Cardiovascular Indicators Surveillance Set

Grant Agreement n.2003118

Project leader: Simona Giampaoli

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EXECUTIVE SUMMARY

I. TECHNICAL INFORMATION

1. AREA OF ACTIVITIES / WORKING PARTY / TASK FORCE: Health Monitoring Programme Working Party Morbidity and Mortality / Task Force on Major and Chronic Diseases	
2. FULL NAME OF PROJECT: European Cardiovascular Indicators Surveillance Set, Phase II	
3. ACRONYM: EUROCISS II	
3. START DATE OF THE PROJECT: 01.05.2004	
4. DURATION OF THE PROJECT: 43 months	
5. PROJECT LEADER / ORGANISATION (include contact address): Simona Giampaoli National Institute of Health Centre for Epidemiology, Surveillance and Health Promotion Unit of Cerebro and Cardiovascular Disease Epidemiology Viale Regina Elena 299 00161 Rome, Italy Tel: +39 06 4990 4231 Fax: +39 06 4990 4230 E-mail: simona.giampaoli@iss.it	
6. PROJECT NUMBER: EUROCISS Phase II (2004-2007): Agreement n. 2003118	
7. SANCO REPRESENTATIVE: Antoni Moliner Montserrat; Jaroslaw Waligora	
8. COUNTRIES INVOLVED	
MEMBER STATES: A (Austria) B (Belgium) CZ (the Czech Republic)	EFTA/EEA COUNTRIES: (IS) Iceland (NO) Norway

D (Germany) DK (Denmark) E (Spain) EL (Greece) F (France) FIN (Finland) HU (Hungary) I (Italy) IRL (Ireland) L (Luxembourg) NL (Netherlands) P (Portugal) PL (Poland) UK (United Kingdom)	OTHERS: European Heart Network
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II. CONTENT RELATED INFORMATION

10. CONTEXT/INTRODUCTION (limit 250 words):

Cardiovascular disease (CVD) is the leading cause of death and hospitalization in both genders in nearly all countries of Europe, thus representing a substantial public health burden.

CVD clinically manifests itself in middle life and older age, after many years of exposure to unhealthy lifestyles (unhealthy diet, physical inactivity, and smoking habit) and risk factors (high blood pressure, high cholesterolemia, diabetes, obesity).

Given the pressing need to implement comprehensive strategies to address this growing epidemic, surveillance remains the primary tool to evaluate the burden and trend of disease.

The magnitude of the CVD burden contrasts with the usual paucity and poor quality of data available on incidence and prevalence of CVD beyond mortality, on distribution of risk factors and prevalence of high risk conditions, other than rigorous but limited studies carried out in certain areas. In addition, the prevalence of complications following acute events is steadily increasing, mainly due to an increase in survival rate.

The development and implementation of effective surveillance systems for CVD produce reliable and comparable indicators, thus enabling health professionals and policy makers to trace differences within and between countries, to study trends and to make better decisions on planning and evaluation of prevention programs, healthcare delivery,

resource allocation, and research.

The European Cardiovascular Indicators Surveillance Set (EUROCISS) Project was launched in 2000 by a partnership of EU countries with the aim of developing health indicators and recommendations for monitoring the distribution and impact of CVD in Europe in order to facilitate cross-country comparisons and improve CVD prevention and control.

The first aims were to prioritize CVD of greatest interest in public health and identify specific indicators for assessing mortality and morbidity in CVD. The indicators were selected after an in-depth discussion among experts on the basis of the available data. Some indicators can be produced in a short time, while others need a long period of time to be processed and validated. Attack rate/incidence, case fatality and prevalence were suggested for inclusion in the European Community Health Indicators Monitoring (ECHIM) short list (http://www.echim.org/).

11. KEYWORDS (use maximum 5 MeSH terms):

Cardiovascular disease, stroke, surveillance, population-based register, HIS/HES.

12. AIM AND OBJECTIVES OF THE PROJECT:

The objectives of the second phase of EUROCISS Project (2004-2007) were:

- to complete the technical and scientific work begun during the first phase of EUROCISS project and necessary to finalize the list of indicators and the standardized procedures and methods of data collection that assist Member States (MS) in producing reliable, valid and comparable data;

- to prepare the Manual of Operations for the implementation of surveillance systems for the collection and validation of indicators, in particular of population-based registers of Acute Myocardial Infarction/Acute Coronary Syndrome (AMI/ACS);

- to prepare the Manual of Operations for the implementation of surveillance systems for the collection and validation of indicators, in particular of population-based registers of stroke;

- to prepare the Manual of Operations for the implementation of CVD Surveys for collecting standardised indicators, in particular for prevalence of ischaemic heart diseases (IHD), heart failure (HF), cerebrovascular accidents (CVA) and other CVD, and to

identify a minimum set of questions and exams to be included in the Health Interview Survey/Health Examination Survey (HIS/HES) for evaluating the prevalence of CVD at European level;

- to develop knowledge, tools and expertise among MS for CVD surveillance and prevention.

13. SPECIFIC CONTRIBUTION(S) TO THE EU HEALTH INFORMATION AND KNOWLEDGE SYSTEM:

Please indicate whether your project has contributed to (multiple areas can be indicated):

[x] Development of new indicators

A list of recommended indicators for CVD surveillance was proposed to improve the knowledge on cardiovascular disease and contribute to the promotion of health and prevention throughout the European Union.

Some indicators are based on available data and can be produced over a relatively short period of time (short-term implementation indicators). Others need a longer period of time to be implemented and require the training of a dedicated team of epidemiologists to support their development (long-term implementation indicators).

Short-term recommended indicators for AMI/ACS include mortality and hospital discharge rates; long-term indicators include incidence/attack rates and case fatality. Also prevalence is recommended for the surveillance of IHD and other CVD.

Recommended indicators for stroke include mortality, hospital discharge rate, incidence/attack rate, case fatality and prevalence.

Incidence/attack rate, case fatality of acute events and prevalence of chronic conditions were recommended for inclusion in the ECHIM short list as they provide important information on morbidity, mortality, disability and survival rate; incidence/attack rate and case fatality are drawn from routine databases and are processed after being pooled and validated. Incidence is particularly relevant in the case of acute events and useful for etiological research objectives; attack rate -- which includes fatal and non-fatal, new and recurrent events occurring in and out of hospital -- is important for disease surveillance, distribution and trend. Incidence/attack rate are collected through population-based registers. Prevalence is important in the case of chronic conditions and can be assessed through a set of questions and exams to

include in HIS/HES.

All these indicators, if used in combination, are able to provide an exhaustive picture of the disease and useful information supporting policy decision makers in planning and evaluating primary and secondary prevention actions.

[x] Revision of existing indicators:

No revision of mortality and hospital discharge records (HDR) was made but it was suggested to use these routine data to build new indicators. This is particularly important for acute coronary events (heart attack) given that today the proportion of events unable to reach hospital is still very high (about 30-40% considering MONICA Project data (MONItoring of trends and determinants in CArdiovascular diseases). Mortality records give information on fatal events, whereas hospital discharge records on non fatal events only. Therefore, if these sources, after being properly linked and validated, are used in combination, they are able to provide an exhaustive picture of the disease and standardized indicators (attack rate/incidence, case fatality). Thanks to advancements in therapy for acute phase of events, survival rate has increased and frequency of complications evolving into chronic conditions has greatly changed. Therefore, the availability of indicators such as incidence/attack rate and prevalence is essential to delineate the complete picture of the disease in the different countries and monitor disease trend over time.

[x] Development of European Health Interview Survey related products:

[x] Questions

The EUROCISS Project recommends to include in the HIS a minimum set of questions together with a longer and more detailed module to be administered periodically in order to assess the prevalence of IHD, old myocardial infarction (MI), HF, Intermittent Claudication (IC), Angina Pectoris (AP), stroke. The minimum set of questions includes: condition diagnosed by a doctor, medicines use, diagnostic and therapeutic procedures performed, family history, presence of diabetes, hypertension, hypercholesterolemia.

[ ] Modules

[x] Guidelines/recommendations:

Manual of Operations for the implementation of CVD Survey: it is a simple guide to performing a population survey

[ ] Other. Please describe shortly:

[x] Development of European Health Examination Survey related products:

[x] Examinations

The minimum set of exams for risk factors measurement includes: arterial blood pressure, anthropometric measurements (height, weight, and waist circumference), lipid and glucose blood assay. Some instrumental examinations such as Electrocardiogram (ECG) and Ankle/Brachial Index (ABI) are strongly recommended to assess IHD and atherosclerosis, provided that resources are available.

[x] Guidelines/recommendations:

Manual of Operations for the implementation of CVD Survey: it is a simple guide to performing a population survey

[ ] Other. Please describe shortly:

[x] Activities related to the operation of registers. Please describe shortly:

It is not important that population-based registers cover the whole national territory, it is important that they cover representative areas of the country.
Population-based registers can be implemented if the following conditions are met:

- *availability of mortality and hospital discharge records for the age range 35-74 years and, particularly for stroke, up to 84 years of age. The age range 25-34, where few events occur, and the age range 85+, for which diagnostic*

information tends to be less reliable due to the existence of comorbidities, are excluded;

- *possibility to perform record linkage (by PIN or by name, date of birth, sex and place of residence);*
- *population big enough to produce 300 total events per year in the age range 45-74 years in order to assess trends (2% per year);*
- *epidemiologic team interested in the development and improvement of surveillance systems of CVD for data processing and event validation.*

Given the still very high out of hospital case fatality of CVD, population-based registers are very important as they allow to evaluate fatal and non-fatal (first and recurrent) events occurring in and out of hospital (see EUROCISS Manuals of Operations in Appendix I).

[ ] Activities related to international coding systems. Please describe shortly:

[ ] Setting up / supporting international expert networks

[x] Making inventory of existing data sources:

During the first months of activity of the 2nd phase, a questionnaire was developed in order to collect data necessary for making the inventory of the main sources of information, available data, validation procedures and methods. In particular, partners were asked to identify the existing population-based registers with specific information on definition of events and to specify if any CVD survey was conducted in their country. Reported data referred to the year 2006.

The inventory helped partners describe appropriate procedures and methods for preparing the Manuals of Operations of population-based registers of AMI/ACS and Stroke and of CVD Surveys.

Data on sources of information in the different countries are available on the Project website (http://www.cuore.iss.it/eurociss/progetto/progetto.asp)

[ ] Collecting new data

Where can the data be found?

[x] Linking data sources

Record linkage of mortality and hospital discharge records and event validation represent the minimum requirement to implement a population-based registrer.

[ ] Developement of international guidelines/recommendations for areas not mentioned above. Please describe shortly:

[ ] Other. Please describe shortly:

14. DELIVERABLES/OUTCOMES:

The most important achievement of the EUROCISS Project has been the development of the Manuals of Operations for the implementation of population-based registers of AMI/ACS, stroke and of CVD surveys.

These Manuals of Operations are the result of a long and fruitful cooperation among many experts, such as epidemiologists, statisticians, cardiologists and public health professionals. These manuals represent a general guide to processing routine data, such as mortality and hospital discharge records, in order to build and validate attack/incidence rate, case fatality, prevalence for the surveillance of CVD. More specifically, they represent a valid scientific support for investigators, health professionals and staff interested in current data collection and analysis and working in National Institutes of Health, National Institute of Statistics, Local Sanitary Units, and other academic and public health institutions operating at both regional and national levels. These Manuals of Operations may support also policy makers in their public health decision processes.

The Manuals of Operations of AMI/ACS and Stroke population-based registers provide simple and comparable tools to support and stimulate implementation of population-based registers in those countries which lack them but collect routine data such as mortality and hospital discharge records. They recommend to start from a minimum data set and follow a step-wise procedure based on standardized data collection, appropriate record linkage and validation method, thus providing a standardized model for producing estimates of attack/incidence rate and case fatality.

The Manual of Operations of CVD Survey provides a general guide and updated methods for the surveillance of CVD and represents a useful tool to estimate the prevalence of

chronic CVD. Population surveys are important as they further supplement the information collected from registers with additional details on socio-demographic characteristics, risk factors, physical/biological measurements and chronic conditions.
Attack/incidence rate, case fatality of acute events and prevalence of chronic conditions are recommended for inclusion in the ECHIM short list.

Another achievement of the EUROCISS Project phase II has been the development of the project WEB SITE (http://www.cuore.iss.it/eurociss/en/progetto/progetto.asp) established within the page of the Progetto CUORE of the Italian Institute of Health (ISS) and Ministry of Health, which financed 40% of the EUROCISS Project. The website provides a detailed and interactive description of the Project and of recommended indicators.
A FORUM for discussion, accessible exclusively by EUROCISS partners, was created to facilitate discussion among project partners.

15. CONCLUSIONS / KEY HEALTH MESSAGES / ADDED VALUE FOR REACHING GOAL OF EU PUBLIC HEALTH PROGRAMME (limit 250 words):

CVD is responsible for a great deal of hospitalization and death. Many sources of information must be integrated to obtain a comprehensive picture of the disease. Clinical events may be acute or chronic and vary in their severity; hospitalization may be for the first occurrence of a disease or for treatment of further episodes or sequelae and complications. Validation of data thus becomes essential and the ability to temporally link events in time is of great potential interest. Following the experience of the Nordic countries, it is therefore also recommended that all medical and death records across Europe adopt a personal identification number (PIN), which would allow an easier and more accurate record linkage among the different sources of information.
In summary, the project added value by:

- *proposing a stepwise procedure for the implementation of acute events indicators such as attack/incidence rate and case fatality (ECHIM recommended indicators) through population-based registers of AMI and Stroke;*
- *identifying a minimum set of questions to be included in the HIS for evaluating the prevalence (ECHIM recommended indicator) of chronic CVD at European level;*
- *identifying a minimum set of exams to be included in the HES for evaluating the prevalence of chronic CVD at European level;*

- *creating a network of experts from each country to support the monitoring of CVD across Europe;*
- *creating a network of experts from each country to assess feasibility of comparison among countries and study CVD trend;*
- *establishing the basis for an improved future regulation in public health policies concerning the surveillance of CVD throughout European countries.*

The application of the recommended standard methodology in all countries will result in the availability of reliable, valid and therefore comparable data on CVD morbidity at the European level and will facilitate implementation of preventive actions.

16. DISSEMINATION OF RESULTS:

a) has a link with the EU Health Portal been established?

Yes

(http://ec.europa.eu/health/ph_projects/2003/action1/action1_2003_10_en.htm)

b) activities carried out so far:

One of the main tasks of the partners, throughout the duration of the Project, was to participate in national and international meetings related to public health and CVD prevention, contributing with their input to the dissemination of the Project results and giving further visibility to the Community approach.

The results of the EUROCISS Project were presented:

- at the Workshop "A Canadian Best Practices system for chronic disease prevention and control" (Toronto Ontario, Canada 10-11 March 2005);

- at the Sixth International Conference on Preventive Cardiology (Foz do Iguassu, Brazil, 21-25 May 2005): "European Cardiovascular Indicators Surveillance Set (EUROCISS): Recommendations for monitoring cardiovascular disease";

- at the ESC Congress 2005 (Stockholm, Sweden, 3-7 September 2005): "Population-based registers of Myocardial Infarction in Europe: results of the EUROCISS Project";

- at the EUPHA 13th European Conference on Public Health (Graz, Austria, 10-12 November 2005): "The EUROCISS Project: development of cardiovascular morbidity indicators for the European Community"; "Cardiovascular registers in Europe: results from EUROCISS Project";

- at the Helsingborg Consensus Conference 'European Stroke Strategies (Helsingborg, Sweden March 22-24, 2006): "The EUROCISS Project: recommended indicators for monitoring stroke in Europe";

- at the EUROPREVENT Congress (Athens, Greece 10-13 May 2006): "EUROCISS: recommendations for coronary event surveillance in Europe"; "The EUROCISS Project: development of standardized measure for monitoring Coronary Heart Disease in Europe";

- at the European Congress of Epidemiology (Utrecht, The Netherlands, 28 June-1 July 2006): "Population-based Registers for Myocardial Infarction in Europe: results from EUROCISS Project";

- at the ESC Congress/World Congress of Cardiology 2006 (Barcelona, Spain, 2-6 September 2006): "Population-based Registers in Europe: results from EUROCISS Project";

- at the EUROPREVENT Congress (Madrid, Spain, 19-21 April 2007). Four presentations within a Specialist symposium entitled: "The EUROCISS Project: Recommendations for cardiovascular surveillance in Europe": 1) How to make routine data comparable across Europe; 2) Population-based AMI registers; 3) CVD Surveys; 4) Population-based stroke registers;

- at the ESC Congress 2007 (Wien, Austria, 1-5 September 2007): "Results and recommendation from EUROCISS-AMI"; "Results and recommendation from EUROCISS-Stroke";

- at the 15th European Conference on Public Health (EUPHA, Helsinki, Finland 11-13 October 2007) within the Symposium of the TFMCD: "The EUROCISS Project: recommendations for myocardial infarction and stroke population-based registers implementation".

The Manuals of Operations were reviewed by external experts: Prof. Shanti Mendis from WHO reviewed the Manual of Operations of population-based register of AMI/ACS; Prof. Birgitta Stegmayr from Umea University (Sweden) reviewed the Manual of Operations of population-based register of stroke; and Prof. Maurizio Trevisan from The Health Sciences System of the Nevada System of Higher Education in Las Vegas (USA) reviewed the Manual of Operations of CVD Survey.

The three Manuals were published on behalf of the EUROCISS Working Group in

November 2007 as Supplement in the European Journal of Cardiovascular Prevention and Rehabilitation, Vol 14 (Suppl 3): S1-S61.

(visit the Journal website www.jcardiovascularrisk.com/)

c) further plans:

The Manuals of Operations represent the starting point for implementing a pilot phase in those countries lacking CVD surveillance systems but willing to implement them in order to monitor disease trend over time and build valid and standardized indicators which are comparable with those already existing in other countries.

17. ACTIVITIES UNDERTAKEN TO GUARANTEE SUSTAINABILITY OF PROJECT OUTCOMES (limit 150 words):

Population-based registers can be implemented if the following conditions are met:

- *availability of mortality and hospital discharge records for the age range 35-74 years and, particularly for stroke, up to 84 years of age, if possible. The age range 25-34, where few events occur, and the age range 85+, for which diagnostic information tends to be less reliable due to the existence of comorbidities, were excluded;*
- *possibility to perform record linkage (by PIN or by name, date of birth, sex and place of residence);*
- *population big enough to produce 300 total events per year in the age range 45-74 years in order to assess trends;*
- *epidemiologic team interested in the development and improvement of surveillance systems of CVD.*

Given the still very high CVD out of hospital case fatality, population-based registers are very important as they allow to evaluate fatal and non-fatal (first and recurrent) events occurring in and out of hospital.

CVD surveillance systems can be further implemented including:

- *a minimum set of questions for HIS;*

- *a minimum set of examinations for HES (blood pressure, anthropometric measurements, laboratory tests, ECG).*

18. NEEDS FOR FUTURE POLICY DEVELOPMENT INDENTIFIED: (limit 250 words):

The Project selected indicators and established standardized methodologies for routine data collection and processing procedures necessary for CVD surveillance, assessment of disease burden and trend.

The succeeding step would be the implementation of the pilot phase in some countries under the coordination of a central body and the support of experts involved in CVD population-based registers. The minimum requirement is the involvement of geographical administrative areas lacking surveillance systems with populations big enough to provide stable estimates and available reliable routine data, such as mortality and hospital discharge records. A team of trained epidemiologists which fully dedicate to record linkage and validation procedures should be also available.

Also the implementation of questions and exams to include in HIS/HES for assessing CVD trend and distribution is feasible.

ABBREVIATIONS

ABI = Ankle Brachial Index
ACC= American College of Cardiology
ACS = Acute Coronary Syndrome
AHA = American Heart Association
AMI = Acute Myocardial Infarction
AP = Angina Pectoris
BCS= British Cardiac Society
CABG = Coronary artery bypass grafting
CSF = Cerebrospinal Fluid
CK-MB = Creatine-Kinase
CT-Scan= Computed Tomography – Scan
CVA = Cerebrovascular Accidents
CVD = CardioVascular Disease
ECHIM = European Community Health Indicators Monitoring
ECG = Electrocardiogram
ESC= European Society of Cardiology
EU = European Union
EUROCISS = European Cardiovascular Indicators Surveillance Set
EUROSTAT = Statistical Office of the European Communities
GP = General Practitioner
HDR = Hospital Discharge Records
HES = Health Examination Surveys
HF = Heart Failure
HIS = Health Interview Surveys
HMP = Health Monitoring Programme
IC = Intermittent Claudication
ICD = International Classification of Diseases
ICPC = International Classification for Primary Care
IHD = Ischaemic Heart Disease
ISS = Istituto Superiore di Sanità
LSHTM = London School of Hygiene and Tropical Medicine
MI = Myocardial Infarction
MONICA = Monitoring trends and determinants of Cardiovascular diseases
MRI = Magnetic Resonance Imaging
MS = Member States
PCI = Percutaneous Coronary Intervention
PIN= Personal Identification Number
PPV= Positive Predictive Value
PTCA = Percutaneous Transluminal Coronary Angioplasty
QoL = Quality of Life
TIA = Transient Ischaemic Attack
WHO = World Health Organization

1. INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death and hospitalization in both genders in nearly all countries of Europe, thus representing a substantial public health burden. Given the pressing need to implement comprehensive strategies to address this growing epidemic, surveillance remains the primary tool to evaluate the burden of disease, to assess trend, to plan preventive actions at both population and individual levels and to estimate efficacy of prevention.

The most frequent CVD are those of atherosclerotic origin, mainly Ischaemic Heart Disease (IHD) and stroke. CVD clinically manifests itself in middle life and older age, after many years of exposure to unhealthy lifestyles (unhealthy diet, physical inactivity, and smoking habit) and risk factors (high blood pressure, high cholesterolemia, diabetes, obesity). Although CVD prevalence is very high, its occurrence is largely preventable: this makes CVD a priority for public health. Epidemiological studies have demonstrated that cardiovascular risk is 'reversible', that means that by lowering the level of risk factors it is possible to reduce the number and severity of events, or delay the event occurrence.

Even though the clinical onset is mainly acute, CVD often evolves gradually, causing substantial loss of quality of life, disability, and life long dependence on health services and medications. CVD may also result in premature deaths and is associated with adverse outcomes in elderly people, including cognitive impairment, dementia and decreased physical performance. The societal costs of CVD are substantial and include not only those directly related to health care and social services, but also those linked to illness benefits and retirement, impact on families and caregivers, and loss of years of productive life.

The magnitude of the CVD burden and the possibility of prevention contrasts with the usual paucity, poor quality and comparability of data available on attack/incidence rate and prevalence of CVD beyond mortality, on distribution of risk factors and prevalence of high risk conditions, other than rigorous but limited studies carried out in certain geographical areas.

The development, testing and implementation of effective surveillance systems for CVD produce reliable and comparable indicators, thus enabling policy makers to trace differences within and between countries and to make better decisions on planning and evaluation of prevention programs, healthcare delivery, resource allocation, and research.

The **European Cardiovascular Indicators Surveillance Set (EUROCISS) Project** was launched in 2000 by a partnership of European Union (EU) countries with the overall aim of developing health

indicators and recommendations for monitoring the distribution and impact of CVD in Europe in order to facilitate cross-country comparisons and improve the prevention and control of CVD.
The ***first phase*** of the EUROCISS Project (2000-2003) involved experts from 14 countries and aimed at a) prioritizing those CVD of greatest interest in public health; b) identifying specific indicators for assessing mortality and morbidity in CVD. The indicators were selected after an in-depth discussion among experts, on the basis of the available data. Some indicators can be produced in a short time, while others need a long period of time to be implemented and then validated; c) developing recommendations for collection and harmonization of data for monitoring CVD in EU countries.

The first phase ended with the production of a Final Report 2003 and the issue of a publication entitled *'Coronary and Cerebrovascular Population-based Registers in Europe: are morbidity indicators comparable? Results from the EUROCISS Project on behalf of the EUROCISS Working Group. European Journal of Public Health 2003; 13 (3 Supplement); 55-60'.*
At the end of the first phase, attack/incidence rate and case fatality for acute events and prevalence for chronic conditions were suggested for inclusion in the European Community Health Indicators Monitoring (ECHIM) short list (http://www.echim.org/).

In the year 2004 the Project was re-funded and more European countries and the European Heart Network were involved. The second phase mainly aimed at suggesting how to build the above core indicators in a simple way, taking into account the experience of those countries already able to provide such indicators.

2. AIMS AND OBJECTIVES

The objectives of the EUROCISS Project ***second phase*** were:

- to complete the technical and scientific work begun during the first phase of EUROCISS project and necessary to finalize the list of indicators, the standardized procedures and methods of data collection for producing reliable, valid and comparable data in Member States (MS);
- to prepare the Manuals of Operations for the implementation of surveillance systems, in particular of population-based registers of Acute Myocardial Infarction/Acute Coronary Syndrome (AMI/ACS) and stroke, to collect and validate those indicators suggested for inclusion in the ECHIM short list (attack/incidence rate and case fatality);
- to prepare the Manual of Operations for the implementation of CVD Surveys for collecting standardized indicators, in particular for prevalence of IHD, heart failure (HF), stroke and other CVD, and to identify a minimum set of questions and exams to be included in the health interview surveys/health examination surveys (HIS/HES) for evaluating the prevalence of CVD at European level;
- to develop knowledge, tools and expertise among MS for CVD surveillance and prevention.

3. ORGANIZATION AND MANAGEMENT

The project involved 18 different MS (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Italy, The Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom) and the European Heart Network.

A ***Steering Committee*** constituted of 4 members (S Giampaoli, M Madsen, A Pajak , P Primatesta, S Sans) was formed. The members of the Steering Committee were elected taking into account the following:

- their expertise in registers and in HIS/HES Surveys, as one of the specific objectives of the EUROCISS phase II Project was to prepare the Manuals of Operations of AMI/ACS and Stroke Registers and of CVD Surveys;
- their contribution to EUROCISS phase I which facilitated the smooth progress of the work;
- their geographical representativeness (Northern, Southern and Eastern Europe).

Their main activities of the Steering Committee were:

- support the coordinating centre in its main decisions;
- represent the project in all occasions;
- assure the involvement of all participating countries in supporting the objectives of the project;
- contribute to the coordination of Working Groups;
- plan the dissemination of final results;
- give its contribution to other EU projects;
- compile a list of contents for each Manual of Operations;
- assist the Writing Groups in organizing the work, discussing and reviewing the Manuals of Operations.

The Steering Committee members met three times:

- on October 12, 2004 in Rome, Italy on the occasion of the 1st meeting of the EUROCISS II phase;
- on February 24-25, 2005 in Rome, Italy;
- on May 11-13, 2006 in Athens, Greece on the occasion of the EUROPREVENT Congress 2006.

Three Partners' meetings were held:

- on October 11-12, 2004 in Rome, Italy;
- on October 4-6, 2005 in Barcelona, Spain;
- on October 11-13, 2006 in Maiori (SA), Italy;

Minutes of these meetings are included in Appendix II.

The EUROCISS members worked harmoniously together and had a clear vision of their role. Beyond specific meetings, they were able to keep in touch through e-mail and website forum, exchanging ideas and supporting each other in all phases of work.

The EUROCISS Group in Barcelona (October 2005)

4. ACTIVITIES (2004-2007)

A general overview of all the activities performed during the second phase of the EUROCISS II Project follows:

4.1 INVENTORY OF POPULATION-BASED REGISTERS AND CVD SURVEYS

The questionnaire produced during the first phase of the Project helped partners identify available indicators to recommend for data collection of CVD in Europe.
During the first months of activity an updated and more detailed version of the first questionnaire was developed in order to collect data necessary for making the inventory of the main sources of information, available data, validation procedures and methods. In particular, partners were asked to identify the existing population-based registers with specific information on fatal and non-fatal events occurred in and out of hospital and to specify if any CVD survey was conducted in their country.
The inventory helped partners describe appropriate procedures and methods for preparing the Manuals of Operations of population-based registers of AMI/ACS and Stroke and of CVD Surveys.

AMI/ACS and Stroke Registers

Partners soon realized that the existing registers in Europe include different populations and adopt different data collection procedures: some registers are based on the direct identification and validation of event as in the MONItoring of trends and determinants in CArdiovascular diseases (MONICA) study, others are based on administrative data with or without record linkage, some are national and some regional. Different age groups are covered and the degree of validation of the diagnostic information varies. These population-based registers are used for different purposes and have different strengths and limitations.

Starting from the data provided by each partner with the questionnaire, a short overview of existing AMI/ACS and stroke registers (population-based and hospital-based) was developed and is provided below. Data from questionnaire refer to the year 2006, therefore information here reported refer to that time frame. In addition, information on countries sources of information are reported as they were provided by partners and are further summarized into Tables 1, 1A, 2, 2A, 3, 4, 4A, 5, 5A, 6.

AUSTRIA

The *Osterrich Infarktregister* is an hospital-based register started in 1990 and covering about 1.6 million of men and women of all ages. Fatal and non-fatal suspected AMI/ACS events are identified from hospital discharge diagnoses, International Classification of Disease (ICD) -10 I20-I22 codes (ICD-9 410, 413), Percutaneous Transluminal Coronary Angioplasty (PTCA) and Coronary Artery Bypass Grafting (CABG).

The *Austrian Stroke Registry*, a nationwide stroke register, was prospectively performed on 15 stroke units from August 1998 to December 2000. The aim was to document the quality performance of Austrian stroke units, focusing on rapid admissions, ready availability of investigations and therapies performed. Outcome measures were Barthel scale, Rankin score and percentages of complications. The register prospectively included 2313 patients with ischaemic stroke or with primary intracerebral haemorrhage admitted to an Austrian stroke unit within 24 hours after onset of symptoms. The overall stroke-unit mortality was about 6.8% and mortality at 3 months was 12.9%. The outcome at 3 months showed a modified Rankin Scale score of 0 or 1 in 47% of patients, denoting none or mild impairment.

No *AMI/ACS and Stroke population-based registers* exist in this country.

BELGIUM

The *MONICA Ghent/Charleroi* recruited two Belgian populations, Charleroi and Ghent.
Population under surveillance were residents ages 25-69 years of 15 municipalities, centred on the city of Charleroi and residents of the town of Ghent. Total population in 1991 was 206,000 in Charleroi and 230,000 in Ghent. Coronary-event registration for MONICA database lasted from 1983 to 1992. It is continuing in both populations and it was extended to the region of Bruges.

Presently, there are three regional *AMI/ACS Population-based Registers in Belgium (data accessibility: University of Ghent and School of Public Health):*
1) With the support of the Flemish government the *AMI Register Ghent* restarted on January 1th 1996. From January 1th 1998 onwards the target population (about 145,000) was extended to the age range 74 years; it is financially secured until 2009; the latest annual report covers the attack rates from 2003.
2) The *AMI Register Bruges* started in 1999 at the request of the Flemish government to have a register in a rural area of Flanders; this register covers the district of Bruges, not only the city; the population in the district is approximately 250,000 men and women ages 25-74 years. This register is also secured until 2009 and the latest report is based on 2003 data.
3) The *AMI Register Charleroi* was launched in 1983 in 15 municipalities centred on the city of Charleroi; the population under surveillance was about 100,000 men and women ages 25-69 years.
In the three registers fatal and non-fatal suspected events were collected by *cold pursuit* method and identified through a deterministic record linkage of mortality data and hospital discharge records (HDR). The following ICD codes were used for the selection of events: ICD-10: I20-I25, I50, R96, I46.1 (ICD-9: 410-414, 428, 798-799) in mortality records, and ICD-10: I20-I25, I50 (ICD-9: 410-414, 428), PTCA and CABG in HDR. Further medical information was obtained from patient's family doctor, or doctor who had certified death, or emergency team who attended acute event.
All the suspected events were validated using MONICA diagnostic criteria. There is a close and good collaboration with the population registers in the cities and towns, with all hospitals, with all primary care physicians, with the Public Health administration of the Flemish government regarding death certification.

No *Stroke population-based register* exists in this country.

CZECH REPUBLIC

Czech-MONICA and MONICA-linked Projects are the only source of data on the prevalence of different cardiovascular risk factors in the population of this country.
Population under surveillance was residents ages 25-64 of the six districts representing the middle, south, east and west of Bohemia. Total population in 1991 was 631,000. Coronary-event registration lasted from 1984 to1993 and used cold pursuit method.

No *AMI/ACS and Stroke population-based registers* exist in this country.

DENMARK

The *DANMONICA* study was population-based and consisted of all citizens ages 25-74 years living in 11 municipalities around Glostrup County Hospital in the western suburbs of Copenhagen. Total population in 1991 was 326,000. Coronary-event registration lasted from 1982 to 1991.
All cases of possible heart attack were identified retrospectively (cold pursuit) based mainly on relevant ICD diagnoses on death certificates and hospital discharge reports and somewhat on reports from general practitioners and nursing homes.

The *DANMONICA* population-based stroke register recorded stroke events until 1991. The main sources of information for the registration of stroke events in the DAN-MONICA stroke register were admission diagnoses to the hospitals and wards of health centers; hospital discharge diagnoses and diagnoses from death certificates were also checked routinely. The register used *cold pursuit* method.

The national *Danish AMI Register (data accessibility National Institute of Public Health www.ktl.fi/cvdr)* goes back to 1978 and was based on administrative data (Hospital Discharge Register and the Causes of Death Register). It aims to identify Myocardial Infarction (MI) events in the entire population of about 5 million men and women, all ages included. Fatal and non-fatal suspected events are identified through a record linkage of mortality data and HDR obtained by Personal Identification Number (PIN). The following ICD codes are used for the selection of events: ICD-10: I20-I25, R96, R98, I46.1 (ICD-8: 410-414, 798) in mortality records, and ICD-10: I20.0, I21, I22 (ICD-8: 410, 411), PTCA and CABG in HDR.
The register has been validated in a sample of cases from the DANMONICA area. In the validation study register data were compared with MONICA data by record linkage. The validation includes the period 1982-1991 when the MONICA study was running.

FINLAND

The *FINMONICA* study was population-based and covered persons ages 25-64 years whose official residence was in the *FINMONICA* study areas: North Karelia and Kuopio provinces in Eastern Finland and Turku/Loimaa area in South-Western Finland. The total population in 1991 was 174,000 in North Karelia, 257,000 in Kuopio and 200,000 in Turku. Coronary and stroke event registration lasted from 1983 to 1992 in North Karelia, Kuopio and Turku. Turku registered stroke at all ages, others registered stroke up to ages 74.
The Register used hot pursuit method. This was done by specially trained study nurses who checked the emergency departments every morning for possible acute events. In addition, hospital discharge lists containing diagnoses for IHD (ICD-9 codes 410-414) were reviewed regularly to catch all events suspected of having an AMI/ACS.

The national *Finnish Cardiovascular Diseases Register (SYVE - data accessibility: National Institute of P. Health www.ktl.fi/cvdr)* started in 1991 and is based on administrative data (Hospital discharge register and the Causes of Death Register). The whole Finnish population is under surveillance (about 5.2 million of men and women of all ages).

Fatal and non-fatal suspected cardiovascular events (AMI/ACS and Stroke) are identified through a record linkage of mortality data and HDR obtained by PIN. The following ICD are used for the selection of AMI/ACS events: ICD-10: I20-I25, I50, R96, I46.1 (ICD-9: 410-414, 428, 798, 799) in mortality records, and ICD-10: I20-25, I50 (ICD-9: 410-414, 428), PTCA and CABG in HDR. To select stroke events the following ICD are used: ICD-9 430-438; ICD-10: I 60-I69, G45
The register has been validated comparing administrative data with diagnoses in the FINAMI Register (regional AMI register validated according to MONICA diagnostic criteria) and using troponin test (European Society of Cardiology - ESC/American College of Cardiology – ACC criteria). The registration ended in 2004.

The *FINSTROKE Register (data accessibility: National Institute of P. Health www.ktl.fi/cvdr)* was implemented from 1993 to 1997 in the Kuopio area and Turku. The register area was reduced in Kuopio to consist of the cities of Kuopio, Varkaus, and Iisalmi, as well as three small rural areas with a combined population of 196,000 inhabitants (93,000 men, 103,000 women) ages 35-85 over. Fatal and non-fatal events were collected by *cold pursuit* method and identified through a record linkage of mortality and hospital discharge records obtained by PIN. In either source of information, the following ICD codes were used for the selection of events: ICD-10: I 60-I62, I64, G45. The register was validated using MONICA procedures and methods of validation.

FRANCE

The geographical areas, about one million inhabitants, involved in *MONICA Lille, MONICA Strasbourg*, and *MONICA Toulouse* were the Urban Community of Lille (Lille) and two French districts: Bas-Rhin (Strasbourg), Haute-Garonne (Toulouse) respectively. Coronary-event registration for the age range 25-64 lasted from 1985 to 1994 in Lille, from 1985-1993 in Strasbourg and Toulouse.
Morbidity data were systematically collected by the investigators (hot and cold pursuit, according to the type of hospital) in the public and private hospitals of the area, in the emergency departments as well as in cardiologists' private practices when necessary. General Practitioners were mainly interviewed during the search for further information on causes of death.

AMI/ACS Population-based Registers in France (data accessibility: INSERM U780). Since 1997 the three French centres have decided to use a simplified registration procedure (*hot* and *cold pursuit*) with regard to the MONICA protocol and to take into account the clinician's diagnosis written on the discharge letter. For fatal events, the validation procedures continue to follow the MONICA protocol. The use of the simplified procedure has permitted to enlarge the recorded age-range up to 74 years (ages: 35-74). However, for hospitalised events, a double registration with the MONICA protocol is performed each year during 15 days to maintain the comparability of the trends over time.
The following ICD codes are used for the selection of events: ICD-10: I20-I25, R96, I46.1 (ICD-9: 410-414, 798-799) in mortality records, and ICD-10: I20-I25, I50 (ICD-9: 410-414, 428) in HDR.
All the suspected events are validated using MONICA diagnostic criteria. Linkage of register data with routine mortality and HDR is currently under study to produce new indicators: fatal and non-fatal suspected events are collected by cold pursuit method and identified through a deterministic record linkage of mortality data and HDR.
Furthermore, a survey is currently being performed (2006-2007) in these three areas to assess the incidence of unstable angina in the 35-74 age group (both genders).

