within two days
- Readmission to acute hospital care within 30 days after end of the first hospital episode
- Readmission to acute hospital care within 30 days after end of the acute hospital care in the first hospital episode
- Complications during the first hospital episode based on main or secondary diagnoses:

    - pulmonary embolism (ICD-9: 415.1* and ICD-10: I26*)
    - Acute myocardial infarction (ICD-9: 410* and ICD-10: I21*, I22*)
    - Phlebitis and thrombophlebitis (ICD-9: 451* and ICD-10: I80*, I81*, I82*)
    - Pneumonia (ICD-9: 480-486* and ICD-10: J12-J18*,J69*)
    - Infection and inflammatory reaction due to other internal orthopaedic prosthetic devices, implants and grafts (ICD-9: 996.67* and ICD-10:T84.7*)
    - Urinary tract infection (ICD-9: 599* and ICD-10: N39.0*).

Adjusting for patient mix

Comparisons of health outcomes between countries need to take into account differences in the patient mix. In addition, countries may differ in the degree to which the relevant information is recorded, the availability of patient information, or variables being very differently defined across countries. In order to the performance indicators to be comparable, the indicators have to be adjusted for confounding factors.

In EuroHOPE this problem was tried to solve by using all relevant registry data available for everyone with a specified health problem, by collecting available information on disease specific

comorbidities, length of hospital stay and medication use prior to the occurrence of the health problem studied - variables potentially having an effect on health outcomes. However, this does not alleviate the problem arising from the potential existence of differences between countries in registering this information.

Three different risk-adjusted outputs are produced for each outcome:

1. adjusted for sex and age
2. adjusted for sex, age, disease-specific comorbidities based on primary and secondary diagnoses[5], the number of hospital days (LOS) the year prior to index admission
3. adjusted for sex, age, disease-specific comorbidities based on primary and secondary diagnoses and medication purchases, LOS the year prior to index admission.

Based on the experiences in the PERFECT project (Peltola et al., 2011), the observed/expected approach described by Ash et al. (2003) is used - this 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. In each country, a common indicator-specific set of coefficients for each factor included in the risk-adjustment is used for calculation the predicted values for the outcome in question. The coefficients applied for calculating the predicted values for each outcome are based on the estimates acquired from the Finnish national comparison data covering the years 2006 to 2013. The coefficients will be updated as data from other countries is available. The method is described in greater detail in Moger and Peltola (2014).

Each country applied a standardized, centrally-constructed Stata syntax code to the national data hip fracture database for calculating the country and regional level indicators. The national files were processed with a common script in order to enable standardized reporting of the data from all countries with minimum workload and minimized possibility of human error in processing the data. This Stata do-file is available upon request from the researchers.

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 the following variables:

- age (in years, classified)
- gender
- comorbidity as defined in separate file (only the comorbid diseases with at least 1% prevalence in the study population in each country of the EuroHOPE partners' data in the year 2007 were included in the risk adjustment as confounding factors: atherosclerosis,

[5] Hypertension, coronary heart disease, atrial fibrillation, cardiac insufficiency, diabetes mellitus, cancer, chronic obstructive pulmonary disease and asthma, dementia, depression, Parkinson's disease

renal insufficiency, mental disorders and alcoholism were not included in the risk adjustment as comorbidities)

- inpatient hospital stay days during one year prior to hip fracture in acute inpatient hospital care.

Levels of analysis

Indicators are produced annually at the national level by types of hip fracture (neck of femur fracture, pertrochanteric fracture, subtrochanteric fracture). Indicators are calculated also at the regional level and at the 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. The definitions for a region and for a hospital are described in Appendix 3.

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Appendix 1. National registers and data sources used in National databases

Hospital discharge register for inpatient care	
Denmark	2005-2014
Finland	2005-2014
Italy	
Hungary	2005-2015
Norway	2008-2015
Spain	
Sweden	2005-2014

Register on use of outpatient services in hospitals and/or other specialist units	
Denmark	2005-2014
Finland	2005-2014
Italy	
Hungary	2005-2015
Norway	
Spain	
Sweden	

Register on prescribed medication	
Denmark	2005-2014
Finland	2005-2014
Italy	
Hungary	2005-2015
Norway	2004-2015
Spain	
Sweden	2005-2014

Causes of death	
Denmark	2005-2013
Finland	2005-2014
Italy	
Hungary	NA (dates of death available for 2005-2015)
Norway	2004-2015
Spain	
Sweden	2005-2014

Appendix 2. Procedure codes used in countries to identify procedures in treatment of hip fracture