The *Dijon Stroke Register (data accessibility: Dijon University Hospital)* is a population-based register launched in 1985. Population under surveillance was the whole inhabitants of the city, about 150,000 (80,000 women and 70,000 men) covering all ages, from the 6 months age to the oldest people.
Fatal and non-fatal events are collected by hot pursuit method and identified through a record linkage of mortality, hospital discharge records from public and private hospitals and General Practitioners' (GP) records (n=250), imaging records obtained by deterministic linkage (first name, last name, date of birth, place of birth, death certificate). Both in mortality and hospital discharge records, the following ICD codes were used for the selection of events: ICD-10: I 60-I69, G45, G46, I72.0

All events are validated using symptoms, surgical or pharmacological treatment, neurologists examinations, Computed Tomography-Scan (CT-Scan), Magnetic Resonance Imaging (MRI) , Carotid Doppler, autopsy, death certificates and MONICA procedures and methods of validation.

GERMANY

MONICA Augsburg consisted in 1991 of about 575,000 men and women ages 25-74 years, residents of the cities of Augsburg and the less urban ones Landkreis Augsburg and Landkreis Aichach-Friedberg. Coronary-event registration of residents lasted from 1985 to 1995 and used hot pursuit method.
MONICA Bremen consisted in 1991 of about 552,000 men and women ages 25-69 years residents of the city of Bremen in two sub-populations: Bremen North and West and Bremen city, South and East. Coronary-event registration lasted from 1985 to 1992.
In the *MONICA East Germany* the total population under surveillance was the residents of the three districts of Erfurt, Chemniz and Zwickau ages 25-74, about 612,000 in 1991. Coronary-event registration lasted from 1984 to 1993.

MONICA/KORA Augsburg Registry of coronary events (data accessibility: National Institute of Staistics.; GSF; Official German health report via internet www.gbe-bund.de) started in 1985 with MONICA Project and included about 407,000 men and women ages 35-74 (25-74 in 2002).
Fatal and non-fatal suspected events were collected by *hot pursuit* method and identified through a record linkage of mortality data and HDR obtained by deterministic linkage (fist name, last name, date of birth, sex). The following ICD are used for the selection of events: ICD-10: I20-I25, I50, R96, I46.1 (ICD-9: 410-414, 428, 798, 799) in mortality records, and ICD-10: I21, I22, I24 (ICD-9: 410, 411), PTCA and CABG in HDR.
The register is validated using MONICA diagnostic criteria and troponin test (ESC/ACC criteria) since 2001.

The *Erlangen Stroke Project (ESPro - data accessibility: University of Erlangen)* is a community-based register located in Bavaria in Southeast Germany and established in 1994. The population under surveillance was the all residents of the Community of Erlangen, about 100,000 inhabitants (49,000 men and 51,000 women) ages 18 years and over. Fatal and non-fatal events were collected by hot pursuit method and identified through a record linkage of mortality, hospital admission and discharge records, GPs' records, relevant hospital wards, nursing homes, emergency services and death certificates. The linkage is obtained by deterministic linkage (fist name, last name, date of birth). Both in mortality and HDR, the following ICD codes are used for the selection of events: ICD-10: I 60-I69, G45. All events are validated using symptoms, surgical or pharmacological treatment, neurologist examinations, CT-Scan, MRI. The register is still running.

The *German Stroke Registers Study Group (ADSR)* investigated predictors for in-hospital mortality and attributable risks of death after ischaemic stroke in a pooled analysis of large German stroke registers. The ADSR is a network of regional stroke registers, combining data from 104 academic and community hospitals throughout Germany. A total of 13 440 ischaemic stroke patients admitted to hospitals between January 1, 2000, and December 31, 2000, were analyzed. The impact of patients' demographic and clinical characteristics, their comorbid conditions, and the treating hospital expertise in stroke care on in-hospital mortality was analyzed.

GREECE

There are *Hospital Discharge Registers* in several institutions. These registers allow the estimation of incidence densities of clinical outcomes and their predictors, but cannot by used to calculate incidence. As an example, the Cardiology Unit of the University of Athens Medical School (Hippokrateion Hospital) has undertaken the GREECS (GREEk aCs) study, based on several hospital-based registers covering men and women of all ages from 2003 to 2004. Suspected events were collected by the hot pursuit method and identified through medical records covering medical history, clinical examination and laboratory results of the patients with symptoms and signs consistent with AMI. These events were validated using Electrocardiogram (ECG), troponin test and enzymes. The ICD-10 coding system was used for recording fatal events and hospital discharge diagnoses.

The *Arcadia Stroke Register (data accessibility: Alexandra Hospital, University of Athens)* is a regional population-based register established from 1993 to 1995 in the Arcadia province at the southern part of Greece. The permanent resident population under surveillance in 1991 ages 20 years and over consisted of 41,864 men and 38,910 women, for a total of 80,774 inhabitants.
Fatal and non-fatal events were collected by the cold pursuit method and identified through GPs' records, medical records from health centres, HDR and death certificates. Both in mortality and hospital discharge records, the ICD-9 codes: 430-438 were used for the selection of events.
All events were validated by reviewing the symptoms, the surgical or pharmacological treatment, neurological examinations, neuroimaging (CT-scan, MRI, Carotid Doppler) and autopsy, if performed.

The *Athens Stroke Registry* (data accessibility: Alexandra Hospital, University of Athens) is a hospital-based study which started in 1992 collecting data on hospitalized patients ages 18 and over. Fatal and non-fatal events were collected by the hot pursuit method and identified through medical records based on history, clinical examination and laboratory results of the patients with symptoms and signs consistent with stroke. Both in mortality and hospital discharge records, ICD codes were used for the selection of events: ICD-9: 430-438 and ICD-9 CM code 38.12 (carotid endoarterectomy). All events are validated by examining the symptomatology of the patient, the surgical or pharmacological treatment administered, neurological examinations, neuroimaging and vascular studies (CT-scan, MRI, Carotid Doppler) and autopsy, if performed.

No *AMI/ACS and Stroke population-based registers* exist in this country.

HUNGARY

The *Centre for Healthcare Information, National Health Insurance Fund, Department of Financial Informatics (data accessibility: GYÓGYINFOK)* is not a "Register" in classical sense but a hospital and out-patient care based information system which primarily aims to provide data for financing purposes to the National Health Insurance Fund. The database contains information about that part of the population which utilizes in- or out-patient health services. On legal basis all hospital and out-patient clinics have to report monthly performance figures to the Centre for Healthcare Information, National health Insurance Fund, Department of Financial Informatics. It started in 1996 and covers about 10 million of men and women of all ages.
AMI/ACS suspected events are identified from hospital discharge diagnoses: ICD-10 codes I20-I25, I50 (ICD-9 410-414, 428) PTCA, CABG. Events are not validated.
Suspected stroke events are collected by cold pursuit method and identified from hospital discharge diagnoses: ICD-10 codes I60-I69, ICD-9 CM code 38.12 (carotid endoarterectomy). Events are not validated.

The *General Practitioners' Morbidity Sentinel Stations Program (data accessibility: National School of Public Health, Faculty of Public Health, University of Debrecen)* is a joint initiative of the Hungarian School of Public Health and the National Public Health Service created in 1998 based on a network of sentinel stations based in primary care facilities in 4 (8 from 2004) Hungarian counties. A total of 148 general practitioners participate, providing care for 7.6% (264,022 people) of the population of all ages and sex. Suspected events are identified linking mortality data and HDR using a unique identifier which is a combination of a special personal code identifying the patient registered in a GP practice and the identification code of the practice itself. ICD selected codes are: ICD-10 codes I20-I22, I25 (ICD-9 410, 412, 413, 414), both for mortality and hospital discharge diagnoses. Suspected events are validated using ECG, symptoms, enzymes and, if performed, autopsy.
The following ICD codes are used for the selection of stroke events: ICD-10 I60-I62, I64, I63 both for mortality and hospital discharge diagnoses. Suspected events are collected by cold pursuit method and validated using symptoms, neurologist examinations, MRI, Carotid Doppler, autopsy.

No *AMI/ACS and Stroke population-based registers* exist in this country.

ICELAND

The *Iceland-MONICA* covered residents ages 25-74 years. The total population in 1991 was 258,000. Coronary-event registration lasted from 1981 to 1994 and used cold pursuit method.

The *MONICA Coronary Event Registration (data accessibility: National Institute of Public Health; Icelandic Heart Association)* is based on administrative data (Hospital discharge register and the Causes of Death Register). The whole Icelandic population of men and women ages 25-74 years is still today under surveillance (about 295,000 persons in 2001). Coronary-event registration was initiated in 1981. Fatal and non-fatal suspected events are identified through a record linkage of mortality data and HDR obtained by PIN and deterministic linkage (first name, last name and birth date). The following ICD codes are used for the selection of events: ICD-10: I20-I25, I50, R96, I46.1 (ICD-9: 410-414, 428, 798, 799) in mortality records, and ICD-10: I21-25 (ICD-9: 410-412, 414).
Each individual case is validated according to MONICA diagnostic criteria.

No *Stroke population-based register* exists in this country.

ITALY

MONICA Brianza. Population under surveillance was residents ages 25-64 of 73 municipalities in Brianza, Lombardy, Northern Italy, between Milan and the Swiss border. The total population in 1991 was 850,000. Coronary-event registration lasted from 1985 to 1994.
MONICA Friuli. Population under surveillance was residents ages 25-64 of 3 provinces of the Friuli-Venezia Giulia region of North-East Italy, bordering Austria and Slovenia. The total population in 1991 was 940,000, including many elderly people. Coronary and stroke event registration lasted from 1984 to 1993.
In both areas, the procedures for notifying the events involved the systematic collection of death certificates and the review of hospital discharge diagnoses following *cold pursuit* methodology suggested by MONICA.

The *National Register of Coronary Events (data accessibility: National Institute of Public Health www.cuore.iss.it)* started in 1998 to monitor both fatal and non fatal coronary events in the general population. Event registration and validation are periodically repeated (1998-99; 2003; 2004-5). The Register was implemented in seven representative geographical areas in the North, Centre and South of the country: the region of Friuli-Venezia Giulia, the area of Brianza, the towns of Naples and Rome, the municipalities of Florence, Modena and Caltanissetta. The covered population is about 3.6 million of men and women ages 35-74 years.
Fatal and non fatal suspected events are identified through deterministic record linkage of mortality data and HDR. To identify current non fatal events, all those cases having codes of ischaemic heart disease (ICD-9 410–414) as underlying or as any of the secondary discharge diagnoses were extracted from the hospital discharge records database. To identify current nonfatal events, all those cases having codes of ischaemic heart disease (ICD-10 I20-I25; ICD-9 410–414) as underlying or as any of the secondary discharge diagnoses were extracted from the hospital discharge records database. To identify current fatal events, all death certificates reporting ischaemic heart disease (ICD-10 I20-I25; ICD-9 410–414) or sudden death (ICD-10 R96; ICD-9 798) or other ill-defined and unknown causes of morbidity and mortality (ICD-10 R98-R99; ICD-9 799) as underlying cause of death, or diabetes (ICD-10 E10-E11; ICD-9 250), hypertensive disease (ICD-10 I11-I13; ICD-9 401–404), other forms of heart disease (ICD-10 I30-I51; ICD-9 420-429), atherosclerosis (ICD-10 I70-I77; ICD-9 440-447) followed by ischaemic heart disease (ICD-10 I20-I25; ICD-9 410–414) were taken into account.
In each area a sample of 1000 suspected coronary events is validated using MONICA diagnostic criteria. The results from validation are used to assess the positive predictive values (PPV) of single codes of hospital discharge and cause of death. The estimation of coronary events occurrence is obtained by applying the PPV to current events generated from record-linkage procedure.

The *National Register of Cerebrovascular Events (data accessibility: National Institute of Public Health www.cuore.iss.it)* is a population-based register which started in 1998 following the experience of the MONICA project. It was implemented in eight areas (the same areas of coronary register plus Veneto Region) of the

country for monitoring about 4.5 million people among men and women ages 35-74 years old. Event registration is repeated periodically (1998-99; 2003; 2004-5).
Fatal and non-fatal events are identified through record linkage of mortality and hospital discharge records (name, date of birth). To identify current nonfatal events, all those cases having codes of cerebrovascular accidents (ICD-10 I60-I69; ICD-9 430–434, 436–438) or hemiplegia (ICD-10 G81; ICD-9 342) as underlying or as any of the secondary discharge diagnoses were extracted from the hospital discharge records database. To identify current fatal events, all death certificates reporting cerebrovascular accident (ICD-10 I60-I69; ICD-9 430–434, 436–438) or hemiplegia (ICD-10 G81; ICD-9 342) as underlying cause of death, or diabetes (ICD-10 E10-E11; ICD-9 250), hypertensive disease (ICD-10 I11-I13; ICD-9 401–404), arrhythmia (ICD-10 I46-I49; ICD-9 427), atherosclerosis (ICD-10 I70; ICD-9 440) followed by cerebrovascular accidents (ICD-10 I60-I69; ICD-9 430–434, 436–438) were taken into account. In each area a sample of 1000 suspected events is validated using MONICA diagnostic criteria to assess the PPV of single codes of hospital discharge and cause of death. Estimates of stroke events occurrence is obtained by applying the PPV to current events generated from record linkage procedure.

THE NETHERLANDS

The *CMR Nijmegen (data accessibility: Prismant www.prismant.nl)* is the oldest GPs' Register of morbidity in the Netherlands. It was created in 1971 and involved 4 general practices, providing care for approximately 12,000 men and women ages 35-85 and over. The National Institute of Public Health and the Environment (RIVM) combined the data from this GP register with those of 3 other regional GP registers to obtain an estimate of the national incidence of CVD. Each register had its own criteria and representativeness.

No *AMI/ACS and Stroke population-based registers* exist in this country.

NORWAY

The *CVD Register (data accessibility: Contact Health Region West www.helse-vest.no/sw7877.asp)* contains information on CVD and diabetes diagnoses and procedure codes related to CVD based on administrative data (Hospital discharge register and the Causes of Death Register). All CVD and diabetes diagnoses are included. In addition circulatory organ diagnoses related to pregnancy, birth and congenital malformations of the circulatory system are included.
Data from 1972 throughout 2001 are available on file. Data for 2002 – 2006 will be included in 2007.
The register covers 3 counties. The population under surveillance is about 1 million men and women of all ages. The total population of Norway is 4.6 millions. Fatal and non-fatal events are identified through record linkage. The following ICD codes are used for selection of AMI events: ICD-10: I21, I22, ICD-9: 410 in mortality records, and ICD-10: I21, I22, ICD-9: 410, PTCA and CABG in HDR. For ACS events ICD-9:411 and ICD-10:I20.0 are also included.
The 'CVD Register' has not yet been used for stroke surveillance but any ICD-9 and ICD-10 codes within Circulatory system diseases can be selected for stroke events. The following ICD codes can be used for the selection of events: ICD-9: 430-438 (ICD-10: I60-I69) in both mortality and hospital discharge records; in addition, ICD-9 CM code 38.12 (carotid endoarterectomy) is considered in HDR.
Until now this register is not population-based as persons that die from a CVD or diabetes are not included if they die outside hospital without previous registration with CVD in Health Region West. These persons are not registered in the Hospital discharge register. From the autumn 2006 such persons will be included, also retrospectively.
This register has no regular validation procedure. A project of controlling the diagnoses with codes in the National hospital discharge register has been performed. Two validation projects for AMI are ongoing in 2006 comparing the diagnoses with clinical data for the years 1995 and 2002, respectively. These validation projects include patients with AMI or elevated troponine/Creatine Kinase -MB (CK-MB) levels.

POLAND

Historical data are available from the *POL-MONICA Project*. Population-based registers of MI and Ischaemic Heart Disease Deaths were carried out from 1984 to 1993 in one rural province (Tarnobrzeg Voivodship) and from 1984 to 1994 in Warsaw capital (two districts). Population under surveillance ages 35-64 was 190,000 in Tarnobrzeg Voivodship and 190,000 in Warsaw.
Fatal and non-fatal coronary suspected events were collected by cold pursuit method and identified using mortality data and hospital discharge diagnoses. The following ICD-9 codes were used for the selection of events: 410-414, 428, 798-799 in mortality, and 410-413 in hospital discharge diagnoses. All the suspected events were validated using MONICA diagnostic criteria.
Regional population-based register for Stroke events was based on data from the POL-MONICA Project (Polish part of The WHO-MONICA Project), collected by cold pursuit method from 1984 to 1994 and available for one urban population of two districts of Warsaw. Mortality and hospital discharge were the main sources of information and in both cases the selection of events were made using ICD-9 codes 430-438 in mortality and in hospital discharge records.

The *Hospital Discharge Register of ACS (data accessibility: Silesian Centre for Heart Disease)* is carried out by the National Health Found in 535 hospitals. The project is coordinated by the Silesian Centre for Heart Disease. All hospitals have in their structure one of the following units: 1) Department of Cardiology/ Intensive Cardiac Care Unit, 2) Department of Internal Diseases, 3) Emergency Unit, 4) Intensive Care Unit/Intensive Therapy Unit, 5) Department of Cardiosurgery. Also involved are hospitals that include neither of the above but hospitalize at least 10 patients with acute coronary care syndromes per year. Data on all patients with discharge diagnosis codes as I20,0 or I21.0-9 or R57 are collected in the standard format and submitted in the electronic version to the Voivodship (provincial) Unit of the National Health Found and then transferred to the central registry in the Silesian Heart Disease Centre. The project was initiated in 2003 in the frames of National Program for Prevention and Treatment of Cardiovascular Disease (POLKARD 2003-2005). Patient's record includes data on hospitalisation, medical diagnosis, symptoms, ECG, complications, CVD risk factors and treatment.

The National Institute of Hygiene *(data accessibility: National Institute of Hygiene, Warsaw)* collects data on all discharged patients in a standard format. Patient's record includes: date of birth, sex, date of admission, outcome of hospitalization, date of discharge/date of death, up to six diagnoses (ICD-10 codes), underlying, direct and secondary causes of death (ICD-10 codes) and up to six medical procedures (Codes of the II Edition of International Classification of Medical Procedures). The estimated coverage is 80%.

No *AMI/ACS and Stroke population-based register*s exist in this country.

PORTUGAL

The Portuguese Society of Cardiology has hospital-based registers of ACS obtained on a voluntary basis from 2002 but not related to any range of the population.

No *AMI/ACS and Stroke population-based registers* exist in this country.

SPAIN

Historical data are available from the *MONICA-Catalonia* project, a regional AMI population-based register, launched in 1985 as part of the WHO-MONICA Project. About 480,000 men and women ages 25-74 years and residents in the geographical and administrative area of Catalonia near the city of Barcelona, in north-eastern Spain were under surveillance. Coronary-event registration lasted from 1985 to 1998 and used *cold pursuit* method.

A population based *AMI register (REGICOR)* in men and women 35 to 74 in three counties contiguous to the MONICA- Catalonia area exists since the late 80's.

The *IBERICA* register *(data accessibility: Municipal Institute of Medical Research)* is a pool of different hospital-based registers which started in 1997 and lasted for one year. It covered geographical areas of 7 regions and included about 4 million men and women ages 35-74. Suspected events were identified from hospital discharge diagnoses and ambulance services: ICD-9 410-414 in hospital discharge diagnosis. Suspected events were validated using ECG, enzymes and symptoms. Although suspected IHD deaths were also registered, fatal and non-fatal cases attended outside hospitals involved in the project are missing

No *Stroke population-based register* exists in this country.

SWEDEN

The *GOT-MONICA* included the residents ages 25-64 of the city of Goteborg (Gothenbourg), in the south-west of Sweden. The total population in 1991 was 433,000. Coronary-event registration lasted from 1984 to 1994 and used cold pursuit method.

The *Northern Sweden MONICA* study included the residents of two Swedish counties in northern Sweden (Norrbotten and Vasterbotten). The total population under surveillance in 1991 was 518,000 for the age range 25-64 years. Coronary-event registration lasted from 1985 to 1995 and used cold pursuit method.

The *Hjärfinfarktstatistinen (AMI Statistics - National Board of Health and Welfare www.sos.se)* started in 1987 and is based on administrative data (Hospital discharge register and the Causes of Death Register). The whole Swedish population was under surveillance (about 9 million of men and women of all ages).
Fatal and non-fatal suspected events are identified through a record linkage of mortality data and HDR obtained by PIN. In either sources of information the following ICD codes are used for the selection of events: ICD-10: I21, I22 (ICD-9: 410). The register is validated using ECG, symptoms, enzymes, and eventually autopsy; troponin test (ESC/ACC criteria) is also used. A retrospective review of records and a linkage to MONICA and WHO registers are performed.

The *Northern Sweden former MONICA Cerebrovascular Accidents (CVA) Register* continues the MONICA experience started in 1985 and is still running. The population under surveillance includes about 160,000 men and 162,000 women for the age range 35-74 years. Fatal and non-fatal suspected events are collected by cold pursuit method and identified through a record linkage of mortality data and HDR obtained by PIN. In either sources of information, the following ICD codes were used for the selection of events: ICD-10 codes I60-I69, G45, G46, for HDR; I60-I69 and R96-99 for mortality. The register follows the MONICA procedures and methods and events are validated according to MONICA criteria.

The *Riks-Stroke*, the Swedish national quality register on stroke care, evaluates stroke units in routine clinical care. Basic patient characteristics, process indicators and outcome variables are recorded in all 85 hospitals admitting acute stroke patients. A 3-month follow-up is included. There are wide variations between hospitals in the proportion of patients admitted to a stroke unit, in secondary prevention and in the proportion of patients in institutional care at 3 months. Even after adjustment for available prognostic indicators, case fatality is lower and functional outcome is better in patients treated in stroke units than in patients treated in general wards.

UNITED KINGDOM

MONICA Belfast included the residents ages 25-64 of Belfast city and the Castlereagh, North Down and Ards health districts in Counties Antrim and Down. The total population in 1991 was 477,000. Coronary-event registration lasted from 1983 to 1993 and used *hot pursuit* method.

Scottish MONICA included the residents ages 25-64 of Glasgow city, north of the River Clyde. The total population in 1991 was 392,000. Coronary-event registration lasted from 1985 to 1994 and used *hot pursuit* method.

No *AMI/ACS population-based register* exists in this country.

The *South London Stroke Register (SLSR - data accessibility: http://www.kcl-phs.org.uk/stroke/research/SLSR.htm)* which started in 1995, is an ongoing population based stroke register recording first stroke in patients of all age groups. By using 12 referral sources cases of stroke are identified in a defined area corresponding to 22 wards of Lambeth, Southwark, and Lewisham Health Commission. The total population is 234,533 men and women. Hospital surveillance of admissions for stroke includes two teaching hospitals within and three outside the study area. Community surveillance of stroke includes patients under the care of all general practitioners within and on the borders of the study area.
The notification sources are accident and emergency records; hospital wards; brain imaging requests; death certificates; coroner's records; general practitioners; hospital medical staff; community therapists; bereavement officers; hospital based stroke registries; general practice computer records; and "miscellaneous" including notification by patients or relatives of patients.
Patients are examined within 48 hours of referral to the register when possible. Subsequently, patients are followed up at 3 months by a register team field worker and then yearly by postal questionnaire. Death certificates with ICD-9 codes 430 to 434 and 436 are validated according to clinical registration criteria. The Office for National Statistics notified the registry of any patients who had died.
Methods used to ensure complete ascertainment of cases included personal visits to all general practitioners before the project started and 1 year later, and regular communication by telephone, posters, and quarterly newsletters. Use of a weekly stroke clinic or domiciliary visit by the study team are also available to general practitioners.

TABLE 1. NATIONAL POPULATION-BASED AMI/ACS REGISTERS: POPULATION CHARACTERISTICS

Country	First year available	Last year available	Ongoing registration	Age range	Population (x 1000)		Access data
					Men	Women	
Denmark	1978	2001	yes	all	2677	2734	NIPH
Finland	1991	2003	yes	all	2600	2600	NIPH
Iceland	1981	2002	yes	25 to 74	170		NIPH; Icelandic Heart Association
Sweden	1987	2001	yes	all	4545	4466	NBHW

NBHW, National Board of Health and Welfare; NIPH, National Institute of Public Health

TABLE 1A. NATIONAL POPULATION-BASED AMI/ACS REGISTERS: CASE DEFINITION

Country	ICD version	Mortality ICD codes *	HDR ICD codes *	Linkage mortality / HDR	Validation
Denmark	VIII, X	410-414	410	PIN	Recommended national diagnostic criteria and MONICA
Finland	X	410-414, 798	410, 411, 413	PIN	Clinical diagnosis, troponine
Iceland	VIII, IX, X	410-414, 428, 798, 799	410-412, 414, PTCA, CABG	PIN/name and date of birth	ECG, enzymes, symptoms, MONICA, autopsy
Sweden	IX, X	410	410	PIN	Recommended national diagnostic criteria

CABG, Coronary Bypass Grafting; ECG, Electrocardiogram; MONICA, MONItoring of trends and determinants in CArdiovascular diseases; PIN, Personal Identification Number; PTCA, Percuteneous Coronary Angioplasty

*all codes are presented in the ICD-9 revision to facilitate the comparison

TABLE 2. REGIONAL POPULATION-BASED AMI/ACS REGISTERS: POPULATION CHARACTERISTICS

Country	Area coverage	First year available	Last year available	Ongoing registration	Age range	Population (x 1000)		Access data
						Men	Women	
Belgium	Charleroi	1983	2003	yes	25 to 69	50	50	School of Public Health
Belgium	Ghent	1983	2003	yes	25 to 74	71	71	University of Ghent
Belgium	Bruges	1999	2003	yes	25 to 74	75	75	University of Ghent
Denmark	Northern Jutland	1978	2001	yes	all	247	247	Aarhus University
Finland		1993	2002	yes	35-85	90	103	NIPH
France	Lille, Strasbourg, Toulouse	1985	2004	yes	25 to 64 (until '96) 35 to 74 (from '97)	752	767	INSERM U780
Germany	Ausburg	1985	2002	yes	25 to 74	203	204	National Institute of Statistics
Italy	7 areas	1998	2003	yes	35 to 74	1300	1400	National Institute of Health
Norway		1972	2002	yes	all	1000		Health Region West
Spain	5 MONICA counties	1985	1998	no	25 to 74	234	246	Institute of Health Studies
Sweden	Northern Sweden	1985	2005	yes	35 to 74	160	162	MONICA

INSERM, Institut National de la Sante et de la Recherche Medicale ; MONICA, MONItoring of trends and determinants in CArdiovascular diseases ; NIPH, National Institute of Public Health

TABLE 2A. REGIONAL POPULATION-BASED AMI/ACS REGISTERS: CASE DEFINITION

		Sources of information			
Country	**ICD version**	**Mortality ICD codes** *	**HDR ICD codes** *	**Linkage mortality / HDR**	**Validation**
Belgium Charleroi, Ghent, Bruges	IX, X	410-414, 428, 798, 799	410-414, 428, PTCA, CAGB	name, date of birth	ECG, enzymes, symptoms, MONICA
Northern Denmark	VIII, X	410	410	PIN	No validation
Finland	X	410, 411, 428, 798, 799	410, 411, PTCA, CABG	PIN	MONICA, troponine
France	IX, X	410-414, 428, 798, 799, others	410-414, 428	name, date of birth	MONICA
Germany	X	410-414, 798, 799	410, 411, PTCA, CABG	name, date of birth	MONICA, troponine
Italy	IX	410-414, 798, 799, other	410-414	name, date of birth	MONICA
Norway	X	410	410, PTCA, CABG	PIN	no validation
Spain	IX	410-414, 428, 798, 799, other	410-414	name, date of birth	MONICA
Northern Sweden MONICA	X	410, 411	410	PIN	MONICA

CABG, Coronary Bypass Grafting; ECG, Electrocardiogram; MONICA, MONItoring of trends and determinants in CArdiovascular diseases; PIN, Personal Identification Number; PTCA, Percuteneous Coronary Angioplasty

*all codes are presented in the ICD-9 revision to facilitate the comparison

TABLE 3. EXAMPLES OF HEALTHCARE SERVICES-BASED AMI/ACS REGISTERS IN COUNTRIES PARTICIPATING IN THE EUROCISS PROJECT

Country	Area Coverage	1st Year	Age range	Population (x 1000)		Access data
				Men	Women	
Austria	National	1990	all	1,600		Austrian Health Foundation
Greece	Regional	2003	all	NA		Hippokrrateion Hospital, University of Athens Medical School
Hungary	National	1996	all	4800	5300	The Centre for Health Information, National Health Insurance Fund, Department of Financial Informatics
Hungary (GP)	Regional	1998	all	125	139	School of Public Health, University of Debrecen
The Netherlands (GP)	Regional	1971	all	12		NIPH - University Nijmegen
Poland	National	2003	all	NA		Silesian Centre for Heart Disease
Spain (IBERICA)	Several provinces	NA	35 to 74	NA		Municipal Institute of Medical Research

NIPH, National Institute of Public Health; NA, not available

TABLE 4. NATIONAL POPULATION-BASED STROKE REGISTERS

Country	Starting year	Last year available	Ongoing experience	Age range	Target population (x 1,000)		Access data
					Men	Women	
Denmark	1978	2001	yes	35 to 85+	2677	2734	NIPH
Finland	1991	2003	yes	35 to 85+	2600	2600	NIPH
Sweden	1994	2006	yes	all	4589	4523	NBHW

NIPH, National Institute of Public Health; NBHW, National Board of Health and Welfare

TABLE 4A. NATIONAL POPULATION-BASED STROKE REGISTERS: CASE DEFINITION

Country	ICD version	Mortality ICD codes*	HDR ICD codes*	Linkage mortality / HDR	Validation
Denmark	VIII, X	430-438	430-438	PIN	-
Finland	X	430-438	430-438	PIN	MONICA CT-Scan
Sweden	X	430-434, 436-438	430-438	PIN	WHO Clinical criteria in sub-

CT-Scan, Comouted Tomography-Scan; MONICA, MONItoring of trends and determinants in CArdiovascular diseases; PIN, Personal Identification Number; WHO, World Health Organization

*all codes are presented in the ICD-9 revision to facilitate the comparison

TABLE 5. REGIONAL POPULATION-BASED STROKE REGISTERS

Country	Area coverage	Starting Year	Last year available	Ongoing experience	Age range	Target population (x 1,000)		Access data
						Men	Women	
Finland		1993	1997		35 to 85+	93	103	NIPH
France	Dijon	1985	2004	yes	6 months→	69	81	CHU Dijon
Germany	Erlangen	1994		yes	18+	49	51	University of Erlangen
Italy	8 areas (North, Centre and South Italy)	1998	2003	yes (every 5 yrs)	35 to 74	2400	2600	National Institute of Health
Norway	3 counties	1972	2002	yes	all	1000		Health Region West
Sweden	Northern Sweden	1985	ongoing	yes	25 to 74	160	162	Umeå University Hospital

NIPH, National Institute of Public Health; CHU, Centre Hospitalier Universitaire

TABLE 5A. REGIONAL POPULATION-BASED STROKE REGISTERS: CASE DEFINITION

Country	*ICD version*	*Mortality ICD codes**	*HDR ICD codes**	*Linkage mortality / HDR*	*Validation*
Regional Registers					
Finland	X	430-432, 435, 436	430-432, 435, 436	ID	MONICA
France	X	430-438, 442.81	430-438, 442.81	PIN, date of birth	WHO Clinical criteria CT-Scan or MRI
Germany	X	430-438	430-438	name, date of birth	CT-Scan, Health Insurance
Greece	IX	430-438	430-438	name, date of birth	CT-Scan
Italy	IX	430-434, 436-438	430-434, 436-438	name, date of birth	MONICA
Norway	X	430-438	430-438	PIN	-
Northern Sweden	X	430-438, 798, 799	430-438	PIN	MONICA

CT-Scan, Comouted Tomography-Scan; MONICA, MONItoring of trends and determinants in CArdiovascular diseases; MRI, Magnetic Resonance Imaging; PIN, Perosnal Identification Number; WHO, World Health Organization

*all codes are presented in the ICD-9 revision to facilitate the comparison

TABLE 6. EXAMPLES OF HEALTHCARE SERVICES-BASED STROKE REGISTERS IN COUNTRIES PARTICIPATING IN THE EUROCISS PROJECT

Country	Area Coverage	1st Year	Age range	Access data
Greece (Athens)	Regional	1992	18+	Alexandra Hospital, University of Athens
Greece (Arcadia)	Regional	1993	20+	Alexandra Hospital, University of Athens
Hungary (HDR)	National	1996	all ages	The Centre for Health Information, National Health Insurance Fund, Department of Financial Informatics
Hungary (GP)	Regional	1998	all ages	School of Public Health, University of Debrecen
Poland	Selected hospitals	2001	all ages	Institute of Psychiatry and Neurology Warsaw
Sweden (Riks-Stroke)	all hospitals (85)	1995	all ages	Department of Internal Medicine, Norrland Umeå University Hospital

GP, General Practitioner; HDR, Hospital Discharge Records

Health Interview and Health Examination Surveys

Here below an overview of HIS/HES performed in partner countries follows. The data here presented derive from the questionnaire filled in by each partner country and refer to the period 2005-2006. Therefore the information are reported as they were provided by partners and are further summarized into Tables 7 and 8.

BELGIUM

Within the *MONICA Project*, three regional surveys were conducted on individuals ages 25-64 years in: 1985-87, 1987-90 (1988-90 Ghent), 1990-93 (1990-92 Ghent). The total sample size in each population survey was about 1200 and the response rate was 50%. The surveys were self-reported questionnaires for IHD and AMI; physical examination was also included.

An *HIS* is periodically conducted every 4 years (first year: 1997; last year: 2004).
The sample size was about 6,000 men and 6,000 women ages 35-85 years and over. The Survey included a specific question on AMI and Percutaneous Coronary intervention (PCI). Collected data are computerized and the last year available is 2001. They are not used to calculate national estimates of IHD prevalence. The response rate was about 60 %.

CZECH REPUBLIC

Within the *MONICA Project*, population surveys were conducted in 1985, 1988, 1992, 1997/98 and 2000/1 on individuals ages 25-64 years. The total sample size was 2573 in 1985, 2769 in 1988, 2353 in 1992, 2087 in 1997/8 and 2078 in 2000/1. The response rate was 83% in 1985, 87% in 1988, 75% in 1992, 65% in 1997/8 and 62% in 2000/1. The assessed diseases in all surveys were: AMI, hypertension, and dyslipidemia. Blood pressure and cholesterol levels were also measured.

An *HIS* is conducted every 3 years (first year: 1993; last year: 2002). Data are available for men and women ages 15 years and over, grouped by 5 years. The total sample size was 1600 in 1993, 3396 in 1996, 2476 in 1999 and 2476 in 2002. The response rate was 60-70% in 1993, 60-70% in 1996, 68,2% in 1999 and 70,7% in 2002.
The *HIS* included a face to face questionnaire and the assessed diseases were hypertension, cerebrovascular diseases and all IHD. Collected data are computerized and the last year available is 2002. They are used to calculate national estimates of IHD prevalence.

DENMARK

Within the *MONICA Project*, population surveys were conducted in 1982-84, 1988, 1992 on individuals ages 25-64 years. The total sample size in each population survey was about 1200.

The *Danish HIS Program* started in 1987 and afterwards has collected data in 1994, 1997, 2000 and 2005. The overall purpose of the survey is to describe the status and trends in health and morbidity in the adult population and in the factors that influence health status, including health behaviour and health habits, lifestyles, environmental and occupational health risks and health resources. The results are used in national, regional and municipal health planning and monitoring as well as in research and analysis.
Design, data collection methods and response rates are shown in the table below:

	1987, 1994, 2000	2005
Sample size	6,000 - 22,500 adult Danish citizens	21,832 adult Danish citizens
Method of data collection	Personal interview + self-administered questionnaire	Personal interview + self-administered questionnaire
Carrying through	3 rounds	1 round
Personal interview	Paper and pencil	CAPI
Response rate	79.9% - 78.0% - 74.2%	66,7%

The Survey includes specific questions on MI/angina pectoris (AP) and high blood pressure. Further a question about longstanding illness, from which all heart diseases can be identified. Collected data are computerized and the last year available is 2005. They are used to calculate national estimates of IHD prevalence.

The *Copenhagen City Heart Study* is an *HES* which started in 1976. The first period of data collection ended in 1978 and the survey was subsequently performed in the years: 1981-83; 1991-93 and 2001-03.
The target population included about 9,300 men and 10,300 women ages 20 years and over. The Survey collected data on AMI, AP, Intermittent Claudication (IC) and Stroke, using the Questionnaire of the London School of Hygiene and Tropical Medicine (LSHTM) for effort angina, AMI and IC. Methods of data collection included also physical examination and ECG codified by Minnesota code.
Collected data are computerized and the last year available is 2000. They are not used to calculate national estimates of IHD prevalence.

FINLAND

FINRISK is an *HES* which started in 1972 and has been performed every 5 years until 2007. In 1982, 1987 and 1992 the FINRISK surveys were also part of the *WHO MONICA Project*. The sample sizes have varied between 6000 and 12000 individuals. The response rates have varied from over 90% to 65%. In 2002, 10000 individuals were examined. The HES collected data on AMI, HF, AP, Stroke, CABG, PTCA and all IHD using a questionnaire. Physical examination was also performed. Collected data are computerized and the last year available is 2002.

Adult Health Behaviour Survey (AVTK) is an *HIS* which has been performed annually for 26 years, from 1978 to 2004. In 2003, the sample size was 5000 individuals ages 15-64 and the response rate was 67%. The Survey included a specific question on AMI, HF and AP. Collected data are computerized and the last year available is 2004. They are not used to calculate national estimates of IHD prevalence.

Health 2000 is a national *HES* which started in 1972 and was performed every 15 years until 2002.
In 2000, the population sample was 8028 individuals ages 30 and over and the response rate was 89%. The Survey collected data on AMI, HF, AP, IC, Stroke, CABG, PTCA and all IHD using a questionnaire. Methods of data collection included also physical examination and ECG coded according to the Minnesota code. Collected data are computerized and the last year available is 2002. They are used to calculate national estimates of IHD prevalence.

FRANCE

Within the *MONICA Project*, population surveys were conducted in 1986-89 and 1995/96 in MONICA Lille; in 1985-87 and 1996-97 in MONICA Strasbourg; in 1985-87, 1988-91 and 1994-96 in MONICA Toulouse. Eligible people were individuals ages 25-64 years. The total sample size in each population survey was about 1,200. Participation rates varied from 47 % (in Strasbourg) to 76 % (in Lille) for men and from 50 % (in

Strasbourg) to 76 % (in Lille) for women. These surveys are conducted to study the trends of cardiovascular risk factors. The methods of data collection were standardized questionnaires on personal data (mainly risk factors: physical activity, tobacco smoking, hypertension, hypercholesterolemia and self reported diabetes), clinical measurements (weight, height, blood pressure) and biological measurements (lipids-including total and HDL cholesterol- blood glucose level). At present, a third survey is being performed in the same areas (2005-2006; ages: 25-74 years; sample sizes: about 1, 600 per area with ECG in Toulouse area).

A national representative *HES* (*ENNS*) is currently being conducted (2006-2007) focused on nutrition and nutritional state (including cardiovascular risk factors). The sample size is about 4,000 adults (18-74 years) and 2,000 children. The methods of data collection also include standardized questionnaires (nutrition, physical activity, tobacco smoking, hypertension, hypercholesterolemia, diabetes), clinical measurements (height, weight, waist and hip circumferences, blood pressure) and biological measurements (total cholesterol, HDL cholesterol, triglycerides, blood glucose level, creatinine levels, etc.).

A national *HIS* started in 1960 and was performed every 10 years (*EDS-INSEE*). The last one was performed in 2002-2003. The target population was the non institutionalized population of Metropolitan France and the sample size was about 41,000 of all ages (20,000 men and 21,000 women). The household response rate was 78 % for the first interview and 68 % for the third one (this survey includes three interviews; there were two months between the first and the third). All assessed diseases were coded (ICD-10). Medication used was reported. This survey includes SF-36 Quality of Life (QoL) and functional health status questionnaires (ADL, IADL). Collected data were computerized and can be used to calculate national estimates of IHD, MI prevalence, etc.

Another national *HIS* is being performed every two years (*ESPS- IRDES*). The last one was performed in 2006. The target population was the whole non institutionalized population of Metropolitan France and the sample size was about 22,000 (participation rate 70 %) in 2004. Assessed cardiovascular diseases were: hypertension, AP, MI, stroke and heart failure. In addition, interview data could be matched with health insurance reimbursement data. Collected data were computerized and can be used to calculate IHD prevalence (ESPS 2006 is currently being carried out).

GERMANY

Within the *MONICA Augsburg*, a CVD survey was carried out in 1984/85, 1989/90 and 1994/95. It referred to cardiovascular risk factors and to IHD, AMI and CVA. In 1984/85 the number of people examined and/or interviewed in the study was 4,022 (2,023 men and 1,999 women) in the age range 25-64 years. The response rate was 79% (2nd MONICA survey 77%; 3rd MONICA survey 75%). Methods of data collection included self-reported questionnaires, physical examination and interview (LSHTM for AP, self-reported previous AMI, and stroke). Except for the survey carried out in 1994/95, automated ECG was collected, but has not been codified by Minnesota code yet. Blood samples were taken, cholesterol and HDL-cholesterol was analyzed. Anthropometric measurements were performed.

KORA Ausburg Survey 2000 (HES) was carried out in 1999 to 2001 in the same area and study population as in MONICA; MONICA procedures were used. It refers to AP, IC and previous AMI and stroke in population ages 25-74 years. Target population is men and women ages 25-64 in the first survey, and up to 74 in the other 3 surveys; all data are computerized. Collected data were not used to calculate national estimates of IHD prevalence. The interview included LSHTM for AP and IC, self-reported AMI, and stroke. The examination included blood sampling and ECG. The response rate was 67%. A follow-up examination of the survey 1994/95 was carried out in 2004/2005 (including LSHTM for AP an IC, echocardiography, Ankle Brachial Index –ABI-). A follow-up examination of the KORA Survey 2000 is ongoing including carotid ultrasonography, measurement of endothelial dysfunction, ECG, and ABI.

The Study of Health in Pomerania (SHIP) was carried out from 1997 to 2001 and referred to a variety of chronic diseases and included previous AMI and stroke, AP and IC. The target population examined and/or interviewed

in the study was 4,310 (2,117 men an 2,193 women) in the age range 20-79 years. The response rate was 69%. Methods of data collection were based on self-reported questionnaires of LSHTM for AP and IC, self-rated AMI, stroke and of procedures as CABG and catheterization. ECG was collected and codified by Minnesota code. Anthropometric measurements were carried out. Physical examinations included carotid ultrasonography, and echocardiography. Systolic and diastolic dysfunction, left ventricular hypertrophy, aortic valve sclerosis were examined. A follow-up examination of the population is ongoing. Collected data are not used to calculate national estimates of IHD prevalence.

The National HIS and HES is based on interview and examination and was expected to be performed every 5-6 years. It covers the age range of 18 to 79 years. The last survey started in 1997 and ended in 1999 and the target population was men and women aged 18-79 years. The response rate was 62%. The Survey included questions on AMI, HF, AP, IC and Stroke, based on a physicians' interview. Blood samples were taken to analyze cholesterol and HDL-cholesterol. Non-fasting trigycerides and glucose were analyzed. Anthropometric measurements were performed. Collected data are computerized and are used to calculate national estimates of IHD prevalence. Data are available as public use file. Every year, since 2002 on a regular basis, telephone interviews are carried out. Questions on previous AMI, stroke, and on AP are included. Data in the Telephone interview of 2002/2003 is available as public use file.

GREECE

National surveys focusing on assessing CVD rates are not performed in the country, though there are several regional surveys, such as the Attica study.

At the national level, the *EPIC-Greece* cohort is the Greek component of the European Prospective Investigation into Cancer and nutrition (EPIC). The aims of EPIC are the elucidation of the role of biological, dietary, lifestyle and environmental factors in the aetiology of chronic diseases. Cancer studies are jointly published by the EPIC consortium, while investigations, such as for cardiovascular diseases, are also undertaken by individual countries.

EPIC-Greece is considered an *HES*, but it is not a permanent system of data collection. Although the sample is not strictly representative, it covers all major regions of Greece and, with certain assumptions, allows estimation of CVD incidence (incidence rate, mortality rate).

Specifically, the baseline data were collected from 1994 to 1999 and follow-up data is performed every 3-4 years which continues today with losses to follow-up less than 5%. The study population is 11,954 adult men and 16,618 adult women. As concerning CVD, volunteers are asked for the presence or absence of the following diseases, as well as for possible risk factors: AMI, ACS, HF, AP, IC, Stroke, CABG, PTCA and all IHD. Further methods of data collection are based on questionnaire and physical examination. Collected data are computerized and the last year available is 2005. Detailed individual validation of cardiovascular cases began in 2005, by reviewing hospital records.

HUNGARY

The National HIS was conducted in 2000 and in 2003 and included 7,000 non-institutionalized men and women ages 18 years and over. In 2003 sample size was 5032 and the response rate was 81%. Diseases of interest were AMI and Stroke, detected through a self-reported questionnaire. Collected data are computerized and the last year available is 2003. National prevalence estimates are available only for AMI and Stroke.

Unknown Morbidity Survey is an *HES* performed in 2001 and lasting 6 months. The target population was 3,735 men and 4,737 women ages 55-64 years. The primary aim of the Unknown Morbidity Survey was to measure the magnitude of unknown cases in two regions (Western and Eastern of Hungary in case of hypertension, diabetes mellitus and chronic liver disease and cirrhosis). Within the framework of the survey, physical examination and laboratory tests had been carried out for establishing diagnoses based on WHO criteria. Collected data were computerized. With newly identified cases, updated prevalence estimates were calculated.

ICELAND

Within the *MONICA Project*, population surveys were conducted in 1983, 1988/89, 1993/94 on individuals ages 25-64 years. The total sample size in each population survey was about 1200.

The *Reykjavic Study* is an *HES* which started in 1967 and is performed continuously. The target population is 30,000 men and women of all ages. The survey collected data on AMI, ACS, HF, AP, IC, stroke and PCI using a questionnaire. Methods of data collection included physical examination and ECG codified by Minnesota code. Collected data are computerized and the last year available is 2005. These data are used to calculate national estimates of IHD prevalence.

ITALY

Within the *MONICA Project*, population surveys were conducted in 1986/87, 1989/90 and 1993/94 in Italy-Brianza and in 1986, 1989 and 1994 in Italy-Friuli. Eligible people were individuals ages 25-64 years. The total sample size in each population survey was 1200.

The Italian HIS: Health condition and the use of health services is a national survey called "Indagine sulle famiglie", performed every 3-4 years and covering all ages. The survey was first performed in 1980, then in 1983, in 1986/87, 1990/91 and 1999/2000. Main diseases assessed were: IHD, AMI, CVA. It consisted of interview, promoted by ISTAT, the Italian National Institute of Statistic. The study was based on a random probability sample of the whole country (180,000 individuals in 1999/2000). Chronic diseases were assessed through a 28 items questionnaire. The response rate in 1999/2000 was about 80%. Collected data are computerized and are used to calculate national estimates of IHD prevalence.

The *Osservatorio Epidemiologico Cardiovascolare (OEC)* is a cardiovascular *HES* which was conducted from 1998 to 2002 on about 10,000 men and women ages 35-74 who were homogeneously spread throughout the Italian territory. The occurrence of AP, IC and old MI was assessed using questionnaires set by the LSHTM, or else through positive anamnesis for bypass or angioplasty surgery. The presence of alterations, such as atrial fibrillation and left ventricular hypertrophy, was decoded using Minnesota code. For the prevalence of cerebrovascular events (stroke or Transient Ischaemic Attack, TIA) the LSHTM questionnaire, validated through clinical records, was used. The prevalence rate of the different diseases in 35-74 years age group is available on the website www.cuore.iss.it. Collected data are computerized and the last year available is 2002.
Next *OEC* is planned for the year 2008.

THE NETHERLANDS

The *POLS survey* is an *HIS*, collecting data at the national level since 1997. These data are continuously collected in representative samples of the population, through self-reported information. The target population is about 5,000 men and 5,000 women per year, all ages. The survey includes a specific question on AMI, ACS, AP and stroke. Collected data are computerized and the last year available is 2004. The response rate is 60%. The data are used to calculate national estimates of IHD prevalence.

Being a *HES*, the *Regenboog project* assesses prevalence of previous MI and stroke, including not only self-reported data, but also a physical examination (weight, height, blood pressure, total and HDL cholesterol). This project started in 1998 and stopped in 2001, collecting data continuously. During 1998-2001, 19,500 participants were interviewed (HIS), with 28% of these undergoing a physical examination at the health centre (HES). The target population over the whole period was for the HES 2,700 men and 2,700 women aged 12 years and older. Collected data were computerized and the last year available is 2001. The data were not used to calculate national estimates if IHD prevalence.

The Rotterdam Study (ERGO) is a *HIS-HES* survey/cohort study. Baseline data collection was performed from October 1990 to July 1993. Since then all participants have been re-examined every 2-3 years. All inhabitants of

Ommoord a suburb of Rotterdam, who were 55 years or older were invited to participate in the study. Out of 10,275 subjects, 7983 agreed to participate (3,105 men and 4,878 women). In 2002, 3011 participants 55 years and older were added to the cohort. In 2005, all inhabitants of Ommoord aged 45 years and older were added to the cohort. Morbidity and mortality is registered through general practitioners practises. Events are coded according to the International Classification for Primary Care (ICPC) and ICD-10 using clinical information obtained from the general practitioner and HDR. IHD, AMI, HF and Cerebrovascular Disease were examined by self reported questionnaire. Standardized physical examination was carried out, including measurement of weight and height (to evaluate the presence of HF the presence of ankle oedema and pulmonary crepitions or rhonchi was also verified); ECG was recorded to assess the presence of atrial fibrillation and left ventricular hypertrophy; Echocardiogramm was use too. Collected data are computerized and the last year avaible is 2005. Response rate in 1991 was 78%.

The Doetinchem Cohort Study started as a *HES*, with a baseline examination during 1987-1991. A population based sample from inhabitants of Doetinchem, a town in the eastern part of the Netherlands, aged 20-59 years was drawn. Response rate was about 60%. Participants are being re-examined at five year intervals, the fourth round now taking place (2003-2007), with respondents being 36-75 years of age. Questionnaires and physical examination are performed (weight, height, waist and hip circumference, blood pressure, ankle-arm index, total and HDL cholesterol, non-fasting glucose). Response rates at re-examination are 75-80%, and the cohort consists of about 5000 men and women. Self-reported AMI and stroke is collected, and linkage is established with HDR, vital statistics and the national mortality register. Data are not used to provide national estimates.

NORWAY

Health surveys started in 1968 and were repeated in 1975, 1985 and 1995. Since 1998 living condition surveys are performed every year with variable main topics, including health every 3 year (1998, 2002 and 2005). These surveys involve representative samples from a population of 3,400 million men and women which are more than 16 years old and are resident in the national territory, excluding persons living in institutions. In 1998 sample size was 7,125 ages 16+ and the response rate was 72%. In 2005 all 10, 000 were selected: 303 had died, emigrated or were living in institutions. Thus, 9697 persons were interviewed and 6766 responded (70%).
The surveys include a self-report of prevalent diseases. CVD are to be specified and coded by ICD-10, thus including any reported diagnoses as MI, ACS, HF, AP, stroke, CABG, PTCA and all IHD. The surveys include a question on the impact of the reported disease on functional capacity and quality of life. In the last period (1998, 2002, 2005) the questions on health were presented together with ”non-health” issues on ”living conditions”, but the way to collect information on diseases was the same.
Collected data are computerized and the last year available is 2002. They are not used to calculate national estimates of IHD prevalence.

HES have been performed in several counties from 1974 to 2000-3. All these surveys have assessed prevalence of MI, AP and stroke by self-reports, and performed physical examination on weight, height, blood pressure, total cholesterol and (non-fasting) triglycerides. The Rose questionnaire (short form) on effort AP has been included. Since 1994 all surveys included also measurement of waist and hip circumferences, (non-fasting) glucose and HDL- cholesterol. The age groups have varied from 35-49, 20 +, 40-42 and included subjects aged 30-, 40-, 45-, 60- and 75 years (2000-2003). The numbers of attendees have varied from more than 100,000 to 5,000 and the attendance rate varied from about 90% to 46%.

The *North-Trøndelag Health Survey* has been performed in 1984-86 and in 1995-97, and data are computerized and available. This survey is ongoing (2006-2008) and involves more than 100, 000 inhabitants aged 20+. The data are being computerized and will be available.

POLAND

Within the *MONICA Project*, population surveys were conducted in 1983/84, 1987/88, 1992/93 in POL-MONICA Krakow and in 1984, 1988, 1993 in POL-MONICA Warsaw. Eligible people were individuals ages 35-64 years. In both sites the total sample size was 2400 in the first and 1200 in the second and third surveys. The response rate was 70-80%. Methods of data collection included standard questionnaires for AMI, IC, AP and Stroke, physical examination, BP measurement, blood lipids determinations and ECG (Minnesota codes).

The *Poland HIS* was a national system of data collection conducted in 1996 and 2004 on men and women of all ages (household survey). The survey included a specific question on all IHD. Collected data are computerized and the last year available is 2004. They are used to calculate national estimates of IHD prevalence. Target population was total population of Poland.

Multi-centre examination of health of Polish population *(Project WOBASZ)* was carried out in 2004-2005 in the frames of the National Program for Prevention and Treatment of Cardiovascular Disease (POLKARD 2003-2005). The sample studied was 19,200 men and women selected from total population of Poland ages 20-74 years (26,360 men and women). Average participation rate was 74% in men and 79% in women. Methods of data collection included standard questionnaires, physical examination, blood pressure measurement and blood lipids. CVD risk factors measured included: demographic characteristics, smoking, social status, social support, depression, physical activity, assessment of diet, blood pressure and blood pressure lowering treatment, blood lipids and lipid lowering treatment, body height and weight, waist circumference, blood glucose, blood homocysteine (sub-sample and C-reactive protein).

PORTUGAL

The Inquérito Nacional de Saude was an *HIS* conducted from 1987 to 1998/99 and performed every 5 years. The last survey was performed during the two year period 2004-2005 and available data are expected for the beginning of 2007. The target population was 48,606 men and women ages 35-74 years and over grouped by 10 years. The response rate was 80,5%. On the whole, the percentage of refusal was only 1,5-2,0%. Data on AMI and stroke were collected by means of face-to face interviews conducted on a probability sample of households selected by the National Statistical Institute and using previously elaborated questionnaires. Collected data are computerized and the last year available is 1998.

SPAIN

Within the *MONICA Project*, the *Catalonia Survey* is an *HES* carried out in 1986-88, 1990-92, 1994-96 and included personal interviewed questionnaires, physical measurements, fasting blood sampling and biological determinations. IHD, previous MI, and stroke were included and the data collection methods were based on LSHTM standard questionnaires for MI, IC, AP and Stroke as well as doctor diagnosed questions and on resting ECG coded by the Minnesota code.
The target population was 1.100.000 persons from Central Catalonia and the metropolitanean area of Barcelona. The original sample size was 3,500-4,500 individuals in each survey (final size 8,990 between the 3 surveys): ages 25-64 years and beyond. The response rate was 74%.

The Encuesta nacional de salud de España is an *HIS* which started in 1987; and repeated in 1995, 1997 and 2003. The target population was 40 million men and women, covering the following age ranges: 0-4, 5-15, 16-24, 25-44, 45-64, 75 and over. The Encuesta nacional de salud de España included a specific question on heart disease and arterial hypertension. Collected data are computerized and the last year available is 2003. Data were not used to calculate national estimates of IHD prevalence.
Some Spanish regions (Comunidades Autònomas) and a few cities carry out their own non-homogeneous mainly HIS-type of surveys on an occasional basis, as the health system in Spain is decentralized.

SWEDEN

Within the *MONICA Project*, population surveys were conducted in 1985/86, 1990/91, 1994/96 in Gothenbourg and in 1986, 1990, 1994 in Northern Sweden. Eligible people were individuals ages 25-64 years. Since then similar surveys have been conducted in Northern Sweden also in 1999 and 2004 on 2000-2500 individuals. The response rate was 80-86%. The contents of the surveys and the methods of data collection followed basically the MONICA study protocol and the surveys included HIS and HES.

UNITED KINGDOM

Within the *MONICA Project*, population surveys were conducted in 1983/84, 1986/87 and 1991/92 in Belfast and in 1986, (1989*), 1992 and 1995 in Glasgow. Eligible people were individuals ages 25-64 years. The total sample size in each population survey was 1200.

Health Survey for England (HSE) is a *HIS/HES* which aims to assess morbidity for AMI, ACS, HF, AP and Stroke. The first year of HSE data collection was 1994 and surveys are performed every year, covering the age range 16-85+ years for adults. Children are also included (age 2-15). Sample size of population depends on survey year and focus of survey question (for HSE 2003 the target population was 13,680). The response rate varies (in HSE 1998 was 63%, in HSE 2000 was 44%).

The survey included specific question on doctor diagnosed AMI, ACS, HF, AP and stroke. Collected data are computerized and made available to researchers immediately after the report is published (around 12 months after completion of data collection). They are not used to calculate national estimates of IHD prevalence.

Scottish Health Survey (SHS) is an *HES* which collects data every 4-5 years since 1994. Age ranges included are 16-84 for adults and 2-15 for children. Since 2001 children under 2 were also included. In 1995 the target population was 7932 individuals and the response rate was 42%. In 1998 the target population was 15332 individuals and the response rate was 54%.The survey included a specific question on AMI, ACS, HF, AP and Stroke. Collected data were computerized and the last year available is 2003. Also physical examination was carried out. Collected data are not used to calculate national estimates of IHD prevalence.

TABLE 7. HES SURVEYS - DISEASE: ALL ISCHAEMIC HEART DISEASE

COUNTRY	Time period covered by surveys	Periodicity	Age range	Population recruited x 1000	Methods of data collection (last survey)			
					LSHTM	Other quest	Exam	ECG
Denmark 1 Copenhagen City Heart Study	1976-2003	performed in: 1976-78; 81-83; 91-93, 2001-03	20+	20	√	-	√	√
Denmark 2 Surveys at the Research Centre for Prevention and Health in Copenhagen	1964-2005	seven cohorts out of 11 examined 2 or more times	35-85+	41	√	√	√	√
Finland FINRISK/Health 2000	1972-2002	every 5 yrs (FINRISK); every 15 yrs (Health 2000)	30+ (Health 2000)	8 (Health 2000) 10 (FINRISK 2002)	-	√	√	√[a]
France (ENNS)	2006-2007	every 5 yrs	3-74	6	-	-	√[b]	-
France (MONICA)	1986-2006	every 10 yrs	35-64 35-74 (2006/2007)	5	-	√	√[b]	√ only in Toulouse
Germany	1997-1999	every 5-6 yrs	18-79	7	-	√	√	-
Greece	1994-2006	every 3-4yrs	Adult population	29	-	√	√	-
Hungary	2001	only once	55-64	8	-	√	√	-
Iceland	1967-2005	continuously	All together	30	-	√	√	√
Italy	1998-2002	performed once Next in 2007	35-74	10	√	√	√	√
The Netherlands	1998-2001	continuously	12+	5	-	√	√	-
Norway 1	1974-2003	discontinuously	30,40,45,60,75	35	√	√	√[b]	-
Norway 2	1984-86 - 1995-97	next in 2006-8	20+	80	-	√	√[b]	-
Poland	2004-2005	performed once	20-74	19	√	√	√	-
Spain (MONICA)	1986-96	every 4 yrs	25-64	1	√	-	-	√
Northern Sweden	1985-2004	every 5 yrs	25-64	2				
UK	1994-2006	every year	16+	14	-	√	√	-

ECG, Electrocardiogram; LHSTM, London School of Hygiene and Tropical Medicine; a) only for Health 2000; b) risk factor

TABLE 8. HIS SURVEYS - DISEASE: ALL ISCHAEMIC HEART DISEASE

COUNTRY	Time period covered by surveys	Periodicity	Age range	Population interviewed x 1000	Questions included (last year)
Belgium	1997-2004	every 4 yrs	35-85+/all together	12	AMI, Percutaneous Coronary Intervention (PCI)
Czech Republic	1993-2002	every 3 yrs	15+, 5 yrs ranges	25	Stroke, IHD, hypertension
Denmark	1987-2005	Performed in 1987, 91, 94, 97, 2000, 2005	15+	22	AP and all heart diseases
Finland	1978-2004	every year	15-64 (in 2003)	5	AMI, AP, HF
France (ESPS)	1988-2006	every 2 yrs	all	22	Hypertension, AMI, AP, HF, Stroke, Arteritis
Germany	1997-1999	5-6 yrs	18-79	7	AMI, AP, HF, IC, Stroke
Hungary	2000-2003	every 3 yrs	18+	7	AMI, stroke
Italy	1999-2000	every 5 years	20-79	14	AMI, Stroke
The Netherlands	1997-ongoing	continuously	0+	10	AMI, ACS, AP, Stroke
Norway	1968-2005	every 3 year	16+	3	all CVD (ICD-X Q20-28)
Poland	1996 and 2004	Performed twice	All ages	26	IHD
Portugal	1987-1998/99	every 5 yrs	35-75+/all together	49	AMI, Stroke
Spain	1987-2003	Performed in 1987, 95, 97, 2003	0-4, 5-74 (10-year grp), 75+	40	IHD, Hypertension
UK	1994-2004	every year	16+	14	AMI, ACS, HF, AP, Stroke

AMI, Acute Myocardial Infarction; ACS, Acute Coronary Syndrome; AP, angina pectoris; CVD, Cardiovascular disease; ESPS, Health Care and Health Insurance Survey; IC, intermittent claudication; IHD, ischaemic heart disease; PCI, percutaneous coronary intervention; HF, heart failure;

4.2 WEB SITE

The EUROCISS Project web site (http://www.cuore.iss.it/eurociss/progetto/progetto.asp) was established within the page of the Italian Progetto CUORE (http://www.cuore.iss.it) of the Italian Institute of Health (ISS), which financed 40% of the EUROCISS Project (Fig 1).

The EUROCISS website (available in both Italian and English versions) gives a detailed and interactive description of the Project and includes the following sections (Fig 2):

- summary of the first and second phases of the Project;
- presentation of the health status indicators, determinants of health and health systems indicators which are reported and described in detail; they are identified for assessing the populations' health status and implementing preventive actions. They are divided into: already available indicators, those to be implemented in the short term and those recommended for long term implementation. Tables summarizing those recommended indicators are available for AMI, ACS, IHD, CVA, HF, other forms of heart disease;
- presentation of databases available at European level (World Health Organization - WHO; EUROSTAT; MONICA);
- a map illustrating the European countries participating in the Project is available. By clicking on each country, it is possible to access tables summarizing available data sources on CVD by single country;
- project results dissemination;
- a list of all partners with their personal information (name of institution, address, phone, fax, e-mail address);
- a **FORUM** (Fig 3) for discussion created to facilitate discussion among project partners. This internal 'working page' could be accessed exclusively by EUROCISS partners through a password.

All partners greatly contributed to its development and updating.

FIGURE 1. CUORE WEBSITE HOME PAGE

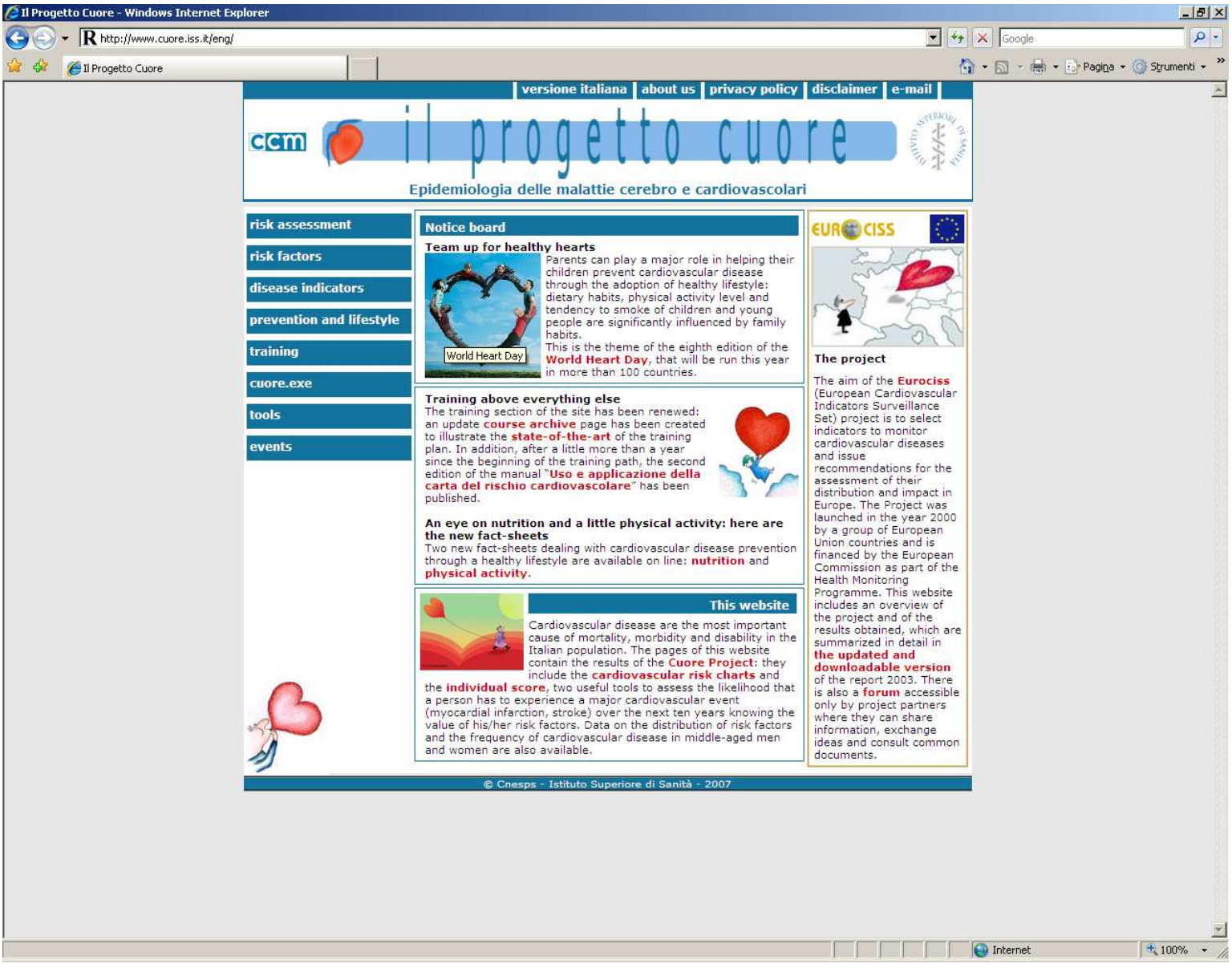


FIGURE 2. EUROCISS WEBSITE HOME PAGE

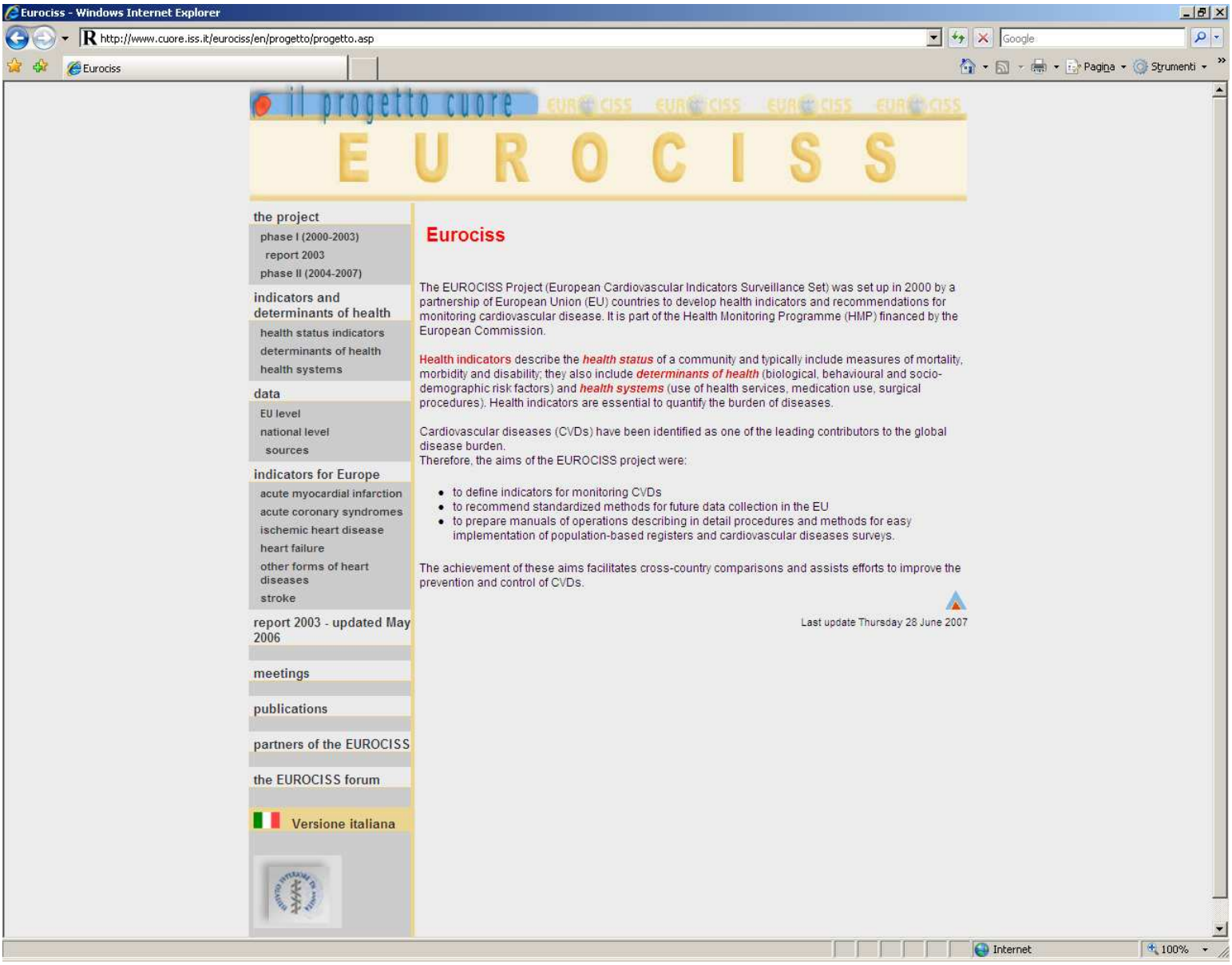
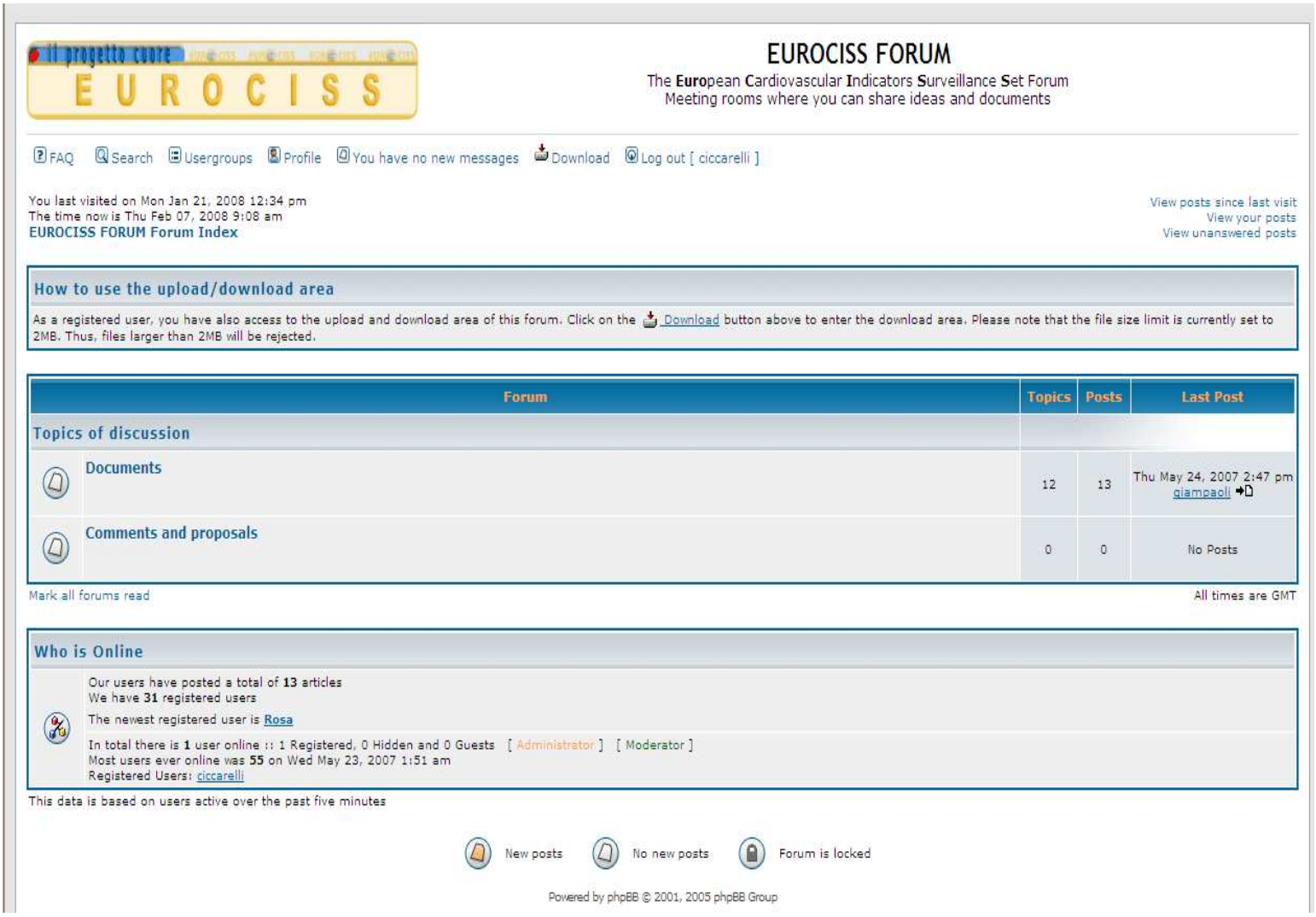


FIGURE 3. THE WEBSITE FORUM



4.3. MANUALS OF OPERATIONS

4.3.1 Background

The main objective and outcome of the 2nd phase of the EUROCISS Project (2004-2007) was to prepare the Manuals of Operations for the implementation of population-based registers of AMI/ACS and stroke in order to produce estimates of incidence/attack rate and case fatality, and of CVD surveys to assess prevalence.

These Manuals of Operations are the result of a long and fruitful cooperation among many experts involved in the EUROCISS Project, such as epidemiologists, statisticians, cardiologists and public health professionals, who aimed to produce a general guide for the surveillance of CVD to investigators, health professionals, policy makers and staff interested in current data collection and analysis. More specifically, they represent a valid scientific support for all those working in National Institutes of Health, National Institute of Statistics, Local Sanitary Units, and other academic and public health institutions operating at both regional and national levels.