Hip fracture		Codes						
OPE	**Procedure code**	**Denmark**	**Finland**	**Hungary**	**Italy**	**Norway**	**Spain**	**Sweden**
PARNCEM	Primary partial prosthetic replacement of hip joint not using cement, other or unspecified	KNFB0*	NFB10	58169				NFB09
PARCEM	Primary partial prosthetic replacement of hip joint using cement, other or unspecified	KNFB1*	NFB20	58169				NFB19
TOTNCEM	Primary total prosthetic replacement of hip joint not using cement	KNFB20	NFB30	58151				NFB29
TOTHYBR	Primary total prosthetic replacement of hip joint using hybrid technique	KNFB30	NFB40	5815E				NFB39
TOTCEM	Primary total prosthetic replacement of hip joint using cement	KNFB40	NFB50	58150				NFB49
TOTOTH	Other primary prosthetic replacement of hip joint	KNFB59, KNFB99	NFB99					
FIXNAIL	Internal fixation of fracture of neck of femur with nail or screw	KNFJ7,KNFJ4	NFJ50	57903, 57904, 5790F, 57924				NFJ79
FIXSCR	Internal fixation of fracture of upper femur with screws and sideplate	KNFJ6	NFJ52	57908, 5792R				NFJ69
FIXGAMM	Internal fixation of fracture of upper femur with gamma nail	KNFJ8	NFJ54	83624				NFJ89
FIXINTR	Internal fixation of fracture of other parts of femur with intramedullary nail	KNFJ5	NFJ60	83626, 8362C, 83620, 5790A				NFJ59
FIXPLAT	Internal fixation of fracture of other parts of femur with plate	KNFJ6	NFJ62	57928, 5792C, 5792N				NFJ89
FIXOTH	Other internal fixation of fracture of other parts of femur	KNFJ8	NFJ64	83301, 57924				NFJ99

Appendix 3. Regions used in reporting of indicators in EuroHOPE countries

Country	Description	Number of regions	Average population size
Finland	Hospital districts and hospital regions responsible for providing specialised health care. Smallest districts combined.	19	280 000
Denmark	Administrative regions.	5	1 000 000
Hungary	19 counties and Budapest area providing self-governmental administrative duties (not health care).	20	500 000
Italy	Counties of the Friulia-Venezia Giulia autonomous region. Counties responsible for providing health care.	4	300 000
Norway	Hospital trusts responsible for providing specialist health care in their geographical areas.	20	250 000
Spain			
Sweden	Counties responsible for providing health care.	21	450 000

Appendix 4. Flow chart describing the construction of the national hip fracture comparison data

This example shows how the Finnish database is formed. However, there will certainly be differences in each country and thus these steps have to be modified accordingly.

1st step: screening inpatient database for patients

Screen hospital database (hospital discharges/hospital department discharges, inpatient social care), from the year 2004 onwards for records with hip fracture (ICD-10: S72.0-2) as main diagnosis in all hospital stays (hospital departments).

2nd step: screening mortality register database for hip fracture patients treated at hospitals

Take patient IDs from the first step and gather their information on date of death and causes of death and place of death.

3th step: merge data

Merge data from steps 1 and 2 together with patient id in order to create a hip fracture ID data that includes four elements:

i. patient ID
ii. main diagnosis of death (if available)
iii. place of death (in hospital / outside hospital)
iv. date of death
v. other reasons of patient drop out (eg. moving from the country).

4th step: **1st data set, hip fracture (prevalence) (1)**

Take patient IDs from the third step and gather their **all records** from hospital records.

5th step : National comparison data (2)

Make the exclusions given in section 2.

Constructing the Finnish databases

Figure A1 describes the construction of Finnish hip fracture data from the year 2013. Total prevalence of hip fracture was 6 906.

Table A1 describes development (2006-2013) of the structure of hip fracture data. The structure has been rather stable during time period.

Prevalence of hip fracture has increased 8 % during the time period. The share of not operated patients has decreased from 11 % to 8 %. Also the amount and share of patients under 50 years has decreased a little during the time period.

There has also been small changes in the share of diagnosis. The share of neck of femur fracture has decreased from 62 % to 60 %, and the share of pertrochanteric fracture has increased from 31 % to 34 %.