The Manuals of Operations of AMI/ACS and Stroke population-based registers provide simple and comparable tools to support and stimulate implementation of population-based registers in those countries which lack them but collect routine data such as mortality and hospital discharge records. They recommend to start from a minimum data set and follow a step-wise procedure based on standardized data collection, appropriate record linkage and validation method, thus providing a standardized model for an efficient implementation of a population-based register.

A substantial number of sudden deaths (about 30% in middle age adults) still occurs out of hospital. Therefore, a population-based register is the best data source for the surveillance of AMI/ACS and stroke morbidity and mortality as it considers both fatal and non-fatal events occurring in-and out-of hospital, thus providing estimates of key indicators such as attack/incidence rate and case fatality. These indicators are included in the ECHIM short list proposed by the ECHIM project (www.echim.org) for improving comparable data collection at the European level.

Data extracted from mortality and hospital discharge records represent the minimum required to achieve a population-based register and are now available in most European countries thanks to the continuing process of computerization. To provide disease trends estimate, a population-based register should monitor a population able to produce a minimum of 300 total events (fatal and non-fatal, men and women together) per year in the age range 45-74 years. The minimum of 300 total events has been established to detect a decrease by 2% in attack rate per year.

Attack rates of acute coronary and cerebrovascular events are in themselves not sufficient to describe the impact of CVD on the population. The demographic changes in Europe with the increasing proportion of older people and the advancements in treatment have resulted in an increasing prevalence of chronic forms of IHD. Because of their frequency and cost there is a need to monitor the occurrence of both acute and chronic forms of the disease.

The EUROCISS Project has therefore produced the Manual of Operations of CVD Survey which provides a general guide and updated standardized methods for the surveillance of CVD and represents a useful tool to estimate CVD prevalence. This core indicator is also recommended by the EUROCISS Project for inclusion in the ECHIM short list. Population surveys are important as they further supplement the information collected from population-based registers with additional details on socio-demographic characteristics, risk factors, physical/biological measurements and chronic conditions.

While population-based registers are particularly useful for those events with a sudden onset requiring hospitalization, population screenings are the best surveillance system for complications of acute events, such as heart failure and arrhythmias, whose onset is not known and which do not require hospitalization.

4.3.2 Writing Groups

To develop the three Manuals of Operations mentioned above, the EUROCISS members were divided into three ***Writing Groups***: the Writing Group of the Manual of Operations of AMI/ACS population-based registers, the Writing Group of the Manual of Operations of Stroke population-based registers and the Writing Group of the Manual of Operations of CVD Surveys. Partners were grouped according to their expertise and each Writing Group was coordinated by a member of the Steering Committee.

The writing group of the Manual of Operations of Register of AMI/ACS was made of eight members: M Madsen (coordinator); V Gudnason.; A Pajak; L Palmieri; E C Rocha; V Salomaa; S Sans; K Steinbach; D Vanuzzo.

The writing group of the Manual of Operations of Register of Stroke is made of four members: S Giampaoli (coordinator); N Hammar; R Adany; C De Peretti.

The writing group of the Manual of Operations of CVD Surveys is made of six members:

P. Primatesta (coordinator); S Allender; P Ciccarelli; A Doring; S Graff-Iversen; J Holub; S Panico; A Trichopoulou; WMM Verschuren.

4.3.3 Essential Bibliography

Before starting the drawing up of the Manuals of Operations, a search for relevant papers published in medical journals from 1996 to 2005 was performed using MEDLINE and OVID databases.
The articles of interest in the field of AMI/ACS, Stroke and CVD Surveys were selected by each Writing Group according to previously defined criteria.
The following key words were used in order to select the most appropriate articles for preparing the Manual of Operations of AMI/ACS population-based registers: MI, coronary heart disease, epidemiological studies, hospital records, medical record linkage, validation studies, diagnostic criteria.

As for the Manual of Operations of stroke population-based registers, the following key words were used in order to select the most appropriate articles: disability, stroke classification, haemorrhagic stroke, ischaemic stroke, neuroimaging technology, MONICA classification, epidemiological studies.

As for Manual of Operations of Cardiovascular Surveys, the following key words were used in order to select the most appropriate articles: questionnaire, health status, health survey, epidemiologic investigation, angina, cardiovascular diseases, chest pain, mortality, self-rated health, validation, quality of life, symptoms, treatment, physical limitations, functional capacity.

The final list of selected articles represents the bibliography of each Manual of Operations.

4.3.4 Developing the Manuals of Operations for population-based registers: discussion issues

The three Manuals of Operations are the result of a long and fruitful cooperation among EUROCISS members. The majority of work was performed through the website Forum, the Partners meetings, the Steering Committee meetings and some meetings held in Rome between the three coordinators of the Writing Groups, which were responsible for the final elaboration of the Manuals.
For reasons of clarity and simplicity, the Manuals do not report all topics addressed by members and the various steps behind the elaboration; therefore, here below the most important and long debated issues are presented.

It was unanimously decided to give a similar structure to the ***Manuals of Operations of AMI and Stroke population-based registers***, and the following issues were basically discussed:

a. purpose
b. organization and content

c. how to summarize available data from countries
d. how to select population under surveillance
e. sources of information to be considered
f. data collection methods to be recommended
g. diagnostic criteria for event validation
h. how to evaluate quality control
i. validation procedures
j. cost-utility considerations
k. ethical issue

In particular, issues (d) and (g) required longer debate due to the fact that at the beginning there was quite a diversity of opinions among the Partners.

4.3.5 Population size

The issue (d) concerns the minimum number of events to suggest in order to set the population size under surveillance and monitor trends with the same degree of precision in the different registers (AMI/ACS and Stroke).

Starting from the procedure reported in the original MONICA Protocol, the change in incidence trend in 10 years was fixed at 10% and 20% for total events (1% and 2% per annum) in persons aged 45-74 years as the basis for statistical power calculation.

It was agreed to include, when possible, the oldest age range 75-84 (particularly for stroke as most events occur in this age range), so that a sufficient number of events could be produced also for women. Including, when possible, also the youngest age group 35-44 might be useful for comparison with previous registers, although the number of events in this age group is always quite small. Here below the procedures followed for calculating the population size to monitor for assessing incidence trends are described in detail:

> When planning a surveillance program, it is important to consider the population size needed to obtain reasonably precise estimates. In this context, it would be necessary to take into account the most basic comparisons of rates. In general, this would concern evaluations of changes in rates over time and of population differences in rates. Two different approaches to determine the required population size are presented below, the first based on a hypothesis testing

approach and the other on a confidence interval approach. The calculations are illustrated by a worked example.

Hypothesis testing approach

Under the hypothesis of a given annual percent change in the attack rate, this approach allows to calculate the necessary population size based on a Poisson probability function where the minimal number of events to be registered per year is given by the following relation:

Number of events per year = X / k =

$= 2 / k^3 *[(\Phi^{-1} (1- \alpha/2) + \Phi^{-1} (1-\beta)) / (t / 100)]^2$

where

X = indicates the number of events over k years;

α = significance level; $1-\beta$ = statistical power;

t = indicates the attack rate percent change per year;

Φ^{-1} = is the inverse of the Poisson probability distribution [http://en.wikipedia.org/wiki/Poisson_distribution].

For example, for an 80% probability ($1-\beta$) of detecting a 2% change in event rate per year over 5 years significant at the 5% level (α, two tailed test), the annual number of events needed is approximately 300:

Number of events per year = X / k =

$= 2 / 5^3 *[(1.96 + 0.84) / (2 / 100)]^2 = 314$

To give an example, the table 5 shows the numbers of events to be collected per year for an 80% probability of detecting a 2% or 1% change in attack rate per year over 10 years, significant at the 5% level (two tailed test), for men and women ages 45-74, for Coronary and Cerebrovascular events separately. In the table, to give an example, population sizes estimated for a low CVD incidence country (Italy) and a high CVD incidence country (Finland) are given. Coronary and Cerebrovascular attack rates used for the calculations derive from the Italian Progetto CUORE [URL http://www.cuore.iss.it/], and the Finnish National Cardiovascular Disease Register [Laatikainen T, et al. National Cardiovascular Disease Register, statistical database. URL http://www.ktl.fi/cvdr/].

In table 5, the column 'Events' shows the number of events to be collected per year to satisfy the chosen parameters; the two columns beside indicate the country specific crude attack rates used for estimating the minimal numbers; the next column shows the number of men and women to be taken under surveillance in the country specific population, calculated on the basis

of events to be collected and country specific attack rates; following, the required total population size based on the number of men and women respectively, using the European standard population structure is reported; the last column shows the correspondent total population size to monitor after 10 years, under the assumption of a constant decrease, in order to maintain statistical power.

Confidence interval width approach

An alternative approach to the hypothesis testing for estimating the population size to monitor is based on the confidence interval width: the requirement could be to have a confidence interval that is not too wide. Given that the purpose of the surveillance is to estimate attack rate and change in attack rate over time rather than testing a predefined hypothesis, this approach might be appealing. It is mainly based on the balance between two competing parameters: the confidence level and the interval width. If the confidence level is increased, the interval width will also increase, which means less information about the true rate. Given the confidence level and the interval width, it is possible to determine the related minimal population size. In a large population or for incidence rates not too small, the Poisson probability distribution can be approximated by the Normal distribution; in this case, estimation of the minimal population size (N) can be calculated using the following relation:

$N >= (2z_{\alpha/2})^2 \, p(1-p) / w^2$

where

p = attack rate estimate;

$p(1-p) = \sigma$ = standard deviation estimate;

α = significance level; in this context a factor specified by the confidence level, e.g. $\alpha=0.05/2$ would correspond to a 95% confidence interval;

z = refers to the use of the standard Normal distribution for deriving probabilities;

w = the chosen absolute interval width.

For example, in a large population with an attack rate of 44.1 / 10,000, given the significance level of 5% (α, two tailed test), and an absolute interval width of 20% of the attack rate, the minimal population size needed is approximately 87,000:

$N>= (2*1.96)^2 *0.00441*(1-0.00441) / (0.00441*20/100)^2 >= 86,727$

Estimating the population size needed for monitoring time trends in event rates is important and the results may limit the number of possible areas able to produce stable trend estimates. What matters is the annual number of events, and not the population size; in high attack rate

countries, smaller populations can be studied and in low attack rate areas larger ones would be needed. The limitations of using less than ideal sizes of populations for study could be reduced by:

i) accepting a higher threshold for the annual rate of change than those used in the example of 2% per year. This would be relevant to areas with low but rapid rates;

ii) increasing alpha and beta to lower the sample size. This would lower the power below 80% and/or increase α , the significance level, from 5% to 10%;

iii) pooling:

(a) results from age groups down to 25 (small effect on numbers);

(b) results from the age groups beyond 74 (large effect);

(c) combining data from both sexes (moderate effect);

(d) combining data from two or more geographically separate areas within one country establish trends, while studying them separately for other purposes;

(e) combining data within collaborative projects for centres in different countries, matched for certain characteristics such as initial event rates, risk factor trends, socio-economic characteristics, or health services.

While pooling data will increase numbers, it may conceal important information.

It is recommended that the minimum period of observation is one complete calendar year because of possible seasonal variations.

TABLE 5 Minimal size of low and high risk population under surveillance required for fatal and nonfatal coronary and stroke events, ages 45-74 years

Attack Rate percent variation (t %)	Events	Attack rate (x 10,000) Men	Attack rate (x 10,000) Women	Male and Female population required according to gender specific attack rates: Male population	Male and Female population required according to gender specific attack rates: Female population	Total population required using EU standard population structure: Total pop based on MEN	Total population required using EU standard population structure: Total pop based on WOMEN	Total population required after 10 years under the assumption of continuous attack rate decrease: Total pop based on MEN	Total population required after 10 years under the assumption of continuous attack rate decrease: Total pop based on WOMEN
2%									
Total Coronary Events Attack rates									
Italy	314	44.1	12.8	71,192	245,277	444,948	1,532,984	544,563	1,876,191
Finland	314	272.7	116.9	11,512	26,846	71,948	167,789	88,056	205,354
Total Cerebrovascular Accidents Attack rates									
Italy	314	33.5	20.3	93,718	154,658	585,737	966,611	716,873	1,183,017
Finland	314	112.0	61.2	28,044	51,317	175,276	320,730	214,517	392,536
1%									
Total Coronary Events Attack rates									
Italy	1256	44.1	12.8	284,767	981,110	1,779,791	6,131,937	1,967,964	6,780,251
Finland	1256	272.7	116.9	46,047	107,385	287,794	671,157	318,222	742,116
Total Cerebrovascular Accidents Attack rates									
Italy	1256	33.5	20.3	374,872	618,631	2,342,949	3,866,443	2,590,663	4,275,232
Finland	1256	112.0	61.2	112,177	205,267	701,104	1,282,921	775,229	1,418,560

4.3.6 Diagnostic criteria of AMI/ACS

The selection of **diagnostic criteria** for the validation of AMI/ACS was another complex issue which required debate.

After discussion, a general agreement was reached on the diagnostic criteria to recommend in the Manual for the validation of a sample of fatal and non fatal events in order to evaluate the PPV of codes selected for the definition of event.

The MONICA diagnostic criteria, based on symptoms, enzymes, ECG and, if possible, autopsy are highly recommended as they can be applied also for validating sudden deaths occurring outside hospital. The ESC/ACC diagnostic criteria, the American Heart Association (AHA) criteria and the British Cardiac Society (BCS) diagnostic criteria are also reported below.

A complete overview of the diagnostic criteria of AMI/ACS is available on the EUROCISS website http://www.cuore.iss.it/eurociss/en/progetto/progetto.asp

MONICA Criteria (1983-84)

The MONICA core study is concerned with coronary events and with two characteristics of the events, apart from their diagnostic category, which are whether they are (a) first or recurrent, and (b) fatal or non-fatal. Each episode must have a defined duration. In the MONICA core study a period of 28 days is used to establish the case-fatality and to distinguish two events from each other.

MONICA Algorithm

The MONICA algorithm classified the event according to location and duration of symptoms, evolution of injury current through ECG findings, variation within 72 hours of cardiac enzyme values and history of IHD, and, if performed, necropsy interpretation in fatal cases, to assign each event to one of the following

MONICA diagnostic categories.

a) *Definite AMI*: definite ECG; probable ECG with abnormal enzymes and symptoms which are typical, atypical; ischaemic or uncodable ECG or ECG not available, with abnormal enzymes and typical symptoms; fatal cases with definite findings in autopsy - recent acute MI or recent coronary occlusion.

b) *Possible AMI*: non-fatal events with typical symptoms whose ECG and enzyme results do not place them in the category 'definite' and in whom there is no good evidence for another diagnosis of the attack; fatal events where there is no evidence for another cause of death clinically or at autopsy, with symptoms typical, atypical or inadequately described, or without typical, atypical or inadequately described symptoms but with evidence of chronic IHD at necropsy, or with a good history of chronic IHD.

c) *Ischaemic cardiac arrest with successful resuscitation:* spontaneous cardiac arrest not provoked by medical intervention or gross physical insult, from presumed primary ventricular fibrillation secondary to IHD in the absence of significant valvular disease or cardiomyopathy.

d) *Insufficient data (unclassifiable):* fatal events with no autopsy, no history of typical, atypical or inadequately described symptoms, no previous history of chronic IHD and no other cause of death.

For a more complete overview of MONICA criteria consult the following publication**:** *World Health Organization: WHO Monica Project: MONICA manual. Part IV: Event Registration.* *http://www.ktl.fi/publications/monica/manual/part4/iv-2.htm#s1-1*

WHO Criteria (1971)

World Health Organization criteria for AMI

1. Definite ECG or

2. Symptoms typical or atypical or inadequately described, together with probable ECG or abnormal enzymes or

3. Symptoms typical with abnormal enzymes with ischaemic or non-codable ECG or ECG not available or
4. Fatal case, whether sudden or not, with naked eye appearance of fresh MI, recent coronary occlusion found at necropsy, or both

For a more complete overview of WHO criteria consult the following publication**:** *'Myocardial infarction community registers : results of a WHO international collaborative study coordinated by the Regional Office for Europe. Copenhagen : Regional Office for Europe, World Health Organization, 1976'*

ESC/ACC Criteria (2000)

Criteria for definition of acute, evolving or recent myocardial infarction

Either one of the following criteria satisfies the diagnosis for an acute, evolving or recent MI:

(1) Typical rise and gradual fall (troponin) or more rapid rise and fall (CK-MB) of biochemical markers of myocardial necrosis with at least one of the following:

(a) ischaemic symptoms;

(b) development of pathologic Q waves on the ECG;

(c) ECG changes indicative of ischemia (ST segment elevation or depression); or

(d) coronary artery intervention (e.g., coronary angioplasty).

(2) Pathologic findings of an acute MI.

Criteria for established MI

Any one of the following criteria satisfies the diagnosis for established MI:

(1) Development of new pathologic Q waves on serial ECGs. The patient may or may not remember previous symptoms. Biochemical markers of

myocardial necrosis may have normalized, depending on the length of time that has passed since the infarct developed.
(2) Pathologic findings of a healed or healing MI.

For a more complete overview of ESC/ACC criteria consult the following publication**:** *The Joint European Society of Cardiology/American College of Cardiology Committee. Myocardial infarction redefined. A consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the Redefinition of Myocardial Infarction. Eur Heart J 2000; 21: 1502-1513.*

American Heart Association Criteria (2003)

Case definitions for Acute Coronary Heart Disease in Epidemiology and Clinical Research Studies

Classification of AMI

	Biomarker Findings							
	Cardiac Symptoms or Signs Present				***Cardiac Symptoms or Signs Absent***			
ECG Findings	Diagnostic	Equivocal	Missing	Normal	Diagnostic	Equivocal	Missing	Normal
Evolvine diagnostic	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite
Positive	Definite	Probable	Probable	No	Definite	Probable	Possible	No
Non specific	Definite	Possible	No	No	Definite*	Possible	No	No
Normal or other ECG findings	Definite	Possible	No	No	Definite*	No	No	No

Classification of case is at highest level allowed by combinations of 3 characteristics (cardiac signs and symptoms, ECG findings, biomarkers).
*In absence of diagnostic troponin, downgrade to possible.

Definitions of IHD

The definition of a IHD case depends on symptoms, signs, biomarkers, and ECG and/or autopsy findings. These data may vary in quantity, quality, and timing. On the basis of the extent and diagnostic quality of data, definite, probable, and possible cases of fatal and nonfatal AMI, procedure-related events, and AP are defined. The recommendations emphasize biomarkers in a setting in which signs, symptoms, and/or ECG findings suggest acute ischemia.

For a more complete overview of AHA criteria consult the following publication: *Luepker VR, Apple FS, Chistenson RH, Crow RS, Fortmann SP, Goff D, Goldberg RJ, Hand MM, Jaffe AS, Julian DG, Levy D, Manolio T, Mendis S, Mensah G, Pająk A, Prineas R, Reddy S, Roger V, Rosamond WO, Shahar E, Sharrett R, Sorlie P, Tunsall-Pedoe H. Case definitions for acute coronary heart disease in epidemiology and clinical research studies. Circulation 2003; 108: 2543-2549.*

Nomenclature for AMI/ACS proposed by British Cardiac Society (2004)

The clinical and cardiac marker manifestations are determined by the volume of myocardium affected and the severity of ischaemia. Despite the similarities in disease mechanism the time course and severity of cardiac complications vary substantially across the spectrum of ACS. Similarly, treatment patterns differ.

BCS proposes that the spectrum of ACS should be subdivided as follows:

ACS with unstable angina

ACS with myocyte necrosis

ACS with clinical AMI.

SPECTRUM OF ACUTE CORONARY SYNDROME (ACS)

	Markers	ECG	Pathology
ACS with unstable angina	Troponin (TnT) and creatine-kinase (CK-MB) undetectable	ST or T non- elevation or transient ST elevation or normal	Partial coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli)
ACS with myocite necrosis	TnT elevation, < 1.0 ng/ml	ST o T elevation or transient ST elevation or normal	Partial coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli), more extended than that provoked by angina
ACS with clinical myocardial infarction	TnT elevation, > 1.0 ng/ml +/- CK-MB elevation	ST elevation or ST non-elevation or T inversion: may evolve Q waves	Complete coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli)

BCS recommends that the term ‘‘unstable angina’’ should be reserved for patients with a clinical syndrome, but with undetectable troponin or CK-MB markers.

Unstable angina requires supporting evidence of coronary disease (abnormal ECG or prior documented coronary disease).

The term ‘‘ACS with myocyte necrosis’’ should be reserved for patients with a typical clinical syndrome plus an increased troponin concentration below the diagnostic threshold (that is, troponin T < 1.0 ng/ml or AccuTnI < 0.5 ng/ml)

The term ‘‘clinical MI’’ should be reserved for patients in the context of a typical clinical syndrome and a marker increase above the diagnostic threshold.

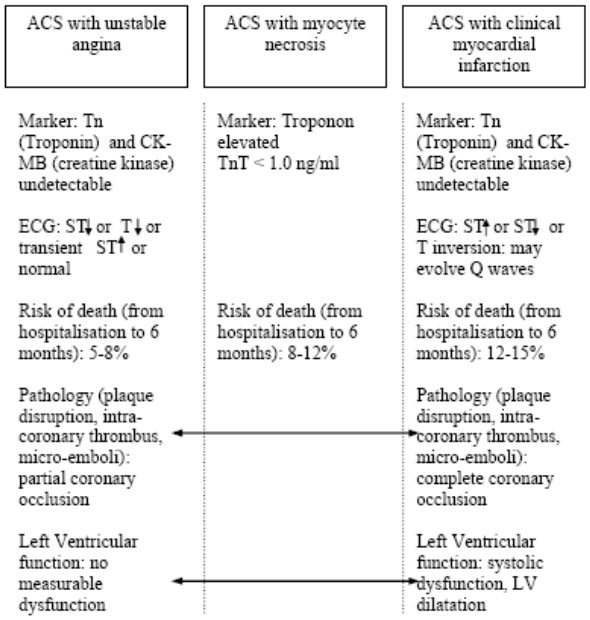
BCS proposes that the threshold for defining clinical AMI be set at 1.0 ng/ml for troponin T or 0.5 ng/ml for AccuTnI (or equivalent threshold with other troponin I methods).

Therefore, BCS recommends that in the context of a typical ACS clinical MI should be diagnosed when the maximum troponin T increase is > 1.0 ng/ml or AccuTnI > 0.5 ng/ml (and/or new Q waves develop on the ECG).

Individual laboratories that use other troponin I assays will need to estimate an equivalent troponin I concentration.

It is well recognised that the myocardium can be damaged after PCI and cardiac markers may increase in up to a third of patients. It is important to bear in mind, just as with spontaneous MI, that cardiac enzyme release after PCI should be integrated with clinical, angiographic, and ECG data to assess prognosis properly. Troponin concentrations should not be considered in isolation. BSC recommends systematic measurement of troponins after PCI (> 6 hours) as part of quality control standards.

The figure reported below describes the spectrum of acute coronary syndrome.



For a more complete overview of BCS criteria consult the following publication: *Fox KAA, Birkhead J, Wilcox R, Knight C, Barth J. British Cardiac Society Working Group on the definition of myocardial infarction. Heart 2004; 90: 603-609.*

4.3.7 Diagnostic Criteria of Stroke

For the population-based register of stroke, it is recommended to validate a sample of fatal and non fatal events in order to evaluate the PPV of codes selected for the definition of event.

In particular, the MONICA diagnostic criteria are recommended.

A complete overview of the diagnostic criteria of stroke is available on the EUROCISS website http://www.cuore.iss.it/eurociss/en/progetto/progetto.asp

MONICA definition

Stroke is defined as rapidly developed clinical signs of focal (or global) disturbance of cerebral function lasting more than 24 hours (except in cases of sudden death or if the development of symptoms is interrupted by a surgical intervention), with no apparent cause other than a vascular origin: it includes patients presenting clinical signs and symptoms suggestive of subarachnoid haemorrhage, intracerebral haemorrhage or cerebral ischaemic necrosis. Global clinical signs are accepted only in cases of subarachnoid haemorrhage or in patients with deep coma. Brain lesions detected by CT-scan but not accompanied by acute focal signs are not accepted as stroke, nor are extradural and subdural haemorrhages. This definition does not include TIA or stroke events in cases of blood disease (e.g. leukemia, polycythaemia vera), brain tumour or brain metastases. Secondary stroke caused by trauma should also be excluded.

The diagnostic classification follows:

(1) Definite focal signs

• unilateral or bilateral motor impairment (including dyscoordination)

• unilateral or bilateral sensory impairment

• aphasis/dysphasis (non-fluent speech)

• hemianopia (half-sided impairment of visual fields)

• diplopia

• forced gaze (conjugate deviation)
• dysphagia of acute onset
• apraxia of acute onset
• ataxia of acute onset
• perception deficit of acute onset.

(2) Not acceptable as sole evidence of focal dysfunction

Although strokes can present in the following way, these signs are not specific and cannot therefore be accepted as definite evidence for stroke.

• dizziness, vertigo
• localized headache
• blurred vision of both eyes
• dysarthria (slurred speech)
• impaired cognitive function (including confusion)
• impaired consciousness
• seizures

On the basis of the background information, each event may be classified into:

Definite stroke

Not stroke

Insufficient data

Insufficient data should be mainly used for fatal cases, especially for cases of sudden death without necropsy.

Cerebrovascular lesions discovered at autopsy are considered for diagnostic category.

All patients having insufficient supporting evidence of stroke, but for whom the diagnosis of stroke cannot be entirely excluded, should be classified as insufficient data, e.g. cases with no necropsy, no documented history of focal

neurologic deficits and no other diagnosis**.** Living patients can be classified into this category if:

• it is impossible to say whether the symptoms were from stroke or from some other disease, e.g. epilepsy, or

• patients with symptoms and clinical findings otherwise typical for a stroke but the duration remaining uncertain.

Subtype definition

Cases identified as 'definite stroke' were classified into stroke subtypes.

The MONICA subtype definition of stroke has to be confirmed by CT-Scan, examination or autopsy.

Subarachnoid Haemorrhage ICD-8 or ICD-9 430 or ICD-10 I60

Symptoms:

Abrupt onset of severe headache or unconsciousness or both. Signs of meningeal irritation (stiff neck, Kernig and Brudzinski signs). Focal neurological deficits are usually not present.

Findings:

At least one of the following must be present additional to typical symptoms.

1. Necropsy - recent subarachnoid haemorrhage and an aneurysm or arteriovenous malformation

2. CT-scan - blood in the Fissura Sylvii or between the frontal lobes or in the basal cistern or in cerebral ventricles

3. CerebroSpinal Fluid (CSF) (liquor) bloody (>2,000 rbc per cm^3) and an aneurysm or an arteriovenous malformation found on angiography

4. CSF (liquor) bloody (>2,000 rbc per cm^3) and xanthochromic and the possibility of intra-cerebral haemorrhage excluded by necropsy or CT-examination

Intracerebral haemorrhage ICD-8 or ICD-9 431 or ICD-10 I61

Symptoms:

Usually sudden onset during activities. Often rapidly developing coma, but small haemorrhage presents no consciousness disturbance.

Findings:

CSF often, but not always bloody or xanthochromic. Often severe hypertension present. Haemorrhage must be confirmed by necropsy or by CT-examination.

Brain infarction due to occlusion of precerebral arteries ICD-8 432 or ICD-9 433 or ICD-10 I65

Symptoms:

May vary.

Findings:

The occlusion must be confirmed by angiography or ultrasound or necropsy.

Brain infarction due to cerebral thrombosis ICD-8 433 or ICD-9 434 or ICD-10 I66

Symptoms:

No severe headache, if at all. Onset acute, sometimes during sleep. Often gradual progression of focal neurologic deficits. Usually, no, or only slight, disturbance of consciousness. TIA can often be detected in history. Often other symptoms of atherosclerosis (IHD, peripheral arterial disease) or underlying diseases (hypertension, diabetes).

Findings:

Brain infarction in the necropsy or in the CT-examination and no evidence for an embolic origin.

OR

CT-scan of satisfactory quality shows no recent brain lesion although clinical criteria of stroke are fulfilled.

Embolic brain infarction ICD-8 434 or ICD-9 434 or ICD-10 I66

Symptoms:

Abrupt onset, usually completion of the neurologic deficits within a few minutes. Disturbance of consciousness absent or only slight at the onset.

Findings:

As in brain infarction due to cerebral thrombosis, but in addition a source of the embolus must be detectable. The most common origins are:

- arhythmia (atrial flutter and fibrillation)
- valvular heart disease (mitral)
- recent AMI (within previous 3 months).

Remarks

If it is impossible to assign to a definite stroke event one of these sub-categories, the subcategory 'Acute, but ill-defined cerebrovascular disease' should be recorded (ICD code 436). If the clinical criteria for a stroke are fulfilled but a CT-Scan (of satisfactory technical quality) fails to reveal a brain lesion of recent origin, the patient has in all probability suffered an ischaemic stroke. In this case, type of stroke should be coded as 434 (infarction).

For a more complete overview of MONICA criteria consult the following publication: *World Health Organization: WHO Monica Project: MONICA manual. Part IV: Event Registration.* *http://www.ktl.fi/publications/monica/manual/part4/iv-2.htm#s1-1*

WHO criteria

The recommended WHO stroke definition is a focal (or at times global) disturbance of cerebral function, lasting more than 24 hours (or leading to death) with no apparent cause other than that of vascular origin. Transient episodes of cerebral ischemia were excluded by definition. Cerebrovascular lesions discovered at autopsy without having shown clinical manifestations in

life were not registered as stroke. A careful review of the patient's history is required to differentiate a previous stroke from previous Transient Ischaemic Attack (TIA), as the two episodes may be misclassified.

This definition is normally used in longitudinal studies. When possible, incidence studies should register TIA because mild strokes are often misdiagnosed as TIA.

For a more complete overview of WHO criteria consult the following publication: *Hatano S on behalf of the participants in the WHO Collaborative Study on the Control of Stroke in the Community. Experience from a multicentre stroke register; a preliminary report. Bull World Health Organ 1976; 54: 541-553.*

4.3.8 How to collect data

Mortality and HDR data file fields provide the necessary information to identify current events and allow record linkage. To give an example, here below standard forms for collection of mortality and HDR are reported. Basic information needed for record linkage include: PIN (or name and surname), place and date of birth, sex, residence; for the death certificate, place and date of death, underlying and secondary causes of death; for hospital discharge diagnosis, date of admission, date of discharge, underlying and other causes of discharge.

The 28-day survival period is the only basis for the assessment of fatal and non-fatal events: if the patient is alive after 28 days from disease onset, the event is defined as non-fatal; if the patient dies after 28 days from disease onset, the first event is defined as non-fatal, the second one as fatal but ischaemic heart disease is reported as underlying cause of death in the death certificate. If the death occurs within 28 days from disease onset, the first and unique event is defined as fatal.

Record linkage between mortality and hospital discharge records may be subject to reporting bias (e.g: errors in recording PIN or anagraphical data).

MORTALITY			
Field	**Type of data**	**Size**	**Description**
PIN (if available)	Text	10-11	Unique id number
Family name	Text	50	
First name	Text	50	
Date of birth	Date/hour	dd/mm/yyyy	
Place of birth	Text	6	Place of birth code
Sex	Text	1	men; women
Residence	Text	6	Residence code
Date of death	Date/hour	dd/mm/yyyy	
Place of death	Text	6	Place of death code
Died in	Text	1	home; private or public hospital; other
Underlying cause (main)	Text	4	Underlying (main) cause of death code
First cause	Text	4	First cause of death code
Intermediate cause	Text	4	Intermediate cause of death code
Final cause	Text	4	Final cause of death code

HOSPITAL DISCHARGE RECORDS			
Field	**Type of data**	**Size**	**Description**
PIN (if available)	Text	10-11	Unique id number
Family name	Text	50	
First name	Text	50	
Hospital code	Text	6	
Hospital discharge record	Text	8	
Admission date	Date/hour	dd/mm/yyyy	
Fiscal or sanitary code	Text	16	Fiscal or sanitary code
Sex	Text	1	1=men; 2=women
Place of birth	Text	6	Place of birth code
Date of birth	Date/hour	dd/mm/yyyy	
Residence	Text	6	Residence code
Types of admission	Text	1	ordinary; urgent; mandatory
Discharge date	Date/hour	dd/mm/yyyy	
Discharge modality	Text	1	ordinary; voluntary; transfer to other structure; died
Underlying (main) discharge diagnosis code	Text	4	Underlying (main) discharge diagnosis code
Secondary discharge diagnosis code	Text	4	Secondary discharge diagnosis code
Secondary discharge diagnosis code	Text	4	Secondary discharge diagnosis code
Discharge diagnosis code	Text	4	Secondary discharge diagnosis code

4.3.9 Developing the Manuals of Operations for CVD Surveys: discussion issues

Discussion mainly focused on the content of the Manual, in particular on the following issues:

a. minimum Set of questions for HIS (questions on disease, risk factors, use of medication and general questions on age, sex, education, occupation, ethnicity, self-reported health);
b**.** minimum Set of examinations for HES *(*height, weight, waist, hip, blood pressure, blood sampling - no fasting -, total and HDL cholesterol);
c. extra examination for HES (ECG, ECHO-cardiography, ABI, blood sample);
d. characteristics of population under surveillance: age-range; inclusion of institutionalized people subject to available resources; minority ethnic groups to be included; people younger than 35 to be excluded; socio-economic characteristics; ethnic origin and migration level;
e. population sampling: random national samples; boost of group of interest (e.g. ethnic groups, regional groups…..);
f. response rate: study of non-respondents; weight for non-respondents;
g. quality control: validation of questionnaires; validation of measurements (intra- and inter-observer variability); observer specific missing checks.

As for issues a) and b), priorities on a minimum set of examinations and questions to include should be based on public health criteria, starting from a basic set of questions/examinations and building up layers of complexity on the basis of user needs and available resources. A stepwise approach was proposed and is reported below:

Level of recommendation	Health Examination Survey (HES)	Health Interview Survey (HIS)
Minimum data collection	• Height • Weight • Blood pressure • Waist circumference • Non-fasting blood sample (Total cholesterol, HDL cholesterol, glucose)	• Age • Gender • Ethnicity • Social class indicator (income, education, occupation) • Smoking • Angina questions • Previous MI questions • Previous stroke questions • Diabetes • Medication use
Minimum + 1	The above plus • Fasting blood sample (e.g. for glucose) • ECG • Ankle/ brachial index • Clinical examination for HF	The above plus • Physical activity • Diet • Alcohol • Heart Failure questions • Rose questionnaire
Minimum + 2	The above plus • Echocardiography	The above plus • Family history • Quality of life • Use of health services
Minimum + 3	The above plus • Ultrasound of peripheral arteries • Other items pertaining to research question	The above plus • PAD questions • Parity • Other items pertaining to research questions

The debate mainly focused on the importance of validating HIS to get the disease prevalence and on the cost of implementation of HES, which need EU financial support since they are very much expensive and if performed only on sub-samples they might not be representative of whole population.

It was also stressed the importance of placing EUROCISS Surveys within the context of EU HIS/HES surveys to be aware of what is going on in Europe and contribute to CVD surveillance.

It was also suggested:

- to add obesity and diabetes to the list of risk factors since they are increasing throughout Europe;
- to perform fasting blood sampling at least in a sub-sample;
- to add disability to the list of questions;
- to perform HES at least in a sub-sample.

5. DISSEMINATION

The partners, throughout the duration of the Project, participated in national and international meetings related to public health and CVD prevention, contributing with their input to the dissemination of the Project results and giving further visibility to the Community approach.

Here below a list of meetings where the Project results were presented is reported:

- at the Workshop "A Canadian Best Practices system for chronic disease prevention and control" (Toronto Ontario, Canada 10-11 March 2005);
- at the Sixth International Conference on Preventive Cardiology (Foz do Iguassu, Brazil, 21-25 May 2005): "European Cardiovascular Indicators Surveillance Set (EUROCISS): Recommendations for monitoring cardiovascular disease";
- at the ESC Congress 2005 (Stockholm, Sweden, 3-7 September 2005): "Population-based registers of Myocardial Infarction in Europe: results of the EUROCISS Project";
- at the EUPHA 13th European Conference on Public Health (Graz, Austria, 10-12 November 2005): "The EUROCISS Project: development of cardiovascular morbidity indicators for the European Community" *(S Giampaoli, M Madsen, P Primatesta, A Pajak, S Sans on behalf of the EUROCISS Research Group. European Journal of Public Health, Vol 15. Suppl 1, 2005: 20)*;

"Cardiovascular registers in Europe: results from EUROCISS Project" *(S Giampaoli, M Madsen, P Primatesta, A Pajak, S Sans on behalf of the EUROCISS Research Group. European Journal of Public Health, Vol 15. Suppl 1, 2005: 153);*

- at the Helsingborg Consensus Conference 'European Stroke Strategies (Helsingborg, Sweden March 22-24, 2006): "The EUROCISS Project: recommended indicators for monitoring stroke in Europe";
- at the EUROPREVENT Congress (Athens, Greece 10-13 May 2006): "EUROCISS: recommendations for coronary event surveillance in Europe" ;

"The EUROCISS Project: development of standardized measure for monitoring Coronary Heart Disease in Europe" *(M Madsen on behalf of the EUROCISS Research Group. European Journal of Cardiovascular Prevention and Rehabilitation, Vol 13, Suppl 1, 2006: S67).*

- at the European Congress of Epidemiology (Utrecht, The Netherlands, 28 June-1 July 2006): "Population-based Registers for Myocardial Infarction in Europe: results from EUROCISS Project";
- at the ESC Congress 2006 (Barcelona, Spain, 2-6 September 2006): "Population-based Registers in Europe: results from EUROCISS Project";
- at the EUROPREVENT Congress (Madrid, Spain, 19-21 April 2007). Four presentations within a Specialist symposium entitled: "The EUROCISS Project: Recommendations for cardiovascular surveillance in Europe": 1) How to make routine data comparable across Europe; 2) Population-based AMI registers; 3) CVD Surveys; 4) Population-based stroke registers;
- at the ESC Congress 2007 (Wien, Austria, 1-5 September 2007): "Results and recommendation from EUROCISS-AMI"; "Results and recommendation from EUROCISS-Stroke";
- at the 15th European Conference on Public Health (EUPHA, Helsinki, Finland 11-13 October 2007) within the Symposium of the TFMCD: "The EUROCISS Project: recommendations for myocardial infarction and stroke population-based registers implementation". *(S Giampaoli on behalf of the EUROCISS Research Group. European Journal of Public Health, Vol 17, Suppl 2, 2007: 14)*

A section illustrating the dissemination of the Project results is available on the website (http://www.cuore.iss.it/eurociss/progetto/progetto.asp).

Regarding the Manuals of Operations, which represent the major achievement of the EUROCISS Project 2nd phase, the EUROCISS Research Group commonly decided to submit them to the European Journal of Cardiovascular Prevention and Rehabilitation

(EJCPR). The Journal represents one of the best channels for the dissemination of information on CVD prevention and surveillance in Europe.

Before publication, the three manuals were submitted to three external reviewers for a final and objective evaluation. The Manual of Operations of AMI/ACS population-based registers was reviewed by Prof. Shanti Mendis from WHO; the Manual of Operations of Stroke population-based registers by Prof. Birgitta Stegmayr and the Manual of Operations of CVD Surveys by Prof. Maurizio Trevisan.
Minor comments were made by the reviewers who overall considered the Manuals of Operations a useful and interesting product.

Publication was accompanied by a foreword prepared and signed by the members of the 'Prevention and Health Policy' Section of the European Association for Cardiovascular Prevention and Rehabilitation (EACPR) within the European Society of Cardiology.
The Manuals have been published on behalf of the EUROCISS Working Group in November 2007 as Supplement in the European Journal of Cardiovascular Prevention and Rehabilitation *Vol 14 (Suppl 3): S1-S61* (visit the Journal website www.jcardiovascularrisk.com/)

- M Madsen, V Gudnason, A Pająk, L Palmieri, EC Rocha, V Salomaa, S Sans, K Steinbach, D Vanuzzo on behalf of the EUROCISS Research Group. "Population-based register of acute myocardial infarction: manual of operations". European Journal of Cardiovascular Prevention and Rehabilitation, Vol 14, Suppl 3, 2007: S3-S22.

- S Giampaoli, N Hammar, R Adany, C De Peretti on behalf of the EUROCISS Research Group. "Population-based register of stroke: manual of operations". European Journal of Cardiovascular Prevention and Rehabilitation, Vol 14, Suppl 3, 2007: S23-S41.

- P Primatesta, S Allender, P Ciccarelli, A Doring, S Graff-Iversen, J Holub, S Panico, A Trichopoulou, WMM Verschuren on behalf of the EUROCISS Research Group. "Cardiovascular surveys: manual of operations". European

Journal of Cardiovascular Prevention and Rehabilitation, Vol 14, Suppl 3, 2007: S43-S61.

The last version of the Manuals submitted to the Journal for publication is reported in Appendix I.

6. PROJECT PARTICIPANTS

The EUROCISS Project benefited from the close interaction between experts in the field of CVD from many European countries. More specifically, the project was a collaborative effort of 18 different Member States and the European Heart Network. Initially, twelve countries signed the agreement to participate (Austria, Belgium, Finland, France, Germany, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom). Two other countries (Denmark and Greece) joined the project later on. In the year 2004 four further countries (Czech Republic, Hungary, Iceland, Poland) were involved in the Project.

Some experts participated only to the first phase of the Project and were replaced by other experts from the same country; others gave their contribution for the whole duration of the Project.

The Project was coordinated by Simona Giampaoli, Head of Unit of Epidemiology of Cerebro and Cardiovascular Diseases, National Centre for Epidemiology, Surveillance and Health Promotion of the Italian Institute of Health. She availed herself of the support of the following national officials: L. Palmieri, P. De Sanctis, C. Lo Noce, A. Giannelli, C. Donfrancesco, F. Dima.

Three full time researchers, P. Ciccarelli (2004-2007), V. Rebella (April-October 2006), T. Castiello (March-December 2005) were assigned to the activities of the Project and were paid by project funds.

The cooperation among EUROCISS Project partners have produced very fruitful results and will have long term positive implications for future regulation in public health policies concerning the surveillance of CVD throughout European countries.

Here below the list of Project partners with personal details follows (the address reported belongs to the last partner involved):

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7. CONCLUSIONS

The EUROCISS Project has created a network of experts from 18 countries to support CVD surveillance in Europe. Experts from various fields (epidemiology, cardiology, statistics etc.) and Institutions (Institute of Health, Institute of Statistics, Local Sanitary Units) gave their contribution to the construction of a surveillance system which is simple, sustainable and applicable in all EU countries.

The indicators (attack/incidence rate, case fatality, prevalence) recommended by the EUROCISS Project and included in the ECHIM shortlist are able to provide a complete overview of all forms of CVD (fatal and non-fatal acute events occurring suddenly, chronic diseases which develop slowly, events which require hospitalizations and event which do not) and are very useful to detect the complications following acute events (AMI) and plan health care services to fight these chronic conditions. Thanks to advancements in therapy for AMI, the number of hospitalizations for complications, such as arrhythmias and heart failure, has increased.

The methodology recommended for the implementation of population-based registers of AMI/ACS and stroke is derived by the important experience of the MONICA Project, but is simplified to make measurements less expensive. This simplified methodology is based on routine data collection and validation by a team of experts epidemiologists following procedures which are simple and easy to apply.

Thanks to the continuing process of computerization, routine data are available in almost all EU countries but, contrary to common belief, they are not so easy to use. In fact, the process of selection of codes to use for event identification and the validation procedure represent the added value of the EUROCISS Project for a good implementation of an health information system which takes into account disease frequency, distribution and trend in the different countries.

The EUROCISS Project also recommended a minimum set of essential questions to include in HIS to assess chronic conditions causing symptoms and impairment in

daily life and a minimum set of standardized measurements to include in HES to assess cardiovascular functionality.

It should be reminded that a good surveillance system based on validated indicators represents the first step towards planning and evaluating preventive strategies at both population and individual levels.

The application of the recommended standard methodology in all EU countries will result in the availability of reliable, valid and therefore comparable data on CVD morbidity for monitoring disease trend over time.

The EUROCISS Project has therefore provided the basis for an improved future regulation in public health policies concerning the surveillance of CVD throughout Europe.

APPENDIX I

Population-Based Register Of Acute Myocardial Infarction: Manual Of Operations

Population-Based Register Of Stroke: Manual Of Operations

Cardiovascular Surveys: Manual Of Operations

POPULATION-BASED REGISTER OF ACUTE MYOCARDIAL INFARCTION: MANUAL OF OPERATIONS

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CONTENTS

ABBREVIATIONS

ACC = American College of Cardiology
AMI = Acute Myocardial Infarction
ACS = Acute Coronary Syndrome
AHA = American Heart Association
BCS = British Cardiac Society
CABG = Coronary Artery Bypass Graft
CK-MB = Creatine-Kinase
CVD = Cardiovascular Disease
DALY = Disability Adjusted Life Year
DRG = Diagnosis Related Groups
ECG = Electrocardiogram
ECHIM = European Community Health Indicators Monitoring
ESC = European Society of Cardiology
EU = European Union
EUROCISS = European Cardiovascular Indicators Surveillance Set
EUROSTAT = Statistical Office of the European Communities
GP = General Practitioner
HDR = Hospital Discharge Records
HES = Health Examination Survey
HIS = Health Interview Survey
ICD = International Classification of Disease
IHD = Ischaemic Heart Disease
MDC = Major Diagnostic Categories
MI = Myocardial Infarction
MONICA = MONItoring trends and determinants of CArdiovascular diseases
OECD = Organisation for Economic Cooperation and Development
PCI = Percutaneous Coronary Intervention
PIN = Personal Identification Number
PTCA = Percutaneous Transluminal Coronary Angioplasty
WHO = World Health Organization

1. INTRODUCTION AND RATIONALE

1.1 Burden of disease

Cardiovascular disease (CVD) is the leading cause of death and hospitalisation in both genders in nearly all countries of Europe. In the European Union (EU)[1] 46% of women and 39% of men die from CVD (Figures 1 and 2) [1].

CVD clinically manifests itself in middle life and older age after many years of exposure to unhealthy lifestyles (smoking habit, unhealthy diet, physical inactivity) and risk factors (total and low-density lipoprotein cholesterol, blood pressure, diabetes). Even though the clinical onset is mainly acute, CVD often evolves gradually. Contrary to common belief of a sudden death and hence of a death free of suffering, CVD causes substantial loss of quality of life, disability, and life long dependence on health services and medications.

For many years CVD mortality has been decreasing in the majority of Western European countries and during recent years this decrease has occurred also in Eastern Europe [2]. However, the absolute number of patients in need of using health services for CVD conditions does not decrease to the same extent because prevalence tends to increase, and this is due to an increase in survival and an increasing proportion of older people in the population. In particular, coronary heart disease is bound to become a more frequent disease of older women [3].

CVD has major economical consequences as well as human costs.

CVD alone accounts for 20% of global total DALYs (Disability Adjusted Life Years) in persons older than 30 years [4]. In terms of health, acute events may mean an increasing number of dependent, chronically ill and disabled people: this may cause increasing costs of healthcare and strain the healthcare system.

Among CVD, Ischaemic Heart Disease (IHD) by itself is the single most common cause of death in the EU accounting for 744,000 deaths each year: around one in six

[1]Data refer to the following 25 member States: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

men (17%) and over one in seven women (16%) die from the disease [1].
In the last decade innovations in diagnostic technologies have facilitated diagnosis at earlier phases in the course of the natural history of disease or in presence of less severe tissue damage. The use of new biomarkers, such as the routine introduction of new myocite damage markers (troponins), has required a rethink of the concept of myocardial necrosis and has led to a new and more exhaustive definition of acute coronary syndrome (ACS) [5,6,7].
Coding changes in international disease classification have also posed new challenges for the comparability of disease indicators. All these factors may produce spurious trends in disease frequency, severity, prognosis and subsequent variations in medical practice if not properly controlled with the adoption of updated and valid epidemiological methods.
The magnitude of the CVD contrasts with the usual paucity and poor quality of data available on the incidence and prevalence of CVD, except for few rigorous but limited studies carried out in certain geographical areas.

According to the Organisation for Economic Cooperation and Development (OECD), it does not appear inevitable that longer life leads to higher healthcare costs. This is one of the reasons why the health system should be largely oriented toward work on preventive actions. Epidemiological studies have shown that IHD is preventable to a large extent. Different preventive strategies can be implemented to reduce the occurrence and impact of IHD, such as the identification of individuals at high risk, and to intensify treatment in those people who have already experienced a coronary event.

At the European level, the World Health Organization (WHO), OECD and the Statistical Office of the European Communities (EUROSTAT) collect simple CVD indicators (mortality, hospital discharge rates) and process them into tables available on web-site (www.euro.who.int/hfadb; www.oecd.org; www.europa.eu.int/comm/eurostat). These data are rarely comparable due to the different methodology and the peculiar health system of each country.

1.2 Disease register

The objectives of a AMI/ACS population-based register is to (a) evaluate the frequency, distribution and prognosis of the disease providing indicators, such as attack rate, incidence rate, prevalence and case-fatality rate; (b) evaluate trends and changing pattern, outcomes and treatment effectiveness; and (c) monitor CVD prevention programmes. If survival rates are assumed to be known, prevalence can also be estimated.

Focusing on general population, a AMI/ACS register may provide a comprehensive picture of this disease in the community, highlight problem areas and suggest where treatment facilities are most in need of improvement. This register may also provide information system needed to plan healthcare services and to develop and test which methods are most useful as a basis for preventive actions.

A population-based register includes all cases in a defined population, whether treated at home or in hospital, in whichever season of the year or time of the day they may occur, and would also include rapidly fatal cases unable to reach the medical service.

Therefore, it is desirable that collection of information on suspected events and application of diagnostic criteria follow a standardised methodology in order to enable data comparison in different areas or between different countries.

To summarise, a population-based register is intended for health professionals and policy makers and provides the means to understand the characteristics, the burden and the consequences of the disease in the population through:

- the monitoring of the occurrence of the disease (i.e. to assess population differences and trends in attack and incidence rates and in mortality over time);
- the understanding of the differences and changes in the natural disease dynamics between genders, age groups, social classes, ethnic groups etc.;
- the identification of vulnerable groups;
- the monitoring of in- and out-of-hospital case fatality;
- the assessment of relations between disease incidence, case-fatality and mortality;
- the monitoring of the consequences of disease in the community in terms of drug

prescriptions and rehabilitation;

- the monitoring of the utilisation of new diagnostic tools and treatments and their impact.

This is crucial in order to:

- develop health strategies and policies;
- plan health services and health expenditures;
- improve appropriate allocation of resources;
- evaluate the effectiveness of interventions.

A register must be validated. Validation provides the means to:

- take into account bias from diagnostic practices and changes in coding systems;
- trace the impact of new diagnostic tools and re-definition of events;
- ensure data comparability within the register (i.e. different sub-populations, different time points, etc);
- ensure data comparability with other registers within and between countries.

1.3 Historical background

The first experience of population-based registers in the field of cardiovascular disease were the *WHO Myocardial Infarction Community Registers* in 1967 [8]; they were implemented by a group of experts convened by the WHO Regional office for Europe to (a) evaluate the extent of AMI in the community; (b) monitor the effect of changes in the management of AMI and different kinds of intervention; (c) provide an assessment of the validity of mortality statistics; (d) select a pool of patients who could be studied in detail and focus attention on specific problem areas. The register examined the incidence of myocardial infarction (MI) and the influence of smoking, obesity and hypertension on MI to show which people in the community were specifically at risk.

The WHO Myocardial Infarction Community Registers were followed by the *WHO MONICA Project* (MONItoring trends and determinants in CArdiovascular diseases) [9] which was indeed designed to answer key questions on decline in coronary heart disease mortality, in particular which part was attributable to survival improvement

and coronary-event decline as a consequence of risk factors reductions and improving coronary care.

During 10 years of surveillance of 37 populations in 21 countries 166,000 events were registered. The mean annual decrease in official coronary mortality rates (based on death certification) was -4% in men and -4% in women. By MONICA criteria, IHD mortality rates were higher but fell less (-3% and -2%). Changes in non-fatal rates were smaller (-2% and -1%). MONICA coronary-event rates (fatal and non-fatal combined) fell more (-2% and -1%) than case fatality (-1% and -1%). Contribution to changing IHD mortality varied, but in populations in which mortality decreased, coronary event rates contributed two thirds and case fatality one third [10].

1.4 Existing registers in Europe – an overview

The data collection for the international MONICA study ended in 1994/95. Some countries continued to collect data every year, while others only periodically (usually every 5 years).

Presently, the existing registers in Europe adopt different data collection procedures: some registers are based on the procedures used in the MONICA study, others on administrative databases with or without record linkage, some are national and some are regional. Different age groups are covered, the degree of validation of the diagnostic information varies and in most registers is much less intensive than in the MONICA study [11].

Tables 1, 2 and 3 give a brief overview of the existing AMI/ACS registers in Europe. Table 1 shows the national registers in the Northern countries, which are all based on record linkage between routine databases (hospital discharge records and cause of death registers).

Table 2A and 2B show regional population-based registers: most of them are based on a disease specific data collection comparable to the MONICA registers, while the others are based on different data collection methods.

Table 3 shows registers based on data from healthcare institutions such as General

Practitioner (GP) and hospitals. These registers do not include out-of-hospital fatal events (sudden death), therefore they are not intended to assess disease occurrence but rather to evaluate outcome and survival of patients.

2. OBJECTIVES

The purpose of the EUROCISS Project is to provide a general guide and updated methods for the surveillance of AMI/ACS to those EU countries which lack appropriate surveillance systems and therefore wish to implement a population-based register in order to produce comparable and reliable indicators.

Taking into account developments in new diagnostic criteria, treatment and information technologies in recent years, this manual provides a standardised and simple model for the implementation of a population-based register. It recommends to start from a minimum data set and follow a step-wise procedure based on standardised data collection, appropriate record linkage and validation methods.

This manual is intended for investigators, health professionals, policy makers and data collection staff interested in the surveillance of AMI/ACS.

Although in many countries data extracted from some sources of information (mortality and hospital discharge records [HDR]) are now available thanks to the continuing process of computerisation, they are rarely reliable and comparable. These data can produce reliable indicators only if properly processed and validated by independent epidemiological sources.

This manual represents a valid tool to build the core indicators (attack rate, incidence, case fatality) recommended by the EUROCISS Project Research Group for inclusion in the short list of health indicators set up by the European Community Health Indicators Monitoring (ECHIM) Project. This Project was launched in 2005 with the aim of implementing health monitoring in EU [12].

3. STRATEGY FOR SURVEILLANCE

3.1 Surveillance methods and types of registers

Surveillance is the ongoing, systematic collection, analysis, interpretation and dissemination of health information to health professionals and policy makers. Surveillance, defined as a continuous, and not episodic or intermittent activity, differs from monitoring [13,14].

Disease surveillance in a population can be done using many different data sources (Table 4). Most countries have national databases on causes of death and discharge diagnoses for hospitalised patients. Mortality statistics have for many years been the main tool for comparing health and disease patterns among countries and today still remain the only source of information for some countries. Since the 1950s, the cause of death has been registered according to the International Classification of Disease (ICD). Different classification of disease within versions and different methods of ascertainment have led to problems in comparison between different revisions of ICD and/or similar versions among countries. In recent years routine statistics have also included discharge diagnoses from hospitalisation and visits to outpatient clinics coded according to the same international classifications as the mortality data.

Some countries have also some kind of Health Interview Survey/Health Examination Survey (HIS/HES). These surveys are primarily used for monitoring prevalence of disease (including IHD, effort angina, old MI), prevalence of risk factors (health behaviour, social network, environmental risk factors) and of disease consequences (disability, reduced physical function, unemployment).

Population-based registers ensure a more precise and valid monitoring of this disease. This register derives from a variety of currently available sources but requires a further level of processing to ensure accuracy.

A population-based register is usually formed through linkage of various sources of information (mortality data, hospital discharge and GP's records) and covers a defined population (entire municipalities, regions or whole country) and a specific age group (35 to74 or 35 to 64 years or all ages).

A population-based register is the best data source for the surveillance of AMI/ACS morbidity and mortality since it considers both fatal and non-fatal events occurring in-and out-of hospital; therefore it provides estimates of key indicators such as attack rate and case fatality. Incidence can be assessed if information on first event is available. If survival rates are available, prevalence can be assessed as well.

Case findings and validation procedures depend on data collection methods, healthcare system, financing system (Diagnosis Related Group, [DRG]) and diagnostic criteria applied in the definition of events. The accuracy of rates produced using a population-based register is related to the completeness and quality control of data collected for numerator (death and hospital discharge registers) and denominator (census or population register). Completeness also depends on tracing subjects treated outside hospital (nursing home, clinic, etc.). A valid population-based register should also collect events in the target population which occur outside the area of surveillance.

The definition of the event must take into account both the ICD codes reported in the hospital discharge diagnoses (main or secondary) or causes of death (underlying or secondary) and the duration of event. This definition is of particular importance since AMI/ACS event may occur more than once and it is therefore necessary to consider both first and recurrent events. In this context, hospital admissions and deaths occurring within 28 days (onset is day 1) are considered to reflect the same event [15] (see definition of event in paragraph 4.1).

A personal identification number (PIN) for each subject is a strong tool in linkage procedures between hospital discharge diagnoses, GP's records and death certificates; alternatively, multiple variables (e.g. name, date and place of birth, gender, residence) may be used for record linkage.

Specific AMI/ACS register

The strength of this register lies in the possibility of validating each single event according to standardised diagnostic criteria and collecting disease-specific clinical and paraclinical data [16,17]. The weakness lies in the fact that data collection is

expensive and this kind of registers can usually be maintained only for a limited period of time in a defined population of reasonable size. Another limitation is that local or regional registers may not be representative for the whole country.

Identification of events can be obtained by *hot pursuit or cold pursuit. Hot pursuit* means identifying case admissions to hospital usually within one or two days from event onset and acquiring relevant information by visiting the ward or interviewing the patient. Information bias is minimised by the *hot pursuit* approach as information is collected immediately after the event. The process is very expensive.

Cold pursuit implies the use of routine and delayed procedures, by means of hospital discharge, review of medical and death records. The process is easier and less expensive than *hot pursuit*; the number of cases studied is typically smaller because discharge diagnoses are more precise and specific than those on admission, but there is a possibility of missing important information. Both methods are used to identify suspected events, which are subsequently validated using specific diagnostic criteria.

A specific AMI/ACS register provides the most valuable epidemiological measures for public health initiatives aimed at preventing the disease. It has been used in the WHO/MONICA Project, where uniform criteria for recording CVD have been applied to 37 population in 21 countries for a period of 10 years [10].

Register based on routine databases

Events are identified using mortality data and HDR. This register has existed for many years in the Northern countries, where all individuals are identified by a PIN which allows record linkage between different information sources. It is economical, covers the whole country, all age groups and collects large numbers of events. The main objective of administrative databases is to produce relevant statistics in order to plan health services and healthcare expenditure and to give internationally data on mortality, causes of death and hospital admissions. The register is not primarily planned for research purposes but is increasingly used in epidemiological research. Its strength lies in the fact that it covers the whole country and the completeness is close to 100%. The weakness lies in the fact that data are not standardised to the same

degree as in the disease specific data collection and clinical and paraclinical data available are limited. If used in research, the register based on routine databases needs to be carefully validated. AMI/ACS registers based on administrative data, such as hospital discharges and death certificates, have been employed in Denmark, Sweden and Finland in order to obtain national rates of AMI/ACS incidence, mortality and case fatality [17-24].

Hospital-based register

A hospital-based register provides the number of hospitalisations but do not provide data on less severe events and out-of-hospital mortality. Hence, it cannot directly be used to estimate incidence or prevalence in a defined population.

Even so, case series from hospital-based register present important clinical information about AMI/ACS.

A hospital-based register collects information about hospital patients through surveillance of admission and discharge records. In particular, it provides detailed information on diagnostic and therapeutic procedures and on risk factor levels prior to admission to hospital. One primary objective of this type of register is to assess length of stay, in-hospital treatment and outcome.

3.2 Target population

A population-based AMI/ACS register may cover a whole country; where this is not feasible, the population under surveillance would typically be residents of a defined region in the country. The target population should preferably cover a well defined geographical and administrative area or region for which population data and vital statistics are routinely collected and easily available each year. Both urban and rural areas should be monitored: differences often exist with regard to exposure to risk factors, treatment of predisposing disease and access to facilities.

It is important that all cases among those with residence in the area are recorded even if the case occurs outside the area (*completeness*). In the same way, all cases treated at hospitals within the area but with residence outside the area must be excluded. If

this is not possible, it is important to give an estimate of the magnitude of the loss of cases and establish whether it could be changing and interfering with the validity of the observed trends in the rates over a period of years.

It is also important to consider to what extent an area is representative for the whole country (*representativeness*): it should be representative according to the CVD mortality rate, distribution of risk factors (socioeconomic status and health behaviour) and distribution of health services (specialised hospital, GP).

The population to be monitored should be selected in order to produce estimates of disease rates that are sufficiently robust from a statistical point of view, so that trends can be established and data comparability ensured. In general, it is necessary to select more than one area in order to have a comprehensive picture for the whole country. In such cases, a coordination between the areas is recommended to ensure comparability. The target population should be selected taking the following parameters into account:

Age: the age range covered by the MONICA Project was 35 to 64 years. The EUROCISS Project suggests the wider age-range 35 to 74 years or even up to 84 years of age when possible, considering that more than half of the events occur in patients above 65 years of age. The age groups recommended from EUROCISS Project to present morbidity and mortality are decennia, in particular the age ranges 35 to 44, 45 to 54, 55 to 64, 65 to 74 and, if possible, 75 to 84. If administrative routine data are used, all ages will automatically be included, but for patients above the age of 85 the diagnostic information tends to be less reliable.

Age-standardised rates (35 to 74 and 35 to 84) are recommended using the European Standard Population as reference.

Gender: the differences in AMI/ACS incidence and mortality between men and women are well documented in literature. Therefore, it is important that the same high quality data collection methods are applied to both women and men.

Population size: the size of the population under surveillance is determined by the number of events. The number of events is determined by the definition of the event and the event rate in the age groups included. In most cases the population size has to

be determined on the basis of mortality statistics. Notably, the mortality rate for 'IHD' is greater than that for 'ACS' which is greater than mortality rate for 'AMI'; in addition, the age-specific mortality rate for men is greater than that for women.

This means that in order to estimate attack rates in middle-age subjects with the same degree of precision, the population should be larger for women than for men.

To estimate the size of the population under surveillance for the register, the age range 45-74 years, instead of 35-44 years where few events occur, is taken into consideration. To be eligible to participate to an AMI/ACS population-based register, a minimum of 300 coronary events (fatal and non fatal, men and women together) per year in the population ages 45-74 years is necessary. The minimum of 300 fatal events has been established in order to detect a decrease by 2% in attack rate per year, taking into account that the population to be under surveillance could range between approximately 1.800.000 (all ages) in a low incidence country like Italy and 200.000 (all ages) in a high incidence country like Finland, basing the calculation on female attack rates usually lower than male attack rates.

If more areas are enrolled, it would be desirable that the same number of 300 total events is considered for each single area.

Patient eligibility: a patient is considered eligible for inclusion in a population-based AMI/ACS register only if he/she is resident in the area under surveillance, meets the selected age and had a AMI/ACS event within the defined time period.

3.3 Data sources

To monitor AMI/ACS in the general population, the following sources of information should be available at a minimum: mortality records with death certificates; and, HDR with clinical information.

Some events occur suddenly and are not able to reach the hospital and some non-fatal cases may not be referred to hospital for treatment. Therefore, additional sources are usually needed to achieve complete information on all fatal and non-fatal events: clinical pathology laboratory (autopsy register), nursing home, clinic, emergency or ambulance service, GP, drug dispensing register.

Death certificate

The death certificate provides complete data on fatal events and is collected in a systematic and continuous way in all EU countries. Mortality statistics are easily accessible in all countries but are usually published in a detailed and complete form after 2-4 years.

The format of the death certificate varies from country to country but generally includes personal identification data, date and place of death (i.e. municipality, nursing home, hospital or other) and causes of death (underlying, immediate and contributing). CVD causes of death are coded according to the ICD. Problems of temporal and geographic comparisons derive from the different versions of the ICD adopted over time (7^{th}, 8^{th}, 9^{th}, 10^{th} revision) and from different coding practices in each country. Furthermore, diagnostic criteria for coding death certificates are not defined at international level and ICD versions are updated every 10 years by WHO.

Some countries code the underlying cause of death only.

The reliability of mortality data depends on the completeness and accuracy of the vital registration system of the country as well as the registration and coding of causes of death. When the proportion of deaths coded as “unknown cause of death” is higher than 5%, cause specific mortality data should be used with caution. The accuracy of the recorded causes of death depends on the autopsy rate. This rate varies largely between countries and over time. In some countries the autopsy rate has declined in recent years, which is a problem for the use of mortality statistics in disease surveillance.

Hospital Discharge Records

HDR give the number of hospitalisations for AMI/ACS, which are absolutely necessary to monitor CVD. Moreover, clinical information and medical care reported in hospital documents are important for validation of events. Hospital discharge data are available in most EU countries, but in some countries only as aggregated tables without detailed information on age and gender distribution and without AMI/ACS as separate diagnostic categories.

HDR include personal data, admission date, type of hospitalisation (urgent, ordinary or transfer to other structure) and discharge diagnoses. Hospital discharge diagnoses are coded by ICD codes (currently ICD-9 or ICD-10). For some countries, only a limited number of diagnoses is coded.

Problems in assessment of a specific coronary event may arise when an acute event is followed by a period of rehabilitation or transfer to other wards and the event could be counted more than once.

Discharge diagnoses are not validated on a routine basis and validation studies are necessary to check the diagnostic quality. The validity of a hospital discharge diagnosis may vary on the basis of patient characteristics, geographical region and type of hospital or clinic.

Hospital admission policies vary over time and place; the registration of the most severe cases dying shortly after the arrival to the hospital differs between hospitals, depending on the administrative procedures connected to hospital admissions. HDR may also include patients not resident in the area under surveillance.

The adoption of new diagnostic techniques, such as troponin, may cause major changes in event rates estimated from hospital discharge data.

A further problem may derive from the use of DRG. In some countries, hospital reimbursement is based on the DRG tariff system, which is built on equal-resources criteria and aggregates events in major diagnostic categories (MDC).

Countries using the DRG system are: Denmark, Finland, France, Germany, Italy, Norway, Portugal, Spain and Sweden. In order to assess the occurrence of AMI/ACS, HDR from all hospital departments should be used. If this is not possible, then at minimum, the following departments must be taken into consideration:

- cardiology;
- heart surgery;
- intensive care (an intensive care unit, including any type of acute medical unit);
- medical (a general medical ward, including a geriatric unit);
- rehabilitation (a specialised rehabilitation unit);

- other (other units, e.g. outliers or patients on surgical wards).

Autopsy register

Not all countries perform autopsy on suspected or sudden deaths on a routine basis. Autopsy is performed on violent deaths or on deaths occurring in hospital when clinical diagnosis is undetermined. The first one is performed by a forensic medicine specialist, the second one by a pathologist of the hospital where death occurred. Data from autopsy register refer therefore to a low percentage of deaths but provide a more valid diagnosis to complement the information reported on the death certificate.

Nursing home and clinic

Nursing home and clinic mainly provide data on cases among elderly patients who sometimes get care from these institutions without being admitted to hospital. Therefore, information on events occurring in the nursing home can be critical, especially if the register covers elderly patient up to 84 years of age.

In some countries rehabilitation after an acute event is provided by the rehabilitation clinic which may give information on patients who have received the acute care outside the region.

Emergency and ambulance services

Data provided by emergency and ambulance services are useful to integrate information for register implementation since patients dying from sudden death or experiencing fatal AMI/ACS are not always able to reach the hospital. These services are able to provide data otherwise not obtainable, such as Electrocardiogram (ECG) during the acute phase of the event, blood pressure measurement, level of consciousness and muscular deficit at the time of event occurrence in paucisymptomatic patients recurring to emergency services. The need of very urgent medical treatment often makes information partial but the integration of these data with those from other sources of information contributes to the implementation of the register and event validation.

General Practitioner register

A GP register gives information on those events which do not reach the hospital and for those patients who are hospitalised outside the area of usual residence. This register may also provide an adequate coverage for prevalence of old MI. This network operates in a few countries (e.g. the Netherlands and UK).

GPs network may be affected by selection bias as usually only volunteer GPs participate in studies. For this reason data from GPs network requires validation.

Drug dispensing register

In some member countries, patients may receive comprehensive drug reimbursement under their national sanitary system, and so drug prescriptions can serve as a proxy for disease. Prescribing guidelines for CVD indicate prescription of anti-hypertensives, low-dose aspirin, antiplatelet, antidiabetic and statins. The administration of thrombolytic therapy can also be used as a proxy for disease.

4. METHODS

4.1 Definition of events

The disease under surveillance is *acute myocardial infarction* (AMI: ICD-9 410; ICD-10 I21, I22) and the broader diagnostic group is *acute coronary syndrome* (ACS: ICD-9 410-411; ICD-10 I20.0, I21, I22). *Acute myocardial infarction* is defined as myocardial cell death due to prolonged ischaemia [5,25].

Criteria for AMI/ACS events

The diagnosis of AMI/ACS events is based on symptoms, ECG changes, elevation of biomarkers, and in fatal cases, autopsy findings. Since the early 1980s, the MONICA definition has been used for standardised diagnostic classification of suspected cases of AMI and IHD death (Table 5) [9]. The situation changed with the adoption of more sensitive and specific biomarkers of myocardial injury, first creatine kinase MB mass (CK-MBm) and then the introduction of cardiac troponins (troponin T and troponin I). In the year 2000 the Joint European Society of Cardiology (ESC) and the American College of Cardiology (ACC) created a new consensus document redefining AMI (Table 6) [5].

In 2003 new case definitions were published as American Heart Association (AHA) statement (Table 7) [6].

A more recent classification is proposed by the British Cardiac Society (BCS, Table 8) [7].

Identification of events

Fatal events include: ICD-9 codes 410-414 (ICD-10: I20-I25) as underlying cause of death as these codes include the majority of definite and possible events.

Non-fatal events include ICD-9 codes 410-411 (ICD-10: I20.0, I21,I22) as primary or secondary hospital discharge diagnosis.

Fatal events		
Version	**Codes**	**Disease**
ICD 8	410	Acute myocardial infarction
ICD 9	411	Other acute and subacute forms of ischemic heart disease
	412	Old myocardial infarction
	413	Angina pectoris
	414	Other forms of chronic ischemic heart disease
ICD 10	I 21, I 22	Acute myocardial infarction
	I 20.0	Other acute and subacute forms of ischemic heart disease
	I 25.2	Old myocardial infarction
	I 20	Angina pectoris
	I 25 (excluded I 25.2)	Other forms of chronic ischemic heart disease
Non-fatal events		
Version	**Codes**	**Disease**
ICD 8	410	Acute myocardial infarction
ICD 9	411	Other acute and subacute forms of ischemic heart disease
ICD 10	I 21, I 22	Acute myocardial infarction
	I 20.0	Other acute and subacute forms of ischemic heart disease

Onset and survival

AMI/ACS events are defined as *first ever, recurrent, non-fatal and fatal*:

- *First ever AMI/ACS event:* refers to people who have never had an AMI/ACS event before.
- *Recurrent AMI/ACS event***:** for a new episode of symptoms to be counted as a new or recurrent AMI/ACS event, general AMI/ACS criteria must be met and either:
    - onset is day one (1);
    - a new AMI/ACS occurring after 28 days is a new event.

  If a patient experiences further acute symptoms suggestive of AMI/ACS within 28 days (as stated above) of the onset of a first episode, this second episode <u>is not counted</u> as a new AMI/ACS event. Equally, if a patient experiences further acute symptoms suggestive of AMI/ACS after 28 days (as stated above) of the onset of a first episode, this second episode <u>is counted</u> as a new event.
- *Non-fatal AMI/ACS event*: refers to cases who survived at least 28 days from the onset of the AMI/ACS symptoms.

- *Fatal AMI/ACS event*: refers to cases who died within 28 days of AMI/ACS symptoms onset.

  It should be noted that each event is registered separately.

4.2 Indicators

Attack rate

Attack rate is calculated identifying the events by using primary or secondary hospital discharge diagnoses or underlying cause of death for out-of-hospital deaths. Almost 32% of the patients die before they reach the hospital, and therefore a hospital discharge register alone is not sufficient [26].

Incidence rate

This indicator can be estimated only if information on first event is available.

In Northern countries an event is defined as first if there is no discharge with AMI as primary or secondary diagnosis in-hospital discharge records of the past 7 years.

Case-fatality

Case fatality is the proportion of events that are fatal by the 28^{th} day.

The EUROCISS Project recommends 1 day and 28 day case fatality. All in- and out-of-hospital fatal and non-fatal events are to be considered as denominator.

4.3 Data collection methods

The different types of registers described in section 3.1 use different data collection methods. Registers with disease specific data collection can be divided into population-based registers using record linkage of administrative databases (mortality, HDR) and disease specific registers using hot and cold pursuit for the identification of events.

AMI/ACS population-based register based on routine administrative data

In recent years, the development of computerised record linkage has made it possible to overcome obstacles in linking existing administrative databases. Record linkage methods can be summarised into three broad categories: *manual*, *deterministic* and *probabilistic*.

Manual matching is the oldest, most time-consuming and most costly method. In general, it is not a feasible option when large databases are involved.

Deterministic linkage matches records from two data sets (or two records from different locations in a single data set) using a unique variable (e.g. PIN or hospital chart number) or by full agreement of a set of common variables (e.g. name, gender, birth date).

Probabilistic [27] linkage is used to identify and link records from one data set to corresponding records in another data set (or two records from different locations in a single data set) on the basis of a calculated statistical probability for a set of relevant variables (e.g. name, gender, date of birth). This type of linkage links records with a specified high probability of match. The method requires detailed prior knowledge about various measures of the relative importance of specific identifier values in both files that are to be linked.

The main limitations of record linkage are the difficulty in:

- obtaining administrative files for research purposes: mortality data files are usually available at the National Institute of Statistics, while hospital discharge data are available at the Ministry of Health. These kinds of data are anonymous and therefore do not allow record linkage. Nominal files of both mortality and hospital discharge are available at the regional level or at the sanitary units;
- combining data: missing events are mainly explained by errors in PIN or in name and they lead to unsuccessful record linkage;
- defining and obtaining minimal data set (for mortality: PIN; family and first name; date and place of birth; gender; residence; date and place of death; underlying and secondary causes of death. For hospital discharge diagnosis the same variables should be considered together with admission date and hospital discharge diagnoses);

- obtaining necessary funds for processing large administrative files.

The national AMI registers in the Northern countries use record linkage between Hospital Discharge Registers and Causes of Death Registers as the basis for the register. The linkage as such is easy because of the PIN attached to every citizen in the country.

However, the linkage has to be followed by many specific definitions on how to handle primary and secondary diagnoses, underlying and contributory causes of death, transfer between hospitals with difference in the diagnoses between the admitting hospital and the hospital where the patient is transferred, how to define date of attack, first time events, reinfarctions etc.

Practical suggestions on how to handle these problems has come from the work carried out in Northern countries [23,28,29].

Specific population-based register

Hot pursuit [15]

This method of detecting events involves identifying patients acutely in hospital and interviewing them directly whilst they are under acute care. The problem with this method is that data collection technique is very difficult to standardise (e.g. descriptions of symptoms may vary with the observer). Periods of staff shortages or holidays may lead to loss of cases that cannot be recovered and a large team is needed to search the wards for cases. However, some information may be more complete than that obtainable from case notes.

Notification of events should be instituted on a routine basis checking admission registers on the wards.