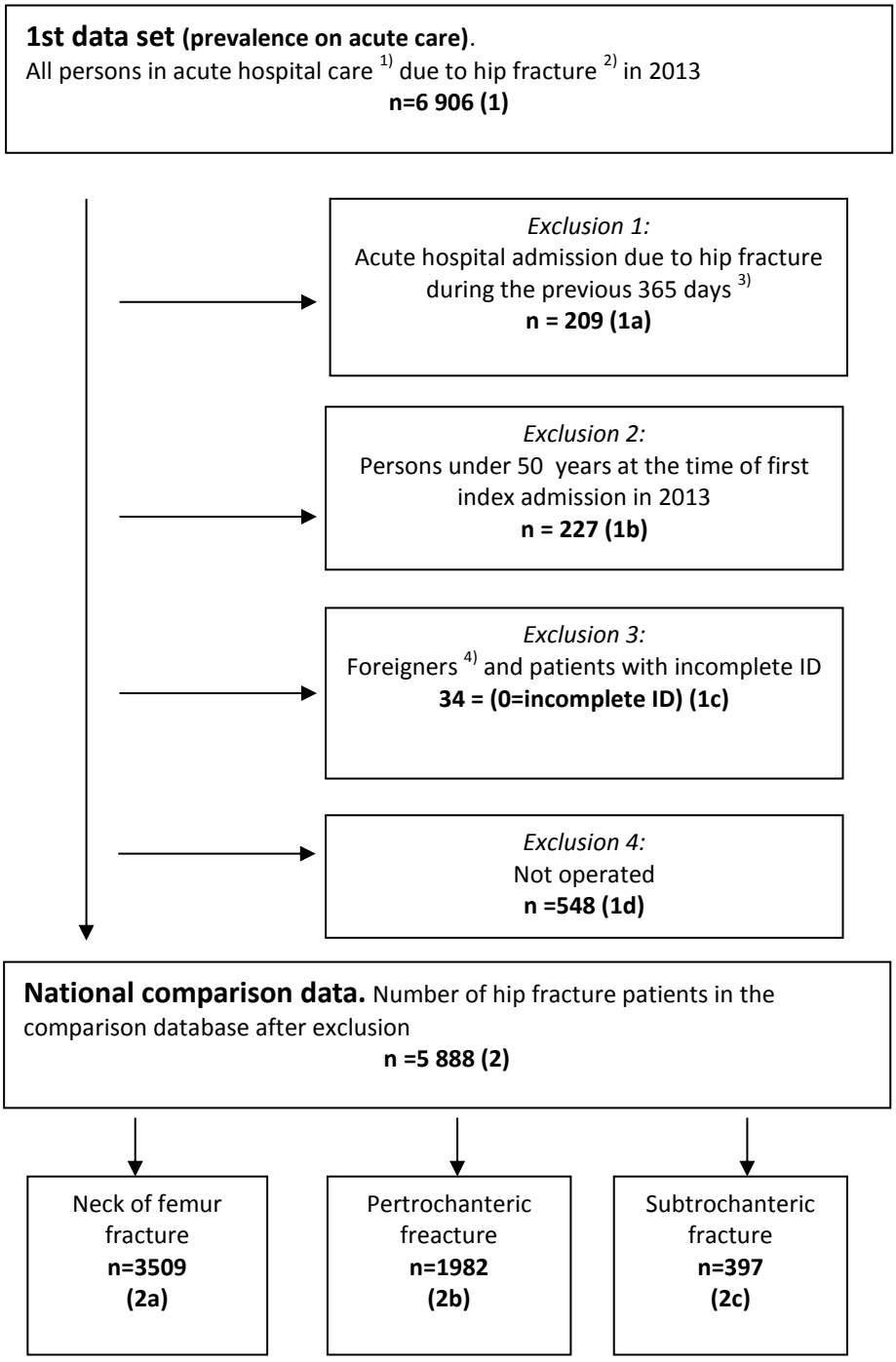

Figure A1. Creation of the Finnish comparison database for hip fracture in 2013

1) Hospital care is defined as inpatient hospital care only.
2) Hip fracture is defined according to the main diagnoses of S72.0, S72.1, S72.2 (ICD-10).
3) Counting starts from the first index admission in 2013.
4) In Finland all patients whose home municipality is Åland or unknown are excluded from the comparison database.

Table A1. Construction of hip fracture databases in Finland 2006-2013

Data	2006	2007	2008	2009	2010	2011	2012	2013
1	**6406**	**6429**	**6814**	**6721**	**6808**	**6655**	**6822**	**6906**
1a	217	221	215	224	205	201	216	209
1b	260	248	235	226	212	232	197	227
1c	75	54	49	47	63	52	65	34
1c1	3	3	1	1	0	0	1	0
1d	683	651	733	697	610	591	549	548
2	**5171**	**5255**	**5582**	**5527**	**5718**	**5579**	**5795**	**5888**
2a	3214	3274	3407	3416	3535	3442	3489	3509
2b	1600	1626	1750	1709	1800	1770	1875	1982
2c	357	355	425	402	383	367	431	397