While the extreme forms of hot pursuit involve getting the information from the patient acutely, an alternative is to use the hot pursuit method to identify the patients of interest and to mark their notes or list them for review later. An efficient reliable routine is needed for picking up the case notes at an identifiable point in their processing.

A benefit of the hot pursuit method is that information on the diagnosis is collected soon after admission. This has its limitations, however, as initial diagnosis can sometimes be superseded by subsequent tests and other more detailed investigation.

Residents hospitalised outside the area will always have to be registered by cold pursuit, weeks or months later.

Cold pursuit [15]

Use of discharge diagnoses rather than hospital admissions is a more simple system of identifying events for the study. Its advantage is that it can be done months or years after the event but it is limited because the information in the case notes may not be complete and the notes themselves may not be accessible.

Once event has been identified, if validation is required, medical notes should be obtained in order to extract the necessary information from them.

When a register is launched for the first time, a plan for future evaluation of trends is recommended. This can be achieved by continuous surveillance as part of a broader health information system or annual register repeated at 5 to 10 year intervals. The minimum recommended period of observation is one complete calendar year because of possible seasonal variation.

Combined approach

A mix of hot and cold pursuit ensures the most complete identification of coronary events.

Some of the patients must have been identified as soon as possible after symptoms onset with the possibility of direct examination, while the remaining events are based on routine data.

It is difficult to check up on a hot pursuit system several months later, but discharge lists can be used as a backup method to ensure that the hot pursuit method had detected all the diagnosed cases. Residents hospitalised outside the area and other late-detected cases mean that a proportion of events will always have to be registered by cold pursuit, weeks or months later.

5. QUALITY CONTROL

Quality control of registers is extremely important for a valid monitoring and comparison between regions and countries. The quality of the register depends on:

- completeness of cases and completeness of information;
- iInternal validity;
- external validity (representativeness).

5.1 Completeness of cases and completeness of information

Completeness of cases means that all AMI/ACS cases in the target population have been included, i.e. both cases taking place within the region and cases taking place outside the region. The register has also to cover hospitalised cases whenever they occur during day/night or winter/summer as well as cases occurring outside hospital (e.g. sudden death among patients who never reach the hospital).

Completeness of information means that all relevant information has been registered (e.g. place of treatment, date of admission, date of discharge, PIN, gender, hospital discharge diagnostic codes, intervention/procedure codes, department/ward, date of birth).

The most important source of systematic bias in estimating incidence is related to the coverage of event registration. The registration system must attempt to identify all possible cases of the disease that have come to the attention of the existing medical and medico-legal sources. The completeness of event identification and the completeness and availability of information, obtainable for event recording and diagnosis, depend on the existing standard of medical care: if the medical care system misses or misdiagnoses cases, the register cannot remedy the omission.

When the event is defined (codes and duration), it may be easy to identify duplicate coding and to take out information for quality control purposes. Duplicate codes may include events transferred from one ward to another, e.g. for an acute PCI. In some cases the duration of the admission is very short (< 2 days) either because of transferral or because of diagnosis misclassification. These cases may also be picked up for validation.

Cases not admitted to general hospitals are a problem when the registration system is based only on hospital records. Another source of potential loss of identification is private practice: private physicians and hospitals may be less cooperative than those in the public system; in private hospitals the staff may be more sensitive to criticism and anxious to show how they register medical documents.

The identification of fatal events is in some way less difficult than that of non-fatal events. Whereas survivors may be lost in the totality of inhabitants of the surveillance area, death is unequivocal. However, registration of causes of death may be incorrect and needs to be validated and collection of information of deaths occurring outside the area of residence has to be ensured. It is to be expected that some events occur outside hospital. If the proportion of fatal events coded as hospitalised is very high it may indicate incomplete registration of out-of-hospital AMI/ACS deaths.

Identification of potential events may be based on many different data sources. This may involve a considerable amount of record linkage, which is facilitated if PIN is adopted.

Another problem relates to medical records whose quality may be variable: younger patients may have had no other illness episodes and the records may be restricted to the relevant coronary event. In older patient, the identification of the event is more complicated due to the existence of comorbidities.

5.2 Internal validity

The most important question regarding validity concerns the diagnostic information.

The diagnostic criteria for the event definition are valid if they measure the AMI/ACS they claim to measure. Validation evaluates the sensitivity, specificity and predictive value of the registered diagnosis compared to a golden standard. To validate coronary events, the MONICA diagnostic criteria [9], the New Criteria of the Joint ESC/ACC [5], the AHA criteria [6] or the BCS criteria [7] may be applied as golden standard.

Nowadays, the MONICA diagnostic criteria (see Table 2B) are the most widely used for the validation of events from population-based registers. The introduction of the new criteria ESC/ACC, based on biomarker findings (troponin, CK-MB), does not

cover early and other fatal cases, and non-fatal cases where tests are partial, delayed, missing or curtailed [30]. The change in diagnostic criteria for AMI and the introduction of the new concept of ACS does not facilitate comparison and interpretation of trends. A comparison between MONICA diagnostic criteria and the different new criteria [31] has been made and published; it concludes that the AHA definition, when applied using troponins, identifies a sizeable new group of MI patients at high risk of a recurrent event among persons with suspected acute coronary syndrome.

Validation studies of routine statistics have been carried out over the years with heterogeneous results due to differences in methodology or reflecting true differences in the validity of the routinely collected data between countries [17,22,28,29]. Some studies have been carried out comparing community registers with national statistics and data from the MONICA project [23,32]. These findings stress the importance of validating routine mortality and hospital statistics against the national register to determine whether and how they can be used to reflect true attack rates and mortality. Consistency of coding with the diagnosis and consistency of coding/comparability of the information for different areas of the country and over time represent other issues for validation.

If it is not possible to validate all the events included in the disease register or in the mortality routine statistics, the objective for validation should be to evaluate a sample of events. The sample should be distributed along a full year in order to ensure that potential seasonal or other time related variations of diagnostic patterns are traced.

5.3 External validity (representativeness)

It is not essential that the whole country is covered by a surveillance system, but it is essential that the registration of events is complete with regard to events occurring in the target population. It is important to know how representative the register is for the whole country according to the IHD mortality rate, the distribution of risk factors (socioeconomic status and health behaviour) and the distribution of health service (specialised hospital, GP).

For the population chosen there must be good demographic data subject to at least annual revision; inaccuracy may become apparent years after the period being studied because of the results of a decennial national census.

A careful description of the population characteristics may help to describe how representative the target population is for the whole country.

5.4 Methods to evaluate diagnostic quality

Register validation can include examination of each single case or validation based on random samples for diagnostic information, name, age, residence.

Validation has to be carried out by an epidemiological team not involved in the treatment of patients. For local registers with a limited number of cases it may be possible to validate each single event, but registers covering wider areas, for practical reasons, can only validate data based on random samples of suspected cases recorded during a selected period or during some days each month. A selection method consists of choosing some days each month and recording all events, extracted either from hospital discharge or mortality records, which occur in those days. In this way seasonal variation can be traced.

In order to produce validated indicators, a conditio sine qua non is to allow access to personal relevant medical records and routine raw data of health statistics.

In some cases it is possible to validate a register by linking the routine register to an independent data source, e.g. a high quality register for a small area within the region.

Validation of diagnosis in fatal events

A register of AMI/ACS is meant to produce frequency indicators of the acute forms of coronary events and of coronary death. These correspond to ICD-10 codes I 20-25 in the underlying cause of death. However, IHD is often associated to other comorbidities, which might produce occasional miscoding of IHD in national mortality registers, in spite of the ICD coding rules. The percentage of such misclassification varies by country, age and gender. It is necessary to ensure that no true cases are hidden under other diagnoses (false negatives) and hence missed in

AMI/ACS registration. In the validation process it is therefore necessary to review and validate the diagnosis in at least a sample of cases for the following diseases, against the standard chosen, in particular when they are followed by IHD as secondary cause of death: sudden death; heart failure; pulmonary thromboembolism; acute pulmonary oedema; aortic aneurisms; arrythmias; diabetes; hypertension.

Some countries only code the underlying cause of death, while others code all four causes of death. Those who rely on underlying cause of death only should perform validation at least twice in every ten years period and for a full year or on a sufficiently sized sample for a full year. Depending on the percentage of false negative diagnoses for IHD death found in the first validation, decisions should be taken about the intensity and duration of the validation exercise for fatal cases throughout the registration period. A false negative rate above 10-15% should in principle be an indication to perform diagnostic validation of deaths certificates on a continuous basis rather than on a periodic or a sample basis.

Validation of diagnosis in non-fatal events

Registration of non-fatal events are based on both primary and secondary hospital discharge diagnoses. In those countries which register the primary diagnosis only, particular attention should be given to this type of validation. Manual coding of the secondary diagnosis may be necessary during the validation to ensure comparability with other countries and completeness of registration.

There are also elective treatment procedures that might hide ACS.

Many AMI cases are treated during the acute phase with PCI and some of these cases may be identified by the ICD-9CM codes for the interventions: code 36.1 for CABG (Coronary Artery Bypass Graft) and codes 36.01, 36.02, 36.05, 36.06 (stent) for PTCA (Percutaneous Transluminal Coronary Angioplasty). Revascularisation procedures alone are not sufficient to define the acute event.

6. ETHICAL ISSUES

The Helsinki Declaration requires that biomedical research with human subjects must conform to generally accepted scientific principles.

The *"Recommendation n. R (97)5 of the committee of ministers to EU member states on the protection of medical data"* [33] gives guidelines to how medical data can be registered, stored and used in a way that ensure the rights and the fundamental freedoms of the individual and in particular the right to privacy. *(Adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting of the Ministers' Deputies).*

In the following the most important recommendations are presented.

"*Medical data should be collected and processed only by health-care professionals, or by individuals or bodies working on behalf of health-care professionals. Individuals or bodies working on behalf of health-care professionals who collect and process medical data should be subject to the same rules of confidentiality incumbent on health-care professionals, or to comparable rules of confidentiality.*"

Therefore it is essential that a cardiologist or physician (or study nurse) with proven experience in the field of cardiovascular disease is involved in the coordination of the AMI register.

"*Medical data shall be collected and processed fairly and lawfully and only for specified purposes."*

"Medical data may be collected and processed:

a. if provided for by law for:

i. public health reasons; or

ii. subject to Principle 4.8[*], the prevention of a real danger or the suppression of a specific criminal offence; or

[*] Processing of genetic data for the purpose of a judicial procedure or a criminal investigation should be the subject of a specific law offering appropriate safeguards.

iii. another important public interest; or

b. if permitted by law:

i. for preventive medical purposes or for diagnostic or for therapeutic purposes with regard to the data subject or a relative in the genetic line; or

ii. to safeguard the vital interests of the data subject or of a third person; or

iii. for the fulfilment of specific contractual obligations; or

iv. to establish, exercise or defend a legal claim; or

c. if the data subject or his/her legal representative or an authority or any person or body provided for by law has given his/her consent for one or more purposes, and in so far as domestic law does not provide otherwise."

Whenever possible, medical data used for scientific research purposes should be anonymous. Professional and scientific organisations as well as public authorities should promote the development of techniques and procedures securing anonymity. However, if such anonymisation would make a scientific research project impossible, and the project is to be carried out for legitimate purposes, it could be carried out with personal data on condition that:

a. *the data subject has given his/her informed consent for one or more research purposes; or*

b. *when the data subject is a legally incapacitated person incapable of free decision, and domestic law does not permit the data subject to act on his/her own behalf, his/her legal representative or an authority, or any person or body provided for by law, has given his/her consent in the framework of a research project related to the medical condition or illness of the data subject; or*

c. *disclosure of data for the purpose of a defined scientific research project concerning an important public interest has been authorised by the body or bodies designated by domestic law, but only if:*

i. the data subject has not expressly opposed disclosure; and

ii. *despite reasonable efforts, it would be impracticable to contact the data subject to seek his consent; and*

iii. *the interests of the research project justify the authorisation; or*

d. *the scientific research is provided for by law and constitutes a necessary measure for public health reasons."*

Record linkage between mortality and hospital discharge records is possible in countries which have adopted a PIN on a national level. Other nominal data (such as name, gender, date and place of birth) are usually available at a regional level. Record linkage permits to identify the event by matching admissions and discharges or admissions and deaths, thus avoiding double counting, which may occur when, for example, the same patient transferred to another ward (e.g. from cardiology to cardiovascular surgery and then to rehabilitation) is registered in the HDR more than once.

Moreover, the identification of patient is essential for the event validation when it is necessary to collect and examine the history and clinical documentation and to assess case fatality at different intervals (28 days, 6 months, 1 year). Before starting any study, it is recommended to seek approval from the local ethics committee.

7. ECONOMIC CONSIDERATION

Overall IHD is estimated to cost the EU economy over 45 billion euro a year. Of the total cost of IHD, 51% is due to direct healthcare costs, 34% to productivity loses and 15% to the informal care of people with IHD [1]. Cost considerations are essential before implementing a population-based register.

Without a valid surveillance system, it is not possible to plan and evaluate health services for populations, implement interventions for prevention and identify "vulnerable" subgroups in terms of burden of disease such as the elderly, the young, the poor, the unemployed. Surveillance and evaluation mean a systematic way of learning from experience and using it to improve current activities and promote better planning by careful selection of alternatives for future actions and allocation of resources. The economic benefit of a good surveillance system clearly exceeds the cost of the registers.

A population-based register may be costly and to produce meaningful data it needs to be in operation for at least one year, but preferably for some years or continuously. However, the importance of a valid and efficient AMI/ACS register justifies the high implementation costs and the consequent need to find adequate financing.

The register based on record linkage between administrative databases is the most cost-effective, but this register depends on the data quality of the Hospital Discharge Register and the Cause of Death Register and also on the possibility of a valid record linkage. In addition, methods need further evaluation and implementation. Notably, if the hospital discharge and mortality registers are available for record linkage, the costs for the linkage and dissemination of results are low. The main costs for using this methodology for assessment of incidence in a defined population concerns the need to perform regular validations of the diagnostic information. It may be recommended to include a basic epidemiologic research in the costs, which may include analysis of risk factors by linkage to health interview surveys and of treatment effect by linking the register to other data sources (e.g. data on drugs and on invasive procedures). Sometimes access to data produces separate costs.

The register based on a disease specific data collection is more expensive especially if hot pursuit is used. Beside the cost mentioned above, this type of register also needs funding for the detailed prospective data collection and for validation of diagnostic information. The data collection includes: identification of patients, reading medical records, making inquiries to additional data sources, filing and validation of the data. This means that a team of epidemiologists, nurse, medical doctors and informatics dedicated to this work full time is absolutely necessary. It should be recognised that this type of register usually collects information that permits analyses of research questions beyond the monitoring of AMI/ACS incidence, mortality and case fatality. This may concern the role of risk factors for disease occurrence or the role of treatment for survival in patients.

8. IMPLEMENTATION - STEPWISE PROCEDURE

This section describes the procedures required to implement an AMI/ACS register taking into account the recommendations reported in this manual of operations.

The flow chart summarises these procedures (Figure 3).

STEP 1. Define target population and routine data

- Select a geographical administrative area with a population big enough to provide stable estimates. This means that a stable population in a representative area of the country with 300 fatal and non-fatal coronary events in the age range 45 to 74 should be chosen.
- Characterise population from a demographic point of view through a detailed description of the characteristics of the population under surveillance, in particular: demographic characteristics (age and gender distribution); socio-cultural characteristics (educational level, occupation, social group, unemployment rate, migration, immigrants with or without citizenship); characteristics of the healthcare system (specialised hospital, GP, rehabilitation clinic); macro and micro areas (urban and rural). Disease frequency is often different in macro areas of the country; a description of difference in mortality and risk factors allows to select those areas to be included in the surveillance system. Within the population-based surveillance study, the phenomenon of immigration plays an important role, therefore immigrants coming from European and extra-European countries resident in the study area must be enrolled. Geographical or administrative borders of the surveillance areas must be clearly defined.
- Analyse existing Hospital Discharge and Mortality data. Events in non-residents occurring in the study area or admitted to hospital in the study area do not qualify. Events of residents occurring out of the area do qualify. Efforts must be made to find them or to estimate the potential loss and whether or not it could be changing and interfering with the validity of the observed trends in rates over a period of years.
- Identify problems with these data: coverage, ICD version, identification of events,

procedures, unit of analysis (number of events or discharges and/or number of patients), PIN, coherence with previous studies, etc. Data files are usually available at the regional level in detailed forms.

When a register is launched for the first time, a plan for future follow-up to measure trends is recommended. This can be achieved by a continuous surveillance as part of a broader health information system or by annual register repeated at 5 to 10 years intervals.

STEP 2. Perform a pilot study and validate routine data

Before starting an AMI/ACS register or a large scale use of linked administrative data, a pilot study on available hospital discharge and mortality data in a small area is recommended in order to study the feasibility and to estimate internal validity.

Validation studies on available data include:

- estimation of coverage: comparison of different routine data sets (electronic or manual), number of patients treated in- and out-of-area, hospital/mortality ratios, age and gender ratios, principal vs. secondary and/or procedure diagnoses;
- validation of discharge diagnoses according to a standard method (including revision and abstraction of medical records) in a random sample or in all cases;
- validation of mortality causes according to a standard method in a random sample or in all cases;
- analysis of demography and representativeness of the area in comparison with the region or country;
- selection of age range of interest (35 to 74 or 35 to 84).

STEP 3. Carry out record linkage of administrative data

In the Northern countries, where every citizen has a PIN included in national registers of hospital discharges and deaths, record linkage for the identification of AMI/ACS events is efficient and reliable. For countries which have not adopted the PIN it may be much more difficult to perform this step. Files have to be organised with the same

format and include the same variables (family name, name, date of birth, residency and place of birth).

It is recommended to:

- explore the feasibility of record linkage within hospital records - probabilistic or deterministic approach or using PIN (within the same hospital, among hospitals of the area, among hospitals at regional or national level). When hospital records are collected at regional or national level, it is possible to collect events that occur out-of-hospital;
- explore the feasibility of record linkage between hospital records and mortality register (probabilistic or deterministic approach or using PIN);
- explore the feasibility of linkage with other sources of information (e.g. GP, drug dispensing register). Not all GPs are organised in networks, with computerised documentation of patient history; when they are, the definition of events rarely uses the same diagnostic criteria.

STEP 4. Set up an AMI/ACS population-based register

After performing STEP 2 and 3 it is possible to set up an AMI/ACS population-based register following A (record linkage between administrative registers) or B (disease specific data collection).

A. Register based on record linkage between routine administrative data:

- when the linkage procedure between hospital discharge and mortality records is feasible, it is important to define the event, the duration, how to handle transfer between hospitals with difference in the diagnoses between the admitting hospital and the hospital where the patient is transferred, how to define first time events, recurrent events, fatal and non-fatal events etc. (see paragraph 4.1). A linkage system and a control for duplicate records should be set up;
- validation of diagnostic information is recommended in a random sample of sufficient size of the identified events, with the estimation of sensitivity and specificity and positive predictive value of the defined events;

- population data by age and gender of the area under surveillance are needed to estimate incidence, recurrence, attack rate, case fatality and mortality rates;
- periodic validations should be performed.

B. Register based on disease specific data collection:

- set up a pilot population-based register with proven standardised protocol for AMI/ACS and evaluate pilot study results (coverage, completeness of information and diagnostic validity);
- based on the results of the pilot study, set up, if feasible, a full scale register and decide whether to use hot or cold pursuit;
- then, if feasible, design the full-scale register (target population, data collection methods and validation procedures).

To set up a full scale register:

- select one or more populations representative for the region or the country;
- for each selected population set up a population-based register with approved standardised protocol for AMI/ACS;
- write a detailed protocol for the data collection including validation procedures;
- evaluate the coverage and representativeness and completeness of information;
- if relevant, use the results from the register to validate administrative data.

STEP 5 Disseminate results

- Set up a strategy for analysis of data and for dissemination of results to decision-makers, politician and broader population.
- Publish yearly on a web-site indicators of attack rate, incidence, case fatality according to gender and age-standardised with European population as reference (35 to 74 and 35 to 84);
- Use data for research. This is very important to ensure a high quality of the register over time. And a high quality register can be the basis for good research.

Figure1. Deaths by cause, men, latest available year, EU

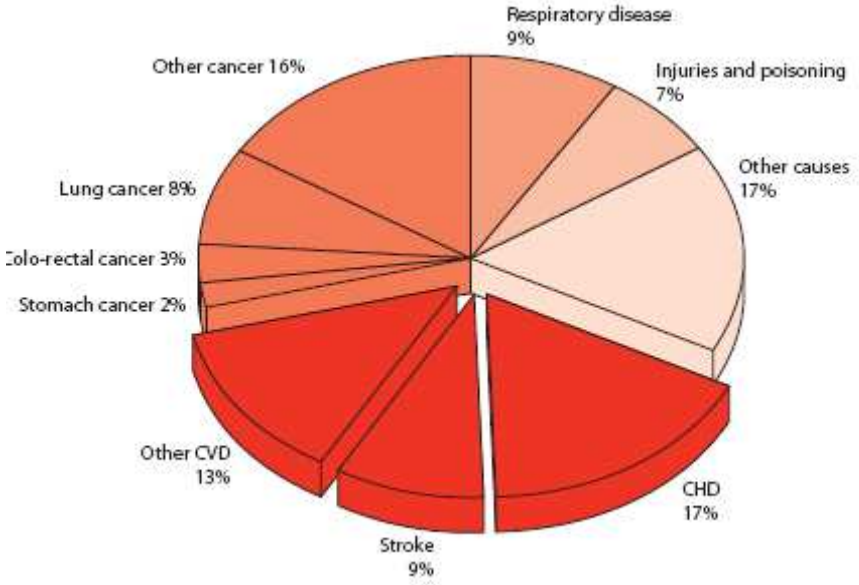
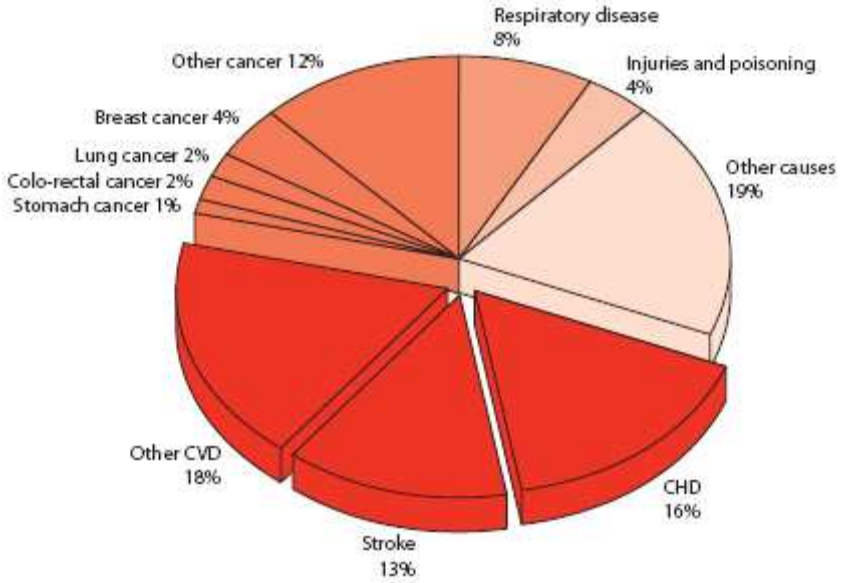


Figure 2. Deaths by cause, women, latest available year, EU



Petersen S, Peto V, Rayner M, Leal J, Luengo-Fernandez R and Gray A (2005). European cardiovascular disease statistics. BHF:London

Figure 3. DESCRIPTION OF STEPWISE PROCEDURE

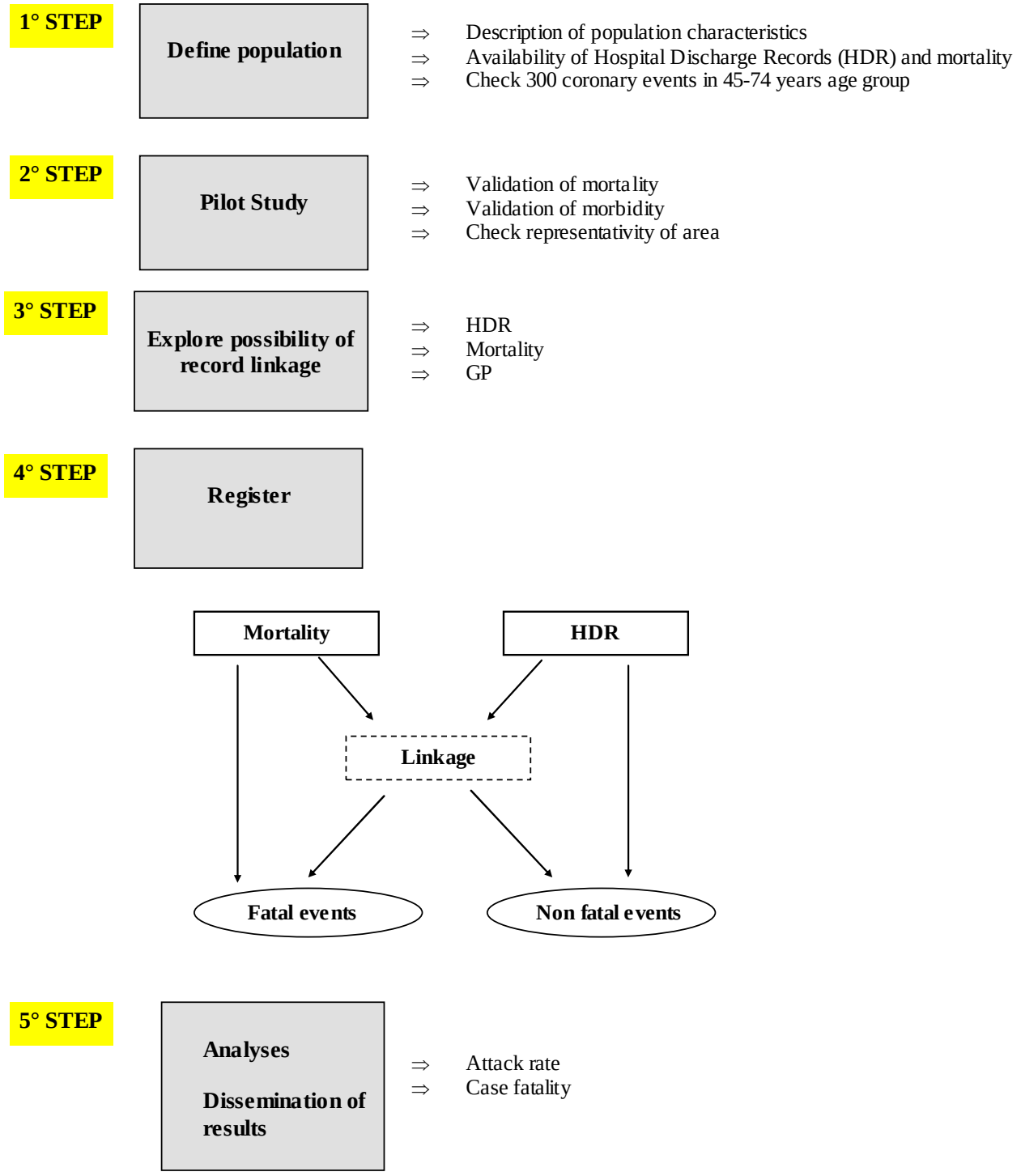


TABLE 1. NATIONAL POPULATION-BASED AMI/ACS REGISTERS

Country	First year available	Last year available	Ongoing registration	Age range	Population (x 1,000)		Access data
					Men	Women	
Denmark	***1978***	***2001***	yes	all	2,677	2,734	NIPH
Finland	***1991***	***2003***	yes	all	2,600	2,600	NIPH
Iceland	***1981***	***2002***	yes	25 to 74	170		NIPH; Icelandic Heart Association
Sweden	1987	2001	yes	all	4,545	4,466	NBHW

NIPH, National Institute of Public Health
NBHW, National Board of Health and Welfare

Source: European J of Public Health 2003; 13 (Suppl 3): 55-60 (updated 2006)

TABLE 2A. REGIONAL POPULATION-BASED AMI/ACS REGISTERS: POPULATION CHARACTERISTICS

Country	First year available	Last year available	Ongoing registration	Age range	Population (x 1,000)		Access data
					Men	Women	
Belgium Charleroi	1983	2003	yes	25 to 69	50	50	School of Public Health
Belgium Ghent	1983	2003	yes	25 to 74	71	71	University of Ghent
Belgium Bruges	1999	2003	yes	25 to 74	75	75	University of Ghent
Denmark Northern Jutland	***1978***	***2001***	yes	all	247	247	Aarhus University
Finland FINAMI	***1993***	***2002***	yes	all	90	103	NIPH
France Lille, Strasbourg, Toulouse	***1985***	***2004***	yes	25 to 64 (until '96); 35 to 74 (from '97)	752	767	INSERM U780
Germany Ausburg	***1985***	***2002***	yes	25 to 74	203	204	National Institute of Statistics
Italy 7 areas	***1998***	***2003***	yes	35 to 74	3,600		Istituto Superiore di Sanità
Norway	1972	2002	yes	all	1,000		Health Region West
Spain 5 areas	1985	1998	no	25 to 74	234	246	Institute of Health Studies
Sweden Northern Sweden	1985	2005	yes	35 to 74	160	162	MONICA

NIPH, National Institute of Public Health
INSERM, Institut National de la Sante et de la Recherche Medicale
MONICA, MONItoring of trends and determinants in CArdiovascular diseases

Source: European J of Public Health 2003; 13 (Suppl 3): 55-60 (updated 2006)

TABLE 2B. REGIONAL POPULATION-BASED AMI/ACS REGISTERS: CASE DEFINITION

		Sources of information			
Country	**ICD version**	**Mortality ICD codes (*)**	**HDR ICD codes (*)**	**Linkage mortality / HDR**	**Validation**
Belgium Charleroi, Ghent, Bruges	IX, X	410-414, 428, 798, 799	410-414, 428, PTCA, CAGB	name, date of birth	*ECG, enzymes, symptoms, MONICA*
Denmark	VIII,X	410	410	ID	no validation
Finland	X	410, 411, 428, 798, 799	410, 411, PTCA, CABG	ID	MONICA, ESC/ACC
France	IX, X	410-414, 428, 798, 799, others	410-414, 428	name, date of birth	MONICA
Germany	X	410-414, 798, 799	410, 411, PTCA, CAGB	name, date of birth	MONICA, ESC/ACC
Italy	IX	410-414, 798, 799, others	410-414	name, date of birth	MONICA
Norway	X	410	410, PTCA, CABG	ID	no validation
Spain	IX	410-414, 428, 798, 799, others	410-414	name, date of birth	MONICA
Sweden	X	410, 411	410, 411	ID	MONICA

(*) all codes are presented in the ICD-9 revision to facilitate comparison

Source: European J of Public Health 2003; 13 (Suppl 3): 55-60 (updated 2006

TABLE 3. INSTITUTIONAL-BASED REGISTERS

NIPH, National Institute of Public Health

Country	Area Coverage	1st Year	Age range	Population (x 1000)		Access data
				Men	Women	
Austria	National	1990	all	1,600		Austrian Health Foundation
Greece	Regional	2003	all	n.a.		Hippokrrateion Hospital, University of Athens Medical School
Hungary	National	1996	all	4,800	5,300	The Centre for Health Information, National Health Insurance Fund, Department of Financial Informatics
Hungary (GP)	Regional	1998	all	125	139	School of Public Health, University of Debrecen
The Netherlands (GP)	Regional	1971	all	12		NIPH - University Nijmegen
Poland	National	2003	all	n.a.		Silesian Centre for Heart Disease
Spain (IBERICA)	Several provinces		35 to 74			Municipal Institute of Medical Research

TABLE 4. METHODS OF SURVEILLANCE OF AMI/ACS

Data sources	Type of registers/health surveys	Data collection	Main indicators
Routine databases	Mortality Hospital registers Drug dispensing registers	National routine databases	Mortality/Hospital Discharges Length of stay Prescribed medications
Surveys	Health interview and health examination	Questionnaire and medical examination of random samples of the population	Prevalence Disability Risk factors
Acute Myocardial Infarction/Acute Coronary Syndrome registers	Population-based	Record linkage between routine databases including cases outside hospital (mortality+hospital discharge records)	Attack rate (Incidence rate) (Prevalence) Case fatality rate Treatment Procedures
		Disease-specific collection of data including fatal and non-fatal cases in and outside hospital by hot/cold pursuit	Attack rate Incidence rate Prevalence Case fatality rate Treatment Procedures Years of life lived with disability Estimate of long-term care needs

Table 5. Criteria for definition of acute myocardial infarction, MONICA Project

a) *Definite AMI*: definite ECG; probable ECG with abnormal enzymes and symptoms (typical/ atypical); ischemic, uncodable or not available ECG, with abnormal enzymes and typical symptoms. Fatal cases with definite findings in autopsy – recent acute myocardial infarction or recent coronary occlusion.
b) *Possible AMI*: non-fatal events with typical symptoms whose ECG and enzyme results do not place them in the category 'definite' and in whom there is no good evidence for another diagnosis of the attack. Fatal events with no evidence for another cause of death (clinically or at autopsy), with typical/atypical symptoms or with evidence of chronic IHD at necropsy, or with a good history of chronic IHD.
d) *Insufficient data (unclassifiable):* fatal events with no autopsy, no history of typical, atypical or inadequately described symptoms, no previous history of chronic IHD and no other cause of death.

For further information, http/www.ktl.fi/publications/monica/manual

TABLE 6. CRITERIA FOR DEFINITION OF ACUTE, EVOLVING OR RECENT MYOCARDIAL INFARCTION – ESC/ACC CRITERIA

Either one of the following criteria satisfies the diagnosis for an acute, evolving or recent myocardial infarction:

(1) Typical rise and gradual fall (troponin) or more rapid rise and fall (CK-MB) of biochemical markers of myocardial necrosis with at least one of the following: *(a) ischemic symptoms* *(b) development of pathologic Q waves on the ECG* *c) ECG changes indicative of ischemia (ST segment elevation or depression); or* *(d) coronary artery intervention (e.g., coronary angioplasty*
(2) Pathologic findings of an acute MI.

Source: Eur Heart J 2000; 21: 1502-1513

TABLE 7. CASE DEFINITION FOR AMI/ACS IN EPIDEMIOLOGY AND CLINICAL RESEARCH STUDIES – AHA CRITERIA

	Biomarker Findings							
	Cardiac Symptoms or Signs Present				***Cardiac Symptoms or Signs Absent***			
ECG Findings	Diagnostic	Equivocal	Missing	Normal	Diagnostic	Equivocal	Missing	Normal
Evolving diagnostic	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite
Positive	Definite	Probable	Probable	No	Definite	Probable	Possible	No
Non specific	Definite	Possible	No	No	Definite*	Possible	No	No
Normal or other ECG findings	Definite	Possible	No	No	Definite*	No	No	No

Classification of case is at highest level allowed by combinations of 3 characteristics (cardiac signs and symptoms, ECG findings, biomarkers).
In absence of diagnostic troponin, downgrade to possible.

Source: Circulation 2003;108: 2543-2549.

TABLE 8. SPECTRUM OF ACUTE CORONARY SYNDROME (ACS) – BCS

	Markers	ECG	Pathology
ACS with unstable angina	TnT and CK-MB undetectable	ST or T non- elevation or transient ST elevation or normal	Partial coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli)
ACS with myocite necrosis	TnT elevation, < 1.0 ng/ml (or AccuTnI<0.5 ng/ml)	ST o T elevation or transient ST elevation or normal	Partial coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli), more extended than that provoked by angina
ACS with clinical myocardial infarction	TnT elevation, > 1.0 ng/ml (or AccuTnI>0.5 ng/ml) +/- CK-MB elevation	ST elevation or ST non-elevation or T inversion: may evolve Q waves	Complete coronary occlusion (plaque disruption, intra-coronary thrombus, micro-emboli)

ACS, Acute Coronary Syndrome
TnT, Troponine T
CK-MB, Creatine-Kinase
BSC recommends systematic measurement of TnT after Percutaneous Coronary Intervention (> 6 hours)

Source: Heart 2004; 90: 603-609.

REFERENCES

1. Petersen S, Peto V, Rayner M, Leal J, Luengo-Fernandez R and Gray A. European cardiovascular disease statistics 2005. BHF: London.
2. Kesteloot H, Sans S, and Kromhout D. Dynamics of cardiovascular and all-cause mortality in western and Eastern Union between 1970 and 2000. Eur Heart J 2006; 27: 107-113.
3. Kattainen A, Salomaa V, Harkanen T, Jula A, Kaaja R, Kesaniemi YA, et al. Coronary heart disease: from a disease of middle-aged men in the late 1970s to a disease of elderly women in the 2000s. Eur Heart J 2006; 27(Suppl 3): 296-301.
4. Strong K, Mathers C, Leeder S, Beaglehole R. Preventing chronic diseases: how many lives can we save? Lancet 2005; 366: 1578-82.
5. The Joint European Society of Cardiology/American College of Cardiology Committee. Myocardial infarction redefined. A consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the Redefinition of Myocardial Infarction. Eur Heart J 2000; 21: 1502-1513.
6. Luepker VR, Apple FS, Chistenson RH, Crow RS, Fortmann SP, Goff D, Goldberg RJ, Hand MM, Jaffe AS, Julian DG, Levy D, Manolio T, Mendis S, Mensah G, Pająk A, Prineas R, Reddy S, Roger V, Rosamond WO, Shahar E, Sharrett R, Sorlie P, Tunsall-Pedoe H. Case definitions for acute coronary heart disease in epidemiology and clinical research studies. Circulation 2003;108: 2543-2549.
7. Fox KAA, Birkhead J, Wilcox R, Knight C, Barth J. British Cardiac Society Working Group on the definition of myocardial infarction. Heart 2004; 90: 603-609.
8. World Health Organisation Regional Office for Europe. Myocardial Infarction Community Registers. Copenhagen: WHO, 1976 (Public Health in Europe report No 5).
9. Tunstall-Pedoe H, Kuulasmaa K, Tolonen H, Davidson M, Mendis S with 64 other contributors for The WHO MONICA Project. MONICA Monograph and Multimedia Sourcebook. Geneva: World Health Organization; 2003.
10. Tunstall-Pedoe H, Kuulasmaa K, Mahonen M, Tolonen H, Ruokokoski E, Amouyel P. Contribution of trends in survival and coronary-event rates to changes in coronary

heart disease mortality: 10-year results from 37 WHO MONICA project populations. Monitoring trends and determinants in cardiovascular disease. Lancet 1999; 353:1547-57.

11. The EUROCISS Working Group. Coronary and Cerebrovascular Population-based Registers in Europe: are morbidity indicators comparable? Results from the EUROCISS Project. European J of Public Health 2003; 13 (Suppl 3): 55-60.
12. European Community Health Indicators Monitoring (ECHIM) Project. http://www.echim.org/ (accessed 16.05.07).
13. WHO STEPS Stroke Manual: the WHO STEPwise approach to stroke surveillance. http://www.who.int/chp/steps/Manual.pdf (accessed 16.05.07).
14. Federici A. Le parole della nuova Sanità. Il Pensiero Scientifico Editore 2002.
15. Tunstall-Pedoe H. Diagnosis, measurements and Surveillance of Coronary Events. Int J Epidemiol 1989; 18 (suppl 1): 169-173.
16. Tunstall-Pedoe H. Problems with Criteria and Quality Control in the Registration of Coronary Events in the MONICA Study. Acta Med Scand Supplementum 1998; 728:17-25.
17. A. Mahonen M, Salomaa V, Keskimaki I et al. The feasibility of routine mortality and morbidity register data linkage to study the occurrence of acute coronary heart disease events in Finland. The Finnish Cardiovascular Diseases Registers (CVDR) Project. Eur J Epidemiol 2000; 16: 701-711.
18. B. Abildstrøm S, Rasmussen S, Rosén M, Madsen M. Trends in incidence and case-fatality after acute myocardial infarction in Denmark and Sweden. Heart 2003; 89: 507-511.
19. C. Rosén M, Alfredsson L, Hammar N, et al. Incidence, mortality and case fatality for acute myocardial infarction in Sweden 1987-1995. Results from the Swedish National AMI Register. J Intern Med 2000; 248: 159-64.
20. D Hammar N, Alfredsson L, Rosén M, et al. A national record linkage to study acute myocardial infarction incidence and case fatality in Sweden. Int J Epidemiol 2001; 30: S30-S34.

21. E Videbæk J, Madsen M. Heart Statistics Denmark 2000-2001. Danish Heart Foundation and National Institute of Public Health, Copenhagen; 2001.
22. F Pajunen P, Koukkunen H, Ketonen M, Jerkkola T, Immonen-Raiha P, et. al. The validity of the Finnish Hospital Discharge Register and the Causes of Death Register data on coronary heart disease. Eur J Cardiovasc Prev Rehabil 2005; 12 (Suppl 2):132-7.
23. G Madsen M, Davidsen M, Rasmussen S, Abildstrøm SZ, Osler M. The validity of the diagnosis acute myocardial infarction in routine statistics. A comparison of mortality data and hospital discharge data with the Danish MONICA registration. J Clin Epidemiol 2003;56:124-13.
24. D Hammar N, Alfredsson L, Rosén M, Spetz C-L, Kahan T, Ysberg A-S. A national record linkage to study acute myocardial infarction incidence and case fatality in Sweden. Int J Epidemiol 2001; 30; S30-S34.
25. Braunwald E. Heart Disease. Philadelphia: Saunders Company, 2005 http://www.ktl.fi/publications/monica/manual (accessed 16.05.07).
26. Chambless L, Keil U, Dobson A et al. Population versus Clinical View of Case Fatality From Acute Coronary Heart Disease. Results from the WHO MONICA Project 1985-1990. Circulation 1997; 96:3849-3859.
27. Fellegi IP, Sunter AB. A Theory for Record Linkage. J Am Stat Ass, 1969; 64: 1183-1210.
28. Mahonen M, Salomaa V, Brommels M, Molarius A, Miettinen H, Pyorala K, et al. The validity of hospital discharge register data on coronary heart disease in Finland. Eur J Epidemiol 1997; 13: 403-15.
29. Hammar N, Nerbrand C, Ahlmark A, et al. Identification of cases of myocardial infarction: Hospital discharge data and mortality data compared to myocardial infarction community registers. Int J Epidemiol 1991; 20:114-20.
30. Tunstall-Pedoe H. Comment on the ESC/ACC redefinition of myocardial infarction by a consensus dissenter. Eur Heart J 2001; 22: 613-615.
31. Salomaa V, Koukkunen H, Ketonen M et al. A new definition for myocardial infarction: what difference does it make? Eur Heart J 2005; 26:1719-1725.

32. Mahonen M, Salomaa V, Torppa J, et al. The Validity of the Routine Mortality Statistics on Coronary Heart Disease in Finland: Comparison with the FINMONICA MI Register Data for the Years 1983-1992. J Clin Epidemiol 1999; 15: 157-166.
33. Recommendation no. R (97) 5 of the Committee of Ministers to Member States on the protection of medical data (Adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting).

POPULATON-BASED REGISTER OF STROKE: MANUAL OF OPERATIONS

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CONTENTS

TABLE 5. Sources of information

REFERENCES

ABBREVIATIONS

CSF = Cerebrospinal Fluid
CT-Scan = Computed Tomography Scan
CVD = Cardiovascular Disease
DRG = Diagnosis Related Group
EROS = European Register Of Stroke
ECHIM = European Community Health Indicators Monitoring
EU = European Union
EUROCISS = European Cardiovascular Indicators Surveillance Set
EUROSTAT = Statistical Office of the European Communities
GP = General Practitioner
HDR = Hospital Discharge Records
HF = Heart Failure
HES = Health Examination Survey
HIS = Health Interview Survey
ICD = International Classification of Diseases
IHD = Ischaemic Heart Disease
MONICA = MONItoring trends and determinants of CArdiovascular diseases
MRI = Magnetic Resonance Imaging
OECD = Organisation for Economic Cooperation and Development
PIN = Personal Identification Number
TIA = Transient Ischaemic Attack
WHO = World Health Organization

1. INTRODUCTION AND RATIONALE

1.1 Burden of disease

The most frequent forms of cardiovascular disease (CVD) are those of an atherosclerotic origin, mainly Ischaemic Heart Disease (IHD), stroke and Heart Failure (HF).

More than 1.9 million people die every year from CVD in the European Union (EU)[2]. Nearly half (42%) of all deaths (46% of deaths in women and 39% deaths in men) are from CVD [1].

CVD clinically manifests itself in middle life and older age after many years of exposure to unhealthy lifestyles (smoking habit, unhealthy diet, physical inactivity) and risk factors (total and low-density lipoprotein cholesterol, blood pressure, diabetes). CVD accounts for over 225,000 premature deaths before the age of 65 in the EU: 7% of all men and 3% of all women die from CVD before the age of 65 [1].

Even though clinical onset is mainly acute, stroke often evolves gradually, causes substantial loss of quality of life, disability, and life long dependence on health services and medications. The societal costs are substantial and they are not only those directly related to healthcare and social services, but also include those linked to a) illness benefits and retirement; b) impact on families and caregivers; and c) loss of years of productive life [1].

Stroke is the second leading cause of death in the European Union accounting for 490,000 deaths each year. Over one in eight women (13%) and one in ten men (9%) die from this disease and many more suffer from non-fatal events [1].

In most Western European countries death from stroke has declined by 30-50% since 1975, but in the countries of Eastern Europe stroke mortality has remained stable or slightly increased over the same period of time [2-5]. Despite the decline in mortality in Western Europe, the annual number of cases of stroke is expected to increase

[2] 25 member States: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

within the next few decades, mainly due to a 30% growth in the elderly population, which will lead to an increase in the health burden of stroke and consequent increase in economic costs [6].

In the last decade, innovations in diagnostic technologies in the cardiovascular field have facilitated diagnosis at earlier phases in the course of the natural history of disease or in presence of less severe tissue damage. The use of diagnostic technologies, such as Computed Tomography Scan (CT-Scan) and Magnetic Resonance Imaging (MRI), has greatly improved the accuracy of diagnoses of hospitalised cerebrovascular events allowing delineation of the location and type of lesion.

The World Health Organization – MONItoring trends and determinants of CArdiovascular diseases (WHO-MONICA) project [7] has demonstrated a large variation between countries in case fatality rates (the proportion of fatalities occurring within 28 days after onset of acute stroke), ranging from 15% in Northern countries to 50% in some Eastern European states. The implications of these findings are that the quality of acute stroke care varies between countries and that an improvement in initial diagnosis, treatment and rehabilitation programmes may reduce case fatality rates [6].

Lifetime costs of first-ever stroke are estimated at between 31,440 euro in the Netherlands and 63,000 euro in Sweden, of which hospital costs account for 45% in the first year after a stroke [8,9]. It is estimated that hospital costs attributed to stroke will increase by 1.5% per year [9].

Across Europe with its ageing population there is a pressing need to cope with costs increase and make stroke prevention and treatment a priority to reduce the growing health burden and lessen its socio-economic impact [10].

According to the Organisation for Economic Cooperation and Development (OECD), it does not appear inevitable that longer life leads to higher costs. This is one of the reasons why the health system should be largely oriented to work on preventive actions. Epidemiological studies have shown that stroke is preventable to a large extent. Different preventive strategies can be implemented to a) reduce the

occurrence and impact of stroke (through, for instance, the identification of individuals at high risk of stroke such as hypertensives, diabetics and smokers); b) intensify treatment in people who have already experienced a stroke or Transient Ischaemic Attack (TIA); or c) improve rehabilitation.

At the European level, WHO, OECD and EUROSTAT (Statistical Office of the European Communities) collect simple indicators (mortality, hospital discharge rates) and process them into tables available on web-site (www.euro.who.int/hfadb; www.oecd.org; www.europa.eu.int/comm/eurostat). These data are rarely comparable due to the different methodology and the peculiar health system of each country.

1.2 Disease register

The objectives of a stroke population-based register is to (a) evaluate the frequency, distribution and prognosis of the disease providing indicators such as attack rate, incidence rate, prevalence and case fatality; (b) compare trends in different countries; (c) evaluate trends and changing pattern, outcomes and treatment effectiveness; and (d) monitor disease prevention programmes.

Focusing on the general population, a stroke register may provide a comprehensive picture of stroke in the community, highlight problem areas and suggest where there are population groups at high risk and where treatment facilities are most in need of improvement. It may provide information needed to plan healthcare services and to develop and test which methods are most useful as a basis for preventive action.

The register includes all cases in a defined population, whether treated at home or in hospital, in whichever season of the year or time of the day they may occur, and would also include rapidly fatal cases unable to reach the medical service.

It is important that collection of information on suspected events and application of diagnostic criteria follow a standardised methodology in order to enable data comparison in different areas of the same country or between different countries.

To summarise, a population-based register is intended for health professionals and policy makers and provides the means to understand the characteristics, the burden and the consequences of the disease in the population through:

- the monitoring of the occurrence of the disease (i.e to assess population differences and trends in attack and incidence rates and in mortality over time);
- the understanding of the differences and changes in the natural disease dynamics between genders, age groups, social classes, ethnic groups, etc.;
- the identification of vulnerable groups;
- the monitoring of in- and out-of-hospital case fatality;
- the assessment of relations between disease incidence, case-fatality and mortality;
- the monitoring of the consequences of disease in the community in terms of drug prescriptions and rehabilitation;
- the monitoring of the utilisation of new diagnostic tools and treatments and their impact.

This is crucial in order to:

- develop health strategies and policies;
- plan health services and health expenditures;
- improve appropriate allocation of resources;
- evaluate the effectiveness of interventions.

In order to provide this, a register must be validated. Validation provides the means to:

- take into account bias from diagnostic practices and changes in coding systems;
- trace the impact of new diagnostic tools and re-definition of events;
- ensure data comparability within the register (i.e. different sub-populations, different time points, etc);
- ensure data comparability with other registers within and between countries.

1.3 Historical background

The *WHO Stroke Register* was the first attempt to collect data on stroke in the community in a uniform manner from countries with different social, cultural, and

environmental background. It lasted from May 1971 to September 1974 and was a joint undertaking of WHO and 15 collaborating centres in 10 countries from Asia, Africa and Europe. About 2 million people were under surveillance and data was obtained from 6,395 new cases of stroke (3,270 men and 3,125 women).

Fourteen of the centres covered the general population in defined geographical areas and one centre covered an occupational group consisting mainly of men below the age of 55 years. No limitations of age and gender were set in the study areas, except for two centres in Sweden and Japan.

A stroke was defined as rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin [11].

The *WHO MONICA* Project [12,13] was started in the first half of the 1980s and lasted until the first half of 1990s. Stroke registers were established in 17 centres in 10 countries.

Study populations were residents in geographically defined areas and included men and women ages 35 to 64 years, with an optional inclusion of the 65 to 74 years decade.

All stroke events in defined populations were ascertained and validated according to a common protocol and uniform criteria. Almost 25,000 stroke events in more than 15 million person-years were analysed.

Stroke was defined “as rapidly developed signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours (unless interrupted by surgery or death), with no apparent nonvascular cause”. This category included patients presenting with clinical signs and symptoms suggestive of subarachnoid haemorrhage, intracerebral haemorrhage, or cerebral ischaemic infarction. This definition excluded patient with TIA or stroke events in cases of blood disease or brain tumors. Secondary stroke caused by trauma was also excluded.

Up to 6-fold differences were observed in stroke mortality. Mortality declined in 8 of 14 populations in men and in 10 of 14 populations in women. An increase in

mortality was observed in Eastern Europe. In the populations with a declining trend, about 2/3 of the change could be attributed to a decline in case fatality. In populations with increasing mortality, the rise was explained by an increase in case fatality.

1.4 Existing registers in Europe – an overview

The data collection for the international MONICA study ended in 1994/95. Some countries continued to collect data every year, while others only periodically (every 5 years).

Presently, the existing registers in Europe adopt different data collection procedures: some registers are based on the procedures used in the MONICA study, others on administrative databases with or without record linkage, some are national and some are regional. Different age groups are covered, the degree of validation of the diagnostic information varies and in most registers is much less intensive than in the MONICA study. The registers are used for different purposes and have different strengths and limitations [14].

Tables 1, 2 and 3 give a brief overview of the existing stroke registers in Europe. As shown in Table 1, Denmark, Finland and Sweden have national stroke registers, which are based on record linkage between hospital registers and cause of death registers.

Table 2 shows regional population-based stroke registers: most of them are based on a disease specific data collection comparable to the MONICA registers, while others are based on other data collection methods.

Table 3 shows examples of registers based on data from healthcare institutions such as General Practitioner (GP) and hospitals. These registers are not population-based since they do not include out-of-hospital cases or cases not seen by GP and thus they do not consider sudden death occurring out-of-hospital. These registers are not intended to assess disease occurrence but rather to evaluate outcome and survival of stroke patients.

It is worthwhile to mention the European Register Of Stroke (EROS), a 4 year prospective study across Europe aiming at estimating the impact of stroke

understanding the factors underlying variation in the quality of care and outcome after stroke, and answering unresolved issues with regard to the influence of socio-demographic, case-mix and stroke healthcare, quality factors on the variations in health or stroke patients around Europe. The cities of London, Helsinki, Glasgow, Edinburgh, St Petersburg, Kaunas, Warsaw, Dijon, Menora, Florence, Stockholm participate in EROS [15].

2. OBJECTIVES

The purpose of the EUROCISS Project is to provide a general guide and updated methods for the surveillance of stroke to those EU countries which lack appropriate surveillance systems and therefore wish to implement a population-based register in order to produce comparable and reliable indicators.

Taking into account developments in new diagnostic criteria, treatment and information technologies in recent years, this manual provides a standardised and simple model for the implementation of a population-based register. It recommends to start from a minimum data set and follow a step-wise procedure based on standardised data collection, appropriate record linkage and validation methods.

This manual is intended for investigators, health professionals, policy makers and data collection staff interested in the surveillance of stroke.

Although in many countries data extracted from some sources of information (mortality and hospital discharge records [HDR]) are now available thanks to the continuing process of computerisation, they are rarely reliable and comparable. These data can produce reliable indicators only if properly processed and validated by independent epidemiological sources.

This manual represents a valid tool to build the core indicators (attack rate, incidence, case fatality) recommended by the EUROCISS Project Research Group for inclusion in the short list of health indicators set up by the European Community Health Indicators Monitoring (ECHIM) Project. This Project was launched in 2005 with the aim of implementing health monitoring in EU [16].

3. STRATEGY FOR SURVEILLANCE

3.1 Surveillance tools and types of registers

Surveillance is the ongoing, systematic collection, analysis, interpretation and dissemination of health information to health professionals and policy makers. Surveillance, defined as a continuous, and not episodic or intermittent activity, differs from monitoring [17,18].

Disease surveillance in a population can be done using many different data sources (Table 4). Most countries have national databases on causes of death and on discharge diagnoses for hospitalised patients.

Mortality statistics have for many years been the main tool for comparing health and disease patterns among countries and today still remain the only source of information for some countries. They have also been used to monitor trends in cerebrovascular disease and compare mortality among countries. Since the 1950s, the cause of death has been registered according to the International Classification of Diseases (ICD) to make data comparable. Different classification of disease within versions and different methods of ascertainment have led to problems in comparison between different revisions of ICD and/or similar versions among countries.

In recent years, routine statistics also include discharge diagnoses from hospitalisation and, for some countries, visits to outpatient clinics coded according to the same international classifications as the mortality data. Stroke can be extracted for relevant populations and age groups and these routine statistics are still very important tools for monitoring the disease.

Many countries have also Health Interview Surveys/Health Examination Surveys (HIS/HES). These surveys are primarily used for monitoring disease prevalence (included cerebrovascular disease), prevalence of risk factors (health behaviour, social network, environmental risk factors) and of disease consequences (disability, reduced physical function, unemployment). They are described in detail in the Manual of Operations of CVD Surveys.

Few countries have an established disease-specific stroke register which ensures a more precise and valid monitoring of this disease.

A population-based register is usually formed through linkage of various sources of information (mortality data, hospital discharge and GP's records) and covers a defined population (entire municipalities, regions or whole country) and a specific age group (35 to 74 or 35 to 64 years or all ages).

A population-based register should be used for the surveillance of stroke morbidity and mortality since it considers both fatal and non-fatal events occurring in- and out-of-hospital; therefore, it provides estimates of key indicators such as attack rate and case fatality. Incidence can be assessed if information on first event is available. If survival rates are available, prevalence can be assessed as well.

Case finding and validation procedures depend on data collection methods, healthcare and financing system, and diagnostic criteria applied in the definition of events. The accuracy of rates produced is related to the completeness and quality control of the data collected for the numerator (death and hospital discharge registers) and the denominator (census or population register). Completeness also depends on tracing subjects treated outside hospital (nursing home, clinic, etc.) and outside the area of surveillance. The routine recording of diagnoses may be a problem for registration of stroke: a large proportion of "new stroke diagnoses" are merely sequelae of an old stroke. This problem increases with ageing.

The definition of the event must take into account both the ICD codes reported in the hospital discharge diagnoses (main or secondary) or in the causes of death (underlying or secondary) and the duration of the event. Stroke may occur more than once and therefore it is necessary to consider both first and recurrent events. In this context, deaths occurring within 28 days are usually considered to reflect the same event [17] (See the definition of recurrent events in paragraph 4.1).

A Personal Identification Number (PIN) is a strong tool in linkage procedures between hospital discharge diagnoses, GP's records and death certificates; alternatively, multiple variables (e.g. name, date and place of birth, gender, residence) may be used for record linkage.

Specific Stroke Register

The strength of this register lies in the possibility of validating each single event according to standardised diagnostic criteria and collecting disease-specific clinical and paraclinical data [19]. The weakness lies in the fact that data collection is expensive and this kind of register can usually be maintained only for a limited period of time in a defined population of reasonable size. Another limitation is that a local or regional register may not be representative of the whole country.

Identification of events can be obtained by *hot pursuit or cold pursuit. Hot pursuit* means identifying case admissions to hospital usually within one or two days from event onset and acquiring relevant information by visiting the ward or interviewing the patient. Information bias is minimised by the *hot pursuit* approach as information is collected immediately after the event. The process is comparatively demanding in terms of resources.

Cold pursuit implies the use of routine and delayed procedures by means of hospital discharge and death records. The process is easier and less expensive than *hot pursuit*; the number of cases studied is typically smaller because discharge diagnoses are more precise and specific than those on admission, but there is a possibility of missing important information. Both methods are used to identify suspected events, which are subsequently validated using specific diagnostic criteria.

The specific stroke register is important since it collects fatal and non-fatal events; actually, official mortality statistics provide only a limited and sometimes biased picture of stroke in the population. A large proportion of stroke victims are left with permanent disability; economic and human consequences of stroke extend far beyond what emerges from routine mortality data. The specific stroke register, which allows to assess incidence and prevalence, reflects better than mortality the impact of stroke in the community. Monitoring non-fatal stroke is associated with a number of problems, the most important being the completeness of case finding, especially in areas where many stroke cases are not treated in hospital. An extensive review of stroke incidence registers showed that few of them provide reliable data [20]. Indeed, it has been claimed that most of the differences in stroke mortality and incidence rates reported to exist between populations are attributable to methodological bias.

A specific stroke register provides standardised and reliable epidemiological data for public health initiatives aimed at preventing the disease. It has been used in the WHO MONICA Project, where uniform criteria for recording cardiovascular disease have been applied to 14 populations in 9 countries [14].

Register based on routine administrative data

Identification of events is based on linkage of mortality data and HDR. The register based on routine administrative data has existed for many years in the Northern countries, where all individuals are identified by a PIN which allows record linkage between different information sources. This register is economical, covers the whole country, all age groups and collects large numbers of events. The main objective of administrative databases is to produce relevant statistics to plan health services and healthcare expenditure and to give internationally comparable data on mortality, causes of death and hospital admissions. The register based on routine administrative data is not primarily planned for research purposes but is increasingly used in epidemiological research. Its strength lies in the fact that it covers the whole country and the completeness is close to 100%. The weakness lies in the fact that data are not standardised to the same degree as in the disease-specific data collection and that clinical and paraclinical data available are limited. If used in research, this register needs to be carefully validated. Stroke registers based on administrative data, such as hospital discharges and deaths, have been employed in Denmark and Finland in order to obtain national rates of stroke incidence, mortality and case fatality [21,22]. A similar approach is being investigated for use in Sweden.

Studies on feasibility of combining data from routine hospital discharge and cause of death registers have been performed in Finland: over 90% of hospitalised acute stroke events (first and recurrent) included in the Finland MONICA Stroke register were found in the HDR with one of the stroke diagnoses. The missing events were mainly explained by errors in the PIN (leading to unsuccessful record linkage) and different practice of defining an event as hospitalised when death occurred in the emergency room (leading to exclusion from the HDR) [21].

In the past, hospitalisations for rehabilitation purposes were often coded using an ICD code for acute stroke; with the introduction of ICD-9 version, a separate diagnosis for acute events and sequelae was made possible. The definition of stroke death also differs between the specific stroke register and the mortality register: in the specific stroke register the death is very strictly defined as a death occurring within 28 days from the onset of event; on the contrary, deaths occurring after 28 days from the onset of symptoms are often coded as stroke in the mortality register [21].

In studies assessing trends in stroke subtypes the change in the use of neuroimaging examinations and autopsy frequency should be reported.

General Practitioner register

The great majority of health problems are managed in primary care and do not go further into other levels of the healthcare system. This is true especially for those less serious problems which do not require hospitalisation. The fact that primary healthcare is generally the first and most frequently utilised health service makes general practice a rich source of information. This further emphasises the need for monitoring health in primary care settings to have a full picture of health status of populations. This is particularly necessary for stroke, which occurs especially among elderly and in some countries patients with stroke are treated at home even during the acute phase: this makes the GP's register a valid source of information for monitoring stroke. Monitoring health in primary care should however not be seen in isolation from other sources of information about health.

Essentially, there are two models for collecting morbidity data in primary care. One is based on episodes of care, recording data on all doctor-patient interactions, gathering information on consultation rates and patterns of clinical management; the other focuses on specific disorders, using a limited number of standardised case definitions and attempting to assess the burden of disease attributable to those disorders in the population in question. The first model is exemplified by the English General Practice Research Database Programme [23,24], and the use of International Classification of Primary Care, ICPC codes [25], while the second one is illustrated

by the Morbidity Sentinel Stations Programme that is now operational in several European countries [26-28].

3.2 Target population

A population-based stroke register may cover a whole country; where this is not feasible, the population under surveillance would typically be residents of a defined region in the country. The target population should preferably cover a well defined geographical and administrative area or region for which population data and vital statistics are routinely collected and easily available each year. Both urban and rural areas should be monitored: differences often exist with regard to exposure to risk factors, treatment of predisposing disease and access to facilities.

It is important that all cases among those with residence in the area are recorded even if the case occurs outside the area (*completeness*). In the same way, all cases treated at hospitals within the area but with residence outside the area must be excluded. If this is not possible, it is important to give an estimate of the magnitude of the loss of cases and establish whether it could be changing and interfering with the validity of the observed trends in the rates over a period of years.

It is also important to consider to what extent an area is representative for the whole country (*representativeness*): it could be representative according to the CVD mortality rate, the distribution of risk factors (socioeconomic status and health behaviour) and the distribution of health services (specialised hospital, GP). In some countries it might be better to start with high risk area.

The population to be monitored should be selected in order to produce estimates of disease rates that are sufficiently robust from a statistical point of view, so that trends can be established and data comparability ensured.

In general, it is necessary to select more than one area representative for socio-economic or ethnic differences in order to have a comprehensive picture for the whole country, and a coordinating body between the areas is recommended to ensure comparability.

The target population should be selected taking the following parameters into account:

age: the age range covered by the MONICA Project was 35 to 64 years. As reported in the final report, the EUROCISS Research Group suggests the wider age range 35 to 74 years, or even up to 84 years of age when possible, considering that in patients above 65 years of age more than half of the stroke events occur. The age groups recommended from EUROCISS Project to present morbidity and mortality are decennia, in particular the age ranges 35 to 44, 45 to 54, 55 to 64, 65 to 74 and 75 to 84. If administrative routine data are used, all ages are automatically included, but for patients ages 85 and above the validity of the diagnostic information tends to be less reliable. Age-standardised rates (35 to 74 and 35 to 84) are recommended using the European Standard Population as reference.

Gender: stroke is an important cause of death and disability in men and women, and the population should include both genders. There are no major gender differences in stroke presentation or management; mortality and quality of life at 6 months are similar in women and men.

Population size: to be eligible to participate in a stroke population-based register, a minimum of 300 stroke events per year in the population ages 45 to 74 years is necessary. The size of the population under surveillance is determined by the number of fatal and non-fatal events and the event rate in the age group concerned. The minimum of 300 events (fatal and non-fatal) has been established in order to detect a decrease in mortality trend by 2% in event rate per year. This means that the population to be under surveillance could range between approximately 1,200,000 (all ages) in low incidence country like Italy and approximately 400,000 (all ages) in a high incidence country like Finland, basing the calculation on female attack rate usually lower than male attack rate. If more areas are enrolled, it would be desirable that the same number of 300 total events is considered for each single area.

Patient eligibility: an individual is considered eligible for inclusion in a stroke population-based register only if he/she is resident in the area under surveillance, meets the selected age and had a stroke event within the defined time period.

3.3 Data sources

To monitor stroke in the general population, the following sources of information should be available at a minimum: mortality records with death certificates; and, hospitalised discharge records with clinical information.

A special stroke register would typically include several sources of information.

Some events occur suddenly and are not able to reach the hospital and some non-fatal cases may not be referred to hospital for treatment, particularly those occurring to very old individuals. Therefore, additional sources are usually needed to achieve complete information on all fatal and non-fatal events: clinical pathology laboratory (autopsy register), nursing home, clinic, emergency or ambulance service, GP, radiology unit (Table 5).

Death Certificate

The death certificate provides complete data on fatal events and are collected in a systematic and continuous way in all EU countries. Mortality statistics are easily accessible in all countries but are usually available in a detailed and complete form after 2-4 years.

The format of the death certificate varies from country to country, but generally it includes personal identification data, date and place of death (i.e. municipality, nursing home, hospital or other) and causes of death (underlying, immediate and contributory). Causes of death are coded according to ICD. Problems of temporal and geographic comparisons derive from the different versions of the ICD adopted over time (7^{th}, 8^{th}, 9^{th}, 10^{th} revision) and from different coding practices in each country. Furthermore, diagnostic criteria for coding death certificates are not defined at the international level and the ICD nosologic and nosographic versions are updated every 10 years by the WHO.

Some countries code the underlying cause of death only.

The reliability of mortality data depends on the completeness and accuracy of the vital registration system as well as the registration and coding of causes of death. When the proportion of deaths coded as "unknown cause of death" is higher than 5%, cause-specific mortality data should be used with caution. The accuracy of the recorded causes of death depends on the autopsy rate. This rate varies largely between countries and over time. In some countries, the autopsy rate has declined in recent years, which is a problem for the use of mortality statistics in disease surveillance.

Hospital Discharge Records

HDR give the number of hospitalisations for stroke, which are absolutely necessary to monitor CVD. Moreover, clinical information and medical care reported in hospital documents are important for validation of events.

Hospital discharge data are available in most EU countries, but in some countries only as aggregated tables without detailed information on age and gender distribution and without haemorrhagic and ischaemic stroke as separate diagnostic categories.

HDR include personal identification data, admission date, type of hospitalisation (urgent, ordinary or transfer to other structure) and discharge diagnoses. Hospital discharge diagnoses are coded by ICD codes (currently ICD-9 or ICD-10). For some countries only a limited number of diagnoses is coded.

Problems in the assessment of a specific stroke event may arise when an acute event is followed by a period of rehabilitation or a transfer to other wards and the event could be counted more than once (sequelae). HDR do not include emergency room and private hospitals or nursing homes are only included in some countries.

Discharge diagnoses are not validated on a routine basis and validation studies are necessary in all countries to check the diagnostic quality. The validity of a hospital discharge diagnosis may vary on the basis of patient characteristics, geographical region and type of hospital or clinic.

Hospital admission policies vary over time and place; the registration of the most severe cases dying shortly after the arrival to the hospital differs between hospitals, depending on the administrative procedures connected to hospital admissions. HDR may also include patients not resident in the area under surveillance.

The adoption of new diagnostic techniques, such as MRI and CT-Scan, may cause major changes in event rates estimated from HDR. Therefore these techniques should be taken into account when interpreting trends.

A further problem may derive from the use of Diagnosis Related Group (DRG). In some countries, financing healthcare services is based on the DRG tariff system, which is built on equal-resources criteria and aggregates events in major diagnostic categories.

DRG may be useful in hospitals for acute events but are not reliable for chronic diseases requiring a long hospital stay and rehabilitation, such as stroke.

Countries using the DRG system are Denmark, Finland, France, Germany, Italy, Norway, Portugal, Spain and Sweden. In order to assess the occurrence of stroke,

HDR from all hospital departments should be used but if this is not possible at least the following departments must be taken into consideration:

- intensive care (an intensive care unit, including any type of acute medical unit);
- medical (a general medical ward, including a geriatric unit);
- neurological/neurosurgical (a general neurological ward);
- rehabilitation (a specialised rehabilitation unit, except a rehabilitation stroke unit);
- stroke (acute and rehabilitation stroke units);
- other (other units, e.g. radiology).

Autopsy register

Not all countries perform autopsy on suspected or sudden deaths on a routine basis. Autopsy is performed on violent deaths or on deaths occurring in hospital when clinical diagnosis is undetermined. The first one is performed by a forensic medicine specialist, the second one by a pathologist of the hospital where death occurred. Data from this register refer therefore to a low percentage of deaths but provide a more valid diagnosis to complement the information reported on the death certificate.

Nursing home and clinic

The nursing home and clinic mainly provide data on cases among older patients who sometimes get care from these institutions without being admitted to hospital. Therefore, information on events occurring in the nursing home can be critical, especially if the register covers elderly patients. In some countries rehabilitation after an acute event is provided by the rehabilitation clinic which may give information on patients who have received the acute care outside the region.

Emergency and ambulance services

Data provided by emergency and ambulance services are useful to integrate information for register implementation since patients dying suddenly or experiencing fatal stroke are not always able to reach the hospital. These services are able to provide data otherwise not obtainable, such as CT-Scan or MRI during the

acute phase of the event or blood pressure measurement, blood glucose, peripheral oxygen saturation, body temperature and fluid balance, level of consciousness (fully conscious; somnolent; semicomatose; comatose) and muscular deficit at the time of event occurrence in paucisymptomatic patients referring to emergency services. The need of very urgent medical treatment often makes information partial but the integration of these data with those from other sources of information contributes to the implementation of the register.

General Practitioner Register

In some countries a GP register can be useful when dealing with events not necessarily requiring hospitalisation. This is particularly important for the elderly population.

Radiology unit

The role of the radiology unit (CT-scan or MRI) is a support in the identification of non-hospitalised events, in the diagnosis of stroke type (haemorrhagic or ischaemic) and in treatment.

4. METHODS

4.1 Definition of events – Subtypes

There are three major stroke subgroups as follows: ischaemic stroke; intracerebral haemorrhage; subarachnoid haemorrhage

Type	Caused by	Diagnosis based on
Ischaemic stroke (ICD-9 434; ICD-10 I63)	Sudden occlusion of arteries supplying the brain, due to a thrombus formed: - directly at the site of occlusion (thrombotic ischaemic stroke), or - in another part of the circulatory system, which follows the blood stream until it obstructs arteries in the brain (embolic ischaemic stroke)	Neuro imaging recordings Note: it may not be possible to decide clinically or radiologically whether it is a thrombotic or embolic ischaemic stroke.
Unspecified stroke (ICD-9 436; ICD-10 I64)		
Intracerebral haemorrhage (ICD-9 431, 432; ICD-10 I61, I62)	Bleeding from one of the brain's arteries into the brain tissue	- Neuro imaging recordings
Subarachnoid haemorrhage (ICD-9 430; ICD-10 I60)	Arterial bleeding in the space between the two meninges, pia mater and arachnoidea. **Note:** Typical symptoms are sudden onset of very severe headache and usually impaired consciousness	- Neuro imaging, or - Lumbar puncture

Modified from WHO STEPS Stroke Manual V2.1

It should be noted that each type differs with respect to survival and long-term disability.

General major symptoms

Symptoms should be of a presumed vascular origin and should include one or more of the following definite focal or global disturbances of the cerebral function:

- unilateral or bilateral motor impairment (including lack of coordination);

- unilateral or bilateral sensory impairment;
- aphasia/dysphasia (non-fluent speech);
- hemianopia (half-sided impairment of visual fields);
- forced gaze (conjugate deviation);
- apraxia of acute onset;
- ataxia of acute onset;
- perception deficit of acute onset.

Other symptoms

Other symptoms that may be present but are not adequate for stroke diagnosis (often resulting from other diseases or abnormalities such as dehydration, cardiac failure, infections, dementia, and malnutrition) are as follows:

- dizziness, vertigo;
- localised headache;
- blurred vision of both eyes;
- diplopia;
- dysarthria (slurred speech);
- impaired cognitive function (including confusion);
- impaired consciousness;
- seizures;
- dysphagia.

Subarachnoid haemorrhage

For subarachnoid haemorrhage at least one of the following must be present in addition to the general major symptoms:

- recent subarachnoid hemorrhage, aneurysm or arteriovenous malformation (necropsy/autopsy);
- blood in the Fissura Sylvii or between the frontal lobes or in the basal cistern or in cerebral ventricles (CT or MRI);

- blood stained cerebrospinal fluid (CSF) (>2000 red blood cells per mm^3), aneurysm or an arteriovenous malformation (angiography);
- blood stained CSF (>2000 red blood cells per mm^3), also xanthochromic and intra-cerebral haemorrhage (necropsy or CT-Scan).

Stroke-like symptoms

A broad range of other diseases may cause similar symptoms, for example, HIV/AIDS, tuberculosis, syphilis, intracerebral cancer. These diseases are known to be able to cause focal neurologic disturbances and thereby mimic a stroke. Attention to the development of symptoms is an important factor to consider in order to avoid other diseases being misinterpreted as vascular disease and leading to ineffective preventive strategies.

Onset and survival

Stroke events are classified as *first ever* or *recurrent, with non-fatal* and *fatal* outcome:

- *First ever stroke event*: refers to people who have never had a stroke before.
- *Recurrent stroke event*: for a new episode of symptoms to be counted as a recurrent event, general stroke criteria must be met and either:
  - onset is day 1 (one);
  - a new stroke occurring after 28 days is a new event.

If a patient experiences further acute symptoms suggestive of stroke within 28 days of the onset of a first episode and in the same carotid or vertebral artery territory, this second episode is not counted as a new stroke event.

Equally, if a patient experiences further acute symptoms suggestive of stroke after 28 days of the onset of a first episode, this second episode is counted as a new stroke event.

- *Non-fatal stroke event*: refers to patient surviving at least 28 days after the onset of the stroke symptoms.

- *Fatal stroke event*: refers to stroke causing death within 28 days of symptoms onset.

It should be noted that each event is registered separately.

4.2 Indicators

Attack rate

Attack rate is the total number of new cases (separated into subtypes and summed) and recurrences per 100,000 target population over 1 year. It is calculated using either the main cause of hospitalisation or, in cases of out-of-hospital deaths, the underlying or contributory causes of death. It should be noted that in the case of stroke the hospital discharge can sometimes be quite distant from the onset of stroke event. Therefore, a hospital discharge register alone is not always an accurate source of information. Ideally, an in-patient inventory should be checked at the end of each year to identify patients who are hospitalised for stroke but not yet discharged [20].

Incidence rate

Incidence is the number of new cases per 100,000 target population over 1 year [20].

Case-fatality

Case fatality is the proportion of events that are fatal by the 28^{th} day.

The EUROCISS Project recommends for cerebrovascular events 7 day and 28 day case fatality. All in- and out-of-hospital fatal and non-fatal events are to be considered as denominator.

4.3 Data collection methods

The different types of registers described in section 3.1 use different data collection methods. Registers with disease-specific data collection can be divided into registers

based on routine administrative data using record linkage, disease specific registers using hot and cold pursuit and GP registers.

Stroke registers based on routine administrative data

In recent years, the development of computerised record linkage has made it possible to overcome obstacles in linking administrative database.

Record linkage methods can be summarised into three broad categories: *manual*, *deterministic* and *probabilistic*.

Manual matching is the oldest, most time-consuming and most costly method. In general it is not a feasible option when large databases are involved.

Deterministic linkage matches records from two data sets (or two records from different locations in a single data set) using a unique variable (e.g. PIN or hospital chart number) or by full agreement of a set of common variables (e.g. name, gender, birth date).

Probabilistic linkage [29] is used to identify and link records from one data set to corresponding records in another data set (or two records from different locations in a single data set) on the basis of a calculated statistical probability for a set of relevant variables (e.g. name, gender, date of birth). This type of record linkage links records with a specified high probability of match. The method requires detailed prior knowledge about various measures of the relative importance of specific identifier values in both files that are to be linked.

The main limitations of record linkage are the difficulty in:

- obtaining administrative files for research purposes: mortality data files are usually available at the National Institute of Statistics, while hospital discharge data are available at the Ministry of Health. These kinds of data are anonymous and therefore do not allow record linkage. Nominal files are available at regional level or at the sanitary units;

- combining data: missing events are mainly explained by errors in PIN or in name; they may lead to unsuccessful record linkage;
- defining and obtaining minimal data set (for mortality: PIN; family and first name; date and place of birth; gender; residence; date and place of death; underlying and secondary causes of death. For hospital discharge diagnosis the same variables should be considered together with admission date and hospital discharge diagnoses);
- obtaining necessary funds for processing large administrative files.

Nonetheless, record linkage studies provide evidence of the statistics that could become available with greater integration of administrative databases.

The national stroke registers in the Northern countries use record linkage between Hospital Discharge Registers and Causes of Death Registers as the basis for the register. The linkage as such is easy because of the PIN attached to every citizen in the country. However, the linkage has to be followed by many specific definitions of how to handle primary and secondary diagnoses, underlying and contributory causes of death, transfer between hospitals with difference in the diagnoses between the admitting hospital and the hospital where the patient is transferred, how to define date of attack, first time events and recurrences. Practical ways how to approach these problems have been suggested from work carried out in Finland [21,22].

It is usually difficult to detect the incident cases (first events): hospitalisation records within the previous 5-7 years are reviewed to check for disease; if no hospital admission for stroke is found, then the stroke case identified is considered a first event. Further problems may arise when estimating trends: for example the changes in the use of neuroimaging examinations and autopsy frequency can lead to an overestimation of the number of events or make the interpretation of stroke subtypes difficult.

Specific Stroke Registers

This kind of register uses hot and/or cold pursuit method for data collection.

Hot pursuit [30]

This method of detecting events involves identifying patients acutely in hospital by interviewing them directly. The problem with this method is that the data collection technique is very difficult to standardise (e.g. descriptions of symptoms may vary with the observer). Periods of staff shortages or holidays may lead to loss of cases that cannot be recovered and a large team is needed to search the wards for cases. However, some information may be more complete than that obtainable from case notes.

Notification of events should be instituted on a routine basis checking admission registers on the wards.

While the extreme forms of hot pursuit involve getting the information from the patient acutely, an alternative is to use the hot pursuit method to identify the patients of interest and to mark their notes or list them for review later. An efficient reliable routine is needed for picking up the case notes at an identifiable point in their processing.

A benefit of the hot pursuit method is that information on the diagnosis is collected soon after admission. This has its limitations, however, as initial diagnosis can sometimes be superseded by subsequent tests and other more detailed investigation.

Residents hospitalised outside the area will always have to be registered by cold pursuit, weeks or months later.

Cold pursuit [30]

Use of discharge diagnoses rather than hospital admissions is a more simple system of identifying events for the study. Its advantage is that it can be done months or years after the event but it is limited because the information in the case notes may not be complete and the notes themselves may not be accessible.

Once the event has been identified and validation is required, medical notes should be obtained in order to extract the necessary information. When a register is launched for the first time, a plan for future evaluation of trends is recommended. This can be achieved by continuous surveillance as part of a broader health information system or

annual register repeated at 5 to 10 year intervals. The minimum recommended period of observation is one complete calendar year because of possible seasonal variation.

Combined approach

A mix of hot and cold pursuit ensures the most complete identification of stroke events.

Some of the patients must have been identified as soon as possible after symptoms onset with the possibility of direct examination, while the remaining events are based on routine data.

It is difficult to check up on a hot pursuit system several months later, but discharge lists can be used as a backup method to ensure that the hot pursuit method had detected all the diagnosed cases. Residents hospitalised outside the area, and other late-detected cases mean that a proportion of events will always have to be registered by cold pursuit, weeks or months later.

5. QUALITY CONTROL

Quality control of registers is extremely important for a valid monitoring and comparison between regions and countries. The quality of the register depends on:

- completeness of coverage (sequence of events) and completeness of information;
- internal validity;
- external validity (representativeness).

The surveillance of stroke is complicated by the fact that a number of cases is not admitted to hospital, particularly in older age. The identification of cases in older populations outside hospital is essential for a precise determination of occurrence. These events are a combination of milder or more severe strokes than those admitted to hospital and, consequently, their inclusion influences incidence as well as case fatality.

5.1 Completeness of coverage and completeness of information

Completeness of coverage means that all stroke cases in the target population are included, i.e. events occurring independently inside or outside the region. The register has also to cover events whenever they occur during day/night or winter/summer as well as events occurring outside hospital (e.g. sudden death among patients who never reach the hospital).

Completeness of information means that all relevant information has been registered (e.g. place of treatment, date of admission, date of discharge, PIN, gender, hospital discharge diagnostic codes, intervention/procedure codes, department/ward, date of birth).

The most important source of systematic bias in estimating incidence is related to the coverage of event registration. The registration system must attempt to identify all possible cases of the disease that have come to the attention of the existing medical and medico-legal sources. The completeness of event identification (acute-care hospital, primary healthcare, nursing home) and the completeness and availability of

information, obtainable for each event recording and diagnosis, depend on the existing standard of medical care: if the medical care system misses or misdiagnoses cases, a register cannot remedy the omission.

When the event is defined (codes and duration), it may be possible to identify duplicate coding and to take out information for quality control purposes. Duplicate codes may include events transferred from one ward to another, e.g. for rehabilitation. In some cases, the duration of the admission is very short (< 2 days) either because of transferral or because of misclassification of the diagnosis. These cases may also be picked up for validation.

Cases not admitted to general hospitals are a problem for registration when the system is based only on hospital records. Another source of potential loss of identification is private practice: private physicians and hospitals may be less cooperative than those in the public system; in private hospitals the staff may be more sensitive to criticism and anxious to show how they register medical documents. GP case records are usually inadequate for full registration because patients are frequently looked after at home.

The identification of fatal events is in some way less difficult than that of non-fatal events. Whereas survivors may be lost in the totality of inhabitants of the surveillance area, death is unequivocal. However, the registration of causes of death may not be correct and needs to be validated. It is to be expected that some stroke deaths occur outside hospital. If the proportion of fatal events coded as hospitalised is very high it may indicate incomplete registration of out-of-hospital stroke deaths. High case fatality may indicate loss of non-fatal cases.

The identification of potential events may be based on many different data sources. This may involve a considerable amount of record linkage, which is facilitated if PIN is adopted.

Another problem relates to medical records, whose quality may be variable: younger patients may have had no other illness episodes and the records may be restricted to the relevant stroke event. In older patient, the identification of the event is more complicated due to the existence of comorbidities.

5.2 Internal validity

The most important question regarding validity concerns the diagnostic information. The diagnostic criteria for the event definition are valid if they measure the stroke they claim to measure. Validation preferably evaluates the sensitivity, specificity and predictive value of the registered diagnosis compared to a golden standard [19].

Validation studies of routine statistics have been carried out over the years with heterogeneous results due to differences in methodology or reflecting true differences in the validity of the routinely collected data between countries. Some studies have been carried out comparing community registers with national statistics and data from the MONICA project. These findings stress the importance of validating routine mortality and hospital statistics against the national register to determine whether and how they can be used to reflect true incidence and mortality [31]. Particular attention in this type of validation should be given to secondary discharge diagnosis or causes of death, especially for diagnostic codes, in order to detect potentially hidden cardiovascular diagnosis.

Consistency of coding with the diagnosis and consistency of coding/comparability of the information for different areas of the country and over time represent other problems for validation.

If it is not possible to validate all the diagnoses included in the disease register or in the mortality routine statistics, the objective for validation should be to evaluate a sample of events. The sample should be distributed along a full year in order to ensure that potential seasonal or other time related variations of diagnostic patterns are traced. The sample could include a feasible fraction of the 365 annual days (working and weekend days). For example in *n* days per month, all consecutive hospital admissions and deaths of eligible ICD codes may be validated.

5.3 External validity (representativeness)

It is not essential that the whole country is covered by a surveillance system but it is essential that the registration system of events is complete with regard to events occurring in the target population. It is important to know how representative the

register is for the whole country according to the CVD mortality rate, the distribution of age and gender and of health determinants (socioeconomic status and health behaviour) and the distribution of health service (specialised hospital, GP).

For the population chosen there must be good demographic data subject to at least annual revision; inaccuracy may become apparent years after the period being studied because of the results of a decennial national census.

A careful description of the population characteristics may help to describe how representative the target population is for the whole country.

5.4 Methods to evaluate the diagnostic quality

Using the diagnostic criteria it is possible to evaluate if the diagnostic tools used to establish application of valid methods are different if hot or cold pursuit is performed. Validation of the diagnostic information recorded in the register can include examination of all events or of random samples. The relevant register data must be checked periodically by sampling, as it is usually not feasible to check all the data [31]. Validation has to be carried out by an epidemiological team not involved in the patient's treatment. For local registers with a limited number of cases it may be possible to validate each single event, while national registers for practical reasons can only validate data based on random samples of suspected cases recorded during a selected period or during some days each month. A selection method consists of choosing some days each month and evaluate all events which have occurred in those days, extracted either from hospital discharge or mortality records, applying diagnostic criteria. In this way, seasonal variation can be traced.

The most important phase is the evaluation of the diagnostic information although other information in the register also needs to be included in the validation.

In order to produce valid indicators, a conditio sine qua non is to allow access to relevant medical records and routine raw data of health statistics.

In some cases it is possible to validate a register by linking the register to an independent data source, e.g. a high quality register for a small area within the region.

Criteria for validation of acute cerebrovascular events

This manual of operations does not aim to improve existing stroke definitions or formulating new ones but only to suggest a definition that already exist and to ensure comparability. According to the WHO criteria, stroke is defined as 'rapidly developing clinical signs of focal (or global) disturbance of cerebral function lasting more than 24 hours (except in cases of sudden death or if the development of symptoms is interrupted by a surgical intervention), with no apparent cause other than a vascular origin' [19,32]. Global clinical signs are accepted only in cases of subarachnoid haemorrhage or in patients with deep coma. Brain lesions detected by CT-scan but not accompanied by acute focal signs are not accepted as stroke, nor are extradural and subdural haemorrhages. Stroke cases with concomitant brain tumour, trauma or severe blood disorders are also excluded [19]. Therefore, key features of the clinical definition are as follows:

- sudden onset;
- neurological deficit;
- lasting 24 hours or longer;
- of presumed vascular origin.

The table below provides an example of some of the diagnoses that should be considered for stroke registration.

Stroke specific	Focal and global signs that could be caused by stroke
• (Acute) stroke *or* (acute) cerebrovascular episode • Cerebral *or* cerebellar embolus, thrombosis *or* infarction • Occlusion, thrombosis *or* embolus of carotid, (pre) cerebral *or* vertebral artery • Lacunar hemorrhage *or* stroke • Subarachnoid, (primary) intracerebral, cerebellar *or* pontine hemorrhage *or* stroke • Ruptured berry aneurysm	• (Acute) hemiplegia *or* (acute) hemiparesis • Faint, fit, funny turn, (acute) confusional state • Loss of consciousness • (Acute) dysphasia, dysarthria, dyspraxia • Homonymous hemianopia • Amaurosis fugax • Acute monocular blindness

A stroke case is recorded as fatal if death occurs within the first 28 days.

6. ETHICAL ISSUES

The Helsinki Declaration requires that biomedical research with human subjects must conform to generally accepted scientific principles.

The *"Recommendation n. R (97)5 of the committee of ministers to EU member states on the protection of medical data"* [33] gives guidelines to how medical data can be registered, stored and used in a way that ensure the rights and the fundamental freedoms of the individual and in particular the right to privacy. *(Adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting of the Ministers' Deputies).*

In the following the most important recommendations are presented.

"*Medical data should be collected and processed only by health-care professionals, or by individuals or bodies working on behalf of health-care professionals. Individuals or bodies working on behalf of health-care professionals who collect and process medical data should be subject to the same rules of confidentiality incumbent on health-care professionals, or to comparable rules of confidentiality*."

Therefore it is essential that a neurological or stroke physician (or study nurse) with proven experience in the field of cerebrovascular is involved in the coordination of the stroke register.

"*Medical data shall be collected and processed fairly and lawfully and only for specified purposes."*

"Medical data may be collected and processed:

a. if provided for by law for:

i. public health reasons; or

ii. *subject to Principle 4.8*[*]*, the prevention of a real danger or the suppression of a specific criminal offence; or*

iii. *another important public interest; or*

b. if permitted by law:

i. *for preventive medical purposes or for diagnostic or for therapeutic purposes with regard to the data subject or a relative in the genetic line; or*

ii. *to safeguard the vital interests of the data subject or of a third person; or*

iii. *for the fulfilment of specific contractual obligations; or*

iv. *to establish, exercise or defend a legal claim; or*

c. if the data subject or his/her legal representative or an authority or any person or body provided for by law has given his/her consent for one or more purposes, and in so far as domestic law does not provide otherwise."

Whenever possible, medical data used for scientific research purposes should be anonymous. Professional and scientific organisations as well as public authorities should promote the development of techniques and procedures securing anonymity.

However, if such anonymisation would make a scientific research project impossible, and the project is to be carried out for legitimate purposes, it could be carried out with personal data on condition that:

a. the data subject has given his/her informed consent for one or more research purposes; or

b. when the data subject is a legally incapacitated person incapable of free decision, and domestic law does not permit the data subject to act on his/her own behalf, his/her legal representative or an authority, or any person or body provided for by law, has given his/her consent in the framework of a research project related to the medical condition or illness of the data subject; or

[*] Processing of genetic data for the purpose of a judicial procedure or a criminal investigation should be the subject of a specific law offering appropriate safeguards.

c. disclosure of data for the purpose of a defined scientific research project concerning an important public interest has been authorised by the body or bodies designated by domestic law, but only if:

i. the data subject has not expressly opposed disclosure; and

ii. despite reasonable efforts, it would be impracticable to contact the data subject to seek his consent; and

iii. the interests of the research project justify the authorisation; or

d. the scientific research is provided for by law and constitutes a necessary measure for public health reasons."

Record linkage between mortality and HDR is possible in countries which have adopted a PIN on a national level. Other nominal data (such as name, gender, date and place of birth) are usually available at a regional level.

Record linkage is important to match admissions and discharges or admissions and deaths, thus avoiding double counting which may occur when, for example, the same patient transferred to another ward (e.g. from neurology to neurosurgery and then to rehabilitation) is registered in the HDR more than once.

Moreover, the identification of patient is essential for the event validation when it is necessary to collect and examine the history and clinical documentation and to assess case fatality at different intervals (6 months, 1 year). Before starting any study, it is recommended to seek approval from the local ethics committee.

7. ECONOMIC CONSIDERATION

Stroke is a costly disease because of the large number of premature deaths, ongoing disability in survivors, impact on families or caregivers and on health services (treatment and rehabilitation).

Stroke is estimated to cost the EU economy over €34 billion a year: around one-fifth of the overall cost of CVD. Of the total cost of stroke in the EU, around 62% is due to direct healthcare costs, 18% to productivity losses and 20% to the informal care of people with stroke [1]. Cost considerations are essential before implementing a population-based register.

Without a valid surveillance system, it is not possible to plan and evaluate health services for populations, implement interventions for primary prevention, and identify "vulnerable subgroups" in terms of burden of disease such as the elderly, the young, the poor, the unemployed. Surveillance and evaluation mean a systematic way of learning from experience and using it to improve current activities and promote better planning by careful selection of alternatives for future actions and allocation of resources. The economic benefit of a good surveillance system clearly exceeds the cost of the registers.

A population-based register may be costly and to produce meaningful data it needs to be in operation for at least one year but preferably for some years. However, the importance of a valid and efficient stroke register justifies the high implementation costs and the consequent need to find adequate financing.

The register based on record linkage between administrative databases is the most cost-effective, but this register depends on the data quality of the Hospital Discharge Register and the Cause of Death Register and also on the possibility of a valid record linkage. In addition, methods need further evaluation and implementation. Notably, if the hospital discharge and mortality registers are available for record linkage, the costs for the linkage and dissemination of results are low. The main costs for using this methodology for assessment of stroke incidence in a defined population concerns the need to perform regular validations of the diagnostic information. It is

recommended to include a basic epidemiologic team in the cost. Sometimes access to data produces separate costs.

The register based on a disease specific data collection is more expensive especially if hot pursuit is used. Beside the cost mentioned above, this type of register also needs funding for the detailed prospective data collection and for validation of diagnostic information. The data collection includes: identification of patients, reading medical records, making inquiries to additional data sources, filing and validation of the data. This means that a team of epidemiologists, nurses, medical doctors and informatics dedicated to this work full time is needed. To give an example, resources needed to run the MONICA Project in Northern Sweden for the stroke registration included: 1 nurse working full time (full time i.e. 40 hours/week); 1 medical secretary working 25% of full time; and 1 internist working 5% of full time [34]. It should be recognised that this type of register usually collects information that permits analyses of research questions beyond the monitoring of stroke incidence, mortality and case fatality. This may concern the role of risk factors for disease occurrence or the role of treatment for survival in stroke patients. In the Northern countries registers based on disease specific data collection have for several years complemented national administrative registers in providing a comprehensive picture of the burden of stroke in the population.

8. IMPLEMENTATION – A STEPWISE PROCEDURE

This section describes the procedures needed to implement a stroke register taking into account the recommendations reported in this manual of operations.

STEP 1. Define target population and routine data

- Select a geographical administrative area with a population big enough to provide stable estimates. This means that a stable population in a representative area of the country with 300 fatal and non-fatal stroke events in the age range 45 to 74 should be chosen.
- Characterise population from a demographic point of view through a detailed description of the characteristics of the population under surveillance, in particular: demographic characteristics: (age and gender distribution); socio-cultural characteristics (educational level, occupation, social group, unemployment rate, migration, immigrants with or without citizenship); characteristics of the healthcare system (specialised hospital, GP, rehabilitation clinic); macro and micro areas (urban and rural). Disease frequency is often different in macro areas of the country; a description of difference in mortality and risk factors allows to select those areas to be included in the surveillance system. Within the population-based surveillance study, the phenomenon of immigration plays an important role, therefore immigrants coming from European and extra-European countries resident in the study area must be enrolled. Geographical or administrative borders of the surveillance areas must be clearly defined.
- Analyse existing Hospital Discharge and Mortality data: events in non-residents occurring in the study area or admitted to hospital in the study area do not qualify. Events of residents occurring out of the area do qualify. Efforts must be made to find them or to estimate the potential loss and whether or not it could be changing

and interfering with the validity of the observed trends in rates over a period of years.

- Identify problems with these data: coverage, ICD version, ICD codes, procedures, DRG, unit of analysis (number of events or discharges and/or number of patients), PIN, coherence with previous studies, etc. Data files are often available in detailed forms at the regional level.

When a register is launched for the first time, a plan for future follow-up to measure trends is recommended. This can be achieved by a continuous surveillance as part of a broader health information system or by annual register repeated at 5 to 10 years intervals.

STEP 2. Perform a pilot study and validate routine data

Before starting a stroke register or a large scale use of linked administrative data, a pilot study on available hospital discharge and mortality data in a small area is recommended in order to study the feasibility and to estimate internal validity.

Validation studies on available data include:

- estimation of coverage: comparison of different routine data sets (electronic or manual), number of patients treated in- and out-of-area, hospital/mortality ratios, age and gender ratios, principal vs. secondary and/or procedure diagnoses;
- validation of discharge diagnoses according to a standard method (including revision and abstraction of medical records) in a random sample or in all cases (including check of other related diagnoses);
- validation of mortality causes according to a standard method in a random sample or in all cases;
- analysis of demography and representativeness of the area in comparison with the region or country;
- selection of the age range of interest (35 to 74 or 35 to 84).

STEP 3. Carry out record linkage using administrative data

In the Northern countries where every citizen has a PIN included in national registers of hospital discharges and deaths, record linkage for the identification of stroke events is efficient and reliable. For countries which have not adopted the PIN it may be much more difficult to perform this step. Files have to be organised with the same format and variables (family name, name, date of birth, residence and place of birth).

It is recommended to:

- explore the feasibility of record linkage within hospital records - probabilistic or deterministic approach or using PIN (within the same hospital, among hospitals of the area, among hospitals at regional or national level). When hospital records are collected at regional or national level, it is possible to collect events that occur out-of-hospital;
- explore the feasibility of record linkage between hospital records and mortality register (probabilistic or deterministic approach or using PIN);
- explore the feasibility of linkage with other sources of information (e.g. GP, drug reimbursement register). Not all GPs are organised in networks, with computerised documentation of patient history; when they are, the definition of events rarely use the same diagnostic criteria.

STEP 4. Set up a stroke register

After performing STEP 2 and 3, it is possible to set up a population-based stroke register following A (record linkage between administrative registers) or B (specific stroke register).

A. Register based on routine administrative data based on record linkage:

- when the linkage procedure between hospital discharge and mortality records is feasible, it is important to define the event, the duration, how to handle transfer between hospitals with difference in the diagnoses between the admitting hospital

and the hospital where the patient is transferred, how to define first time events, recurrent events, fatal ad non-fatal events etc. (See paragraph 4.1). A linkage system and a control for duplicate records should be set up;

- validation of diagnostic information is recommended in a random sample of sufficient size of the identified events, with the estimation of sensitivity and specificity and positive predictive value of the defined events;
- target population data by age and gender are needed to estimate incidence, recurrence, attack rate, case fatality and mortality rates;
- periodic validations should be performed.

B. Specific Stroke Register:

- set up a pilot population-based register with proven standardised protocol for stroke and evaluate the pilot study results (coverage, completeness of information and diagnostic validity);
- based on the results of the pilot study, set up, if feasible, a full scale register and decide whether to use hot or cold pursuit;
- then, if feasible, design the full-scale register (target population, data collection methods and validation procedures).

To set up a full scale register:

- select one or more populations representative for the region or the country;
- for each selected population set up a population-based register with approved standardised protocol for stroke;
- write a detailed protocol for the data collection including validation procedures for each single case;
- evaluate the coverage, representativeness and completeness of information;
- use the results from the register to validate the administrative data.

STEP 5 Disseminate results

- Set up a strategy for analysis of data and for dissemination of results;

- indicators of attack rate, incidence, case fatality and other indicators defined in EUROCISS phase I should be published yearly, e.g. on a web-site, according to gender, age and other relevant characteristics;
- use data for research. This is very important to ensure a high quality of the register over time. And a high quality register can be the basis for good research.

TABLE 1. NATIONAL POPULATION-BASED STROKE REGISTERS

Country	Starting year	Last year available	Ongoing experience	Age range	Target population (x 1,000)		Access data
					Men	Women	
Denmark	1978	2001	yes	35 to 85+	2,677	2,734	NIPH
Finland	1991	2003	yes	35 to 85+	2,600	2,600	NIPH
Sweden	1994	2006	yes	all	4,589	4,523	NBHW

NIPH, National Institute of Public Health
NBHW, National Board of Health and Welfare

Source: European J of Public Health 2003; 13 (Suppl 3): 55-60 (updated 2006)

TABLE 2. REGIONAL POPULATION-BASED STROKE REGISTERS

Country	Area coverage	Starting Year	Last year available	Ongoing experience	Age range	Target population (x 1,000)		Access data
						Men	Women	
Finland	FINSTROKE	1993	1997		35 to 85+	93	103	NIPH
France	Dijon	1985	2004	yes	6 months→	69	81	CHU Dijon
Germany	Erlangen	1994		yes	18+	49	51	University of Erlangen
Greece	Arcadia	1993	1995	no	20+	42	39	Alexandra Hospital, University of Athens
Italy	8 areas (North, Centre and South Italy)	1998	1999	yes (every 5yrs)	35 to 74	4,500		Istituto Superiore di Sanità
Norway	3 counties	1972	2002	yes	all	1,000		Health Region West
Sweden	Northern Sweden	1985	ongoing	yes	25 to 74	160	162	Umeå University Hospital

NIPH, National Institute of Public Health
CHU, Centre Hospitalier Universitaire

Source: European J of Public Health 2003; 13 (Suppl 3): 55-60 (updated 2006)

TABLE 3. EXAMPLES OF HEALTHCARE SERVICES-BASED STROKE REGISTERS IN COUNTRIES PARTICIPATING IN THE EUROCISS PROJECT

Country	Area Coverage	1st Year	Age range	Access data
Greece (Athens)	Regional	1992	18+	Alexandra Hospital, University of Athens
Greece (Arcadia)	Regional	1993	20+	Alexandra Hospital, University of Athens
Hungary (HDR)	National	1996	all ages	The Centre for Health Information, National Health Insurance Fund, Department of Financial Informatics
Hungary (GP)	Regional	1998	all ages	School of Public Health, University of Debrecen
Poland	Selected hospitals	2001	all ages	Institute of Psychiatry and Neurology Warsaw
Sweden (Riks-Stroke)	all hospitals (85)	1995	all ages	Department of Internal Medicine, Norrland Umeå University Hospital

TABLE 4. METHODS FOR SURVEILLANCE OF CEREBROVASCULAR DISEASE IN THE POPULATION

Type of registers/health surveys	Data sources	Data collection	Indicators
Specific stroke registers	Mortality HDR GP Records Other sources	Collection of data including fatal and non fatal cases in and outside hospital by hot/cold pursuit	Attack rate / Incidence rate / Prevalence/ Case fatality rate Treatment Years of life lived with disability (YLDS) Estimate of long-term care needs
Registers based on routine administrative data	Mortality registers Hospital registers Drug-dispensing registers	Hospital discharge and mortality data unlinked with or without validation	Mortality Hospitalisation Length of stay Prescribed medication
		Extraction of hospital discharge and mortality data with record linkage and with or without validation of a sample	Attack rate / Case fatality rate
GP based-registers	GP reports to national centres	GP databases	Incidence rate / Prevalence
Surveys	Health interview and/or health examination	Questionnaire and medical examination of random population samples	Prevalence Risk factors

TABLE 5. SOURCES OF INFORMATION

Data sources	Routine administrative register	Specific stroke register
Death certificate	X	X
HDR	X	X
Autopsy register		X
Nursing home and clinic		X
Emergency and ambulance		X
GP register		X
Radiology		(X)

REFERENCES

1. Petersen S, Peto V, Rayner M, Leal J, Luengo-Fernandez R and Gray A. European cardiovascular disease statistics 2005. BHF: London.
2. Asplund K. Stroke in Europe: widening gap between East and West. Cerebrovasc Dis 1996; 6: 3-6.
3. Khaw K. Epidemiology of stroke. Journal of Neurol, Neurosurg and Psychiatry 1996; 61: 333-338.
4. Stegmayr B, Harmsen P, Rajakangas AM et al. Stroke around the Baltic Sea: incidence, case fatality and population risk factors in Denmark, Finland, Sweden and Lithuania. Cerebrovasc Dis 1996; 6:80–88.
5. Stegmayr B, Asplund K. Exploring the declining case fatality in acute stroke. Population-based observations in the northern Sweden MONICA Project. J Intern Med 1996; 240 (Suppl 3):143-9.
6. European Federation of Neurological Societies Task Force. Neurological acute stroke care: the role of European neurology. Eur J Neurol 1997; 4: 435-441.
7. Thorvaldsen PM, Asplund K, Kuulasmaa K, Rajakangas A-M, and Schroll M. Stroke incidence, case fatality, and mortality in the WHO MONICA project. Stroke 1995; 26: 361-367.
8. Asplund K, Marke L, Terent A, Gustafsson S and Wester PO. Costs and gains in stroke prevention: European perspective. Cerebrovasc Dis 1993; 3 (Suppl l): 34-42.
9. Bergman L, Van der Meulen JHP, Limburg M and Habbema JDF. Costs of medical care after first-ever stroke in the Netherlands. Stroke 1995; 26: 1830-1836.
10. Strong K, Mathers C, Leeder S, Beaglehole R. Preventing chronic diseases: how many lives can we save? Lancet 2005; 366: 1578-82.
11. The EUROCISS Working Group. Coronary and Cerebrovascular Population-based Registers in Europe: are morbidity indicators comparable? Results from the EUROCISS Project. European J of Public Health 2003; 13 (Suppl 3): 55-60.

12. Hatano S on behalf of the participants in the WHO Collaborative Study on the Control of Stroke in the Community. Experience from a multicentre stroke register; a preliminary report. Bull World Health Organ 1976; 54: 541-553.
13. Thorvaldsen P, Kuulasmaa K, Rajakangas AM, Rastenyte D, Sarti C, Wilhelmsen L. Stroke trends in the WHO MONICA project. Stroke 1997; 28 (Suppl 3):500-6.
14. Sarti C, Stegmayr B, Tolonen H, Mahonen M, Tuomilehto J, Asplund K; for the WHO MONICA Project. Are Changes in Mortality from Stroke Caused by Changes in Stroke Event Rates or Case Fatality? Results From the WHO MONICA Project. Stroke 2003; 34: 1833-41.
15. The European Register Of Stroke (EROS) www. http://www.ktl.fi/eros/index.html (accessed 21 March 2007).
16. European Community Health Indicators Monitoring (ECHIM) Project. http://www.echim.org/ (accessed 16 May 2007)
17. WHO STEPS Stroke Manual: the WHO STEPwise approach to stroke surveillance. http://www.who.int/chp/steps/Manual.pdf (accessed 21 March 2007).
18. Federici A. Le parole della nuova Sanità. Il Pensiero Scientifico Editore 2002.
19. Asplund K, Tuomilehto J, Stegmayr B, Wester PO, Tunstall-Pedoe H. Diagnostic criteria and quality control of the registration of stroke events in the MONICA project. Acta Med Scand Supplementum 1998; 728: 26-39.
20. The EUROCISS Project Research Group. EUROCISS Project final report 2003 http://www.cuore.iss.it/eurociss/en/rapporto03/rapporto2003.asp (accessed 17 May 2007).
21. Mähönen M, Salomaa V, Keskimäki I, Moltchanov V, Torppa J, Molarius A, Tuomilehto J, Sarti C for the FINMONICA Stroke Register Study Group. The feasibility of combining data from routine hospital discharge and causes-of-death registers for epidemiological studies on stroke. Eur J Epidemiol 2000; 16: 815-7.

22. Pajunen P, Pääkkönen R, Hämäläinen H, Keskimäki I, Laatikainen T, Niemi M, Rintanen H, Salomaa V. Trends in fatal and non-fatal strokes among persons aged 35-85+ years during 1991-2002 in Finland. Stroke 2005; 36: 244-248.
23. Fleming DM. The measurement of morbidity in general practice. J. Epidemiol. Community Health1991; 45: 180-183.
24. Walley T, Mantgani A. The UK General Practice Research Database. The Lancet1997; 350: 1097-99.
25. Brage S, Bentsen BG, Bjerkedal T, Nygard JF, Tellnes G. ICPC as a standard classification in Norway. Fam. Pract 1996; 13: 391-396.
26. Chauvin P, Valleron A. Participation of French general practitioners in public health surveillance: a multidisciplinary approach. J. Epidemiol. Community Health 1998; 52 (suppl 1): 2s-8s.
27. Milne RM, Taylor MW, Taylor RJ. Audit in populations in general practice: the creation of a national resource for the study of morbidity in Scottish general practice. J. Epidemiol. Community Health 1998; 52 (Suppl 1): 20s-24s.
28. Szeles Gy, Voko Z, Jenei T, Kardos L, Pocsai Z, Bajtay A, Papp E, Pasti G, Kosa Z, Molnar I, Lun K, Adany R. A preliminary evaluation of a health monitoring programme in Hungary. Eur. J. Pub. Health 2005; 15: 26-32.
29. Fellegi IP, Sunter AB. A Theory for Record Linkage. J Am Stat Ass 1969; 64: 1183-1210.
30. Tunstall-Pedoe H. Diagnosis, measurements and Surveillance of Coronary Events. Int J Epidemiol 1989; 18 (Suppl 3): S169-173.
31. Leppala JM, Virtamo J, Heinonen OP. Validation of stroke diagnosis in the National Hospital Discharge Register and the Register of Causes of Death in Finland. Eur J Epidemiol 1999;15(Suppl 2):155-60.
32. World Health Organization: Cerebrovascular Diseases. Prevention, Treatment, and Rehabilitation. WHO Tech Report Ser 1971; 469.
33. Recommendation no. R (97) 5 of the Committee of Ministers to Member States on the protection of medical data (Adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting.

34. Stegmayr B, Lundberg V, and Asplund K. The events registration and survey procedures in the Northern Sweden MONICA Project. Scand J Public Health 2003; 31(Suppl.61):9-17.

CARDIOVASCULAR SURVEYS: MANUAL OF OPERATIONS

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APPENDIX I

London School of Hygiene Cardiovascular Questionnaire and Diagnostic Criteria

REFERENCES

ABBREVIATIONS

ABI = Ankle/Brachial Index
ACS = Acute Coronary Syndromes
AMI = Acute Myocardial Infarction
AP = Angina Pectoris
ATC = Anatomical Therapeutic Chemical (classification system)
CABG = Coronary Artery Bypass Graft
CHD = Coronary Heart Disease
CVD = CardioVascular Disease
CW = Continuous Wave
2D = 2-Dimensional
DALY = Disability Adjusted Life Year
ECG = Electrocardiogram
ECHIM = European Community Health Indicators Monitoring
EHRM = European Health Risk Monitoring
EU = European Union
EUROCISS = European Cardiovascular Indicators Surveillance Set
EUROSTAT = Statistical Office of the European Communities
GP = General Practitioner
HDR = Hospital Discharge Records
HES = Health Examination Survey
HF = Heart Failure
HIS = Health Interview Survey
IC = Intermittent Claudication
ICD = International Classification of Diseases
IHD = Ischaemic Heart Disease
ISI = International Statistical Institute
LSHTM = London School of Hygiene and Tropical Medicine
MI = Myocardial Infarction
MONICA = MONItoring trends and determinants of CArdiovascular diseases
OECD = Organisation for Economic Cooperation and Development
PAD = Peripheral Arterial Disease
PCI = Percutaneous Coronary Intervention
PIN = Personal Identification Number
PTCA = Percutaneous Transluminal Coronary Angioplasty
PVD = Peripheral Vascular Disease
PW = Pulsed Wave
QoL = Quality of Life
SEP = Socioeconomic Position
WHO = World Health Organization

1. INTRODUCTION AND RATIONALE

1.1 Burden of disease

The most frequent forms of cardiovascular disease (CVD) are those of an atherosclerotic origin, mainly Ischaemic Heart Disease (IHD), stroke, Heart Failure (HF) and Peripheral Vascular Disease (PVD).

CVD clinically manifests itself in middle life and older age, after exposure to risk factors. Even though clinical onset is mainly acute, CVD often evolves gradually and causes substantial loss of quality of life, disability, and life long dependence on health services and medications. The societal costs of CVD are substantial and they are not only those directly related to healthcare and social services, but also include those linked to: a) illness benefits and retirement; b) impact on families and caregivers; and c) loss of years of productive life.

Changes in society's socio-economic conditions and their concomitant influence on lifestyles affect the level and evolution of CVD in populations and individuals, in such a way that small changes in the prevalence of common risk factors like hypertension or smoking might have a large impact on the incidence of CVD [1]. However, the absolute number of patients in need of using health services for CVD conditions does not decrease to the same extent due to an increase in survival and a growth in the proportion of older people.

The magnitude of the problem contrasts with the usual paucity and poor quality of data available on incidence and prevalence of CVD, except for few rigorous but limited studies carried out in certain geographical areas.

Leading causes of CVD morbidity and mortality are IHD and stroke. Just under half of all deaths from CVD are from IHD and nearly a third are from stroke, and this is the case in almost all the European Union (EU) countries.

In 2005, all chronic diseases accounted for 72% of the total global burden of disease in the population ages 30 years and older. CVD alone accounts for 20% of global total Disability Adjusted Life Years (DALYs) in those older than 30 years of age [2].

In terms of health, acute events may mean an increasing number of dependent, chronically ill and disabled people which may cause increasing costs of healthcare

and strain the healthcare system. Despite this, according to the Organisation for Economic Cooperation and Development (OECD), it does not appear inevitable that longer life leads to higher costs. This is one of the reasons why the health system should be largely oriented to work on preventive actions.
Epidemiological studies have shown that CVD is preventable to a large extent. Public actions to lower the prevalence of risk factors in the population require a clear understanding and knowledge of the magnitude and consequences of CVD. Once reliable data are available, different preventive strategies can be implemented to reduce the occurrence and impact of disease.

Health Interview and Health Examination Surveys (HIS/HES) to determine the distributions, frequencies and determinants of CVD and their trends are essential to plan and implement prevention and control programmes.

1.2 Cardiovascular Disease Surveys

The objectives of a population health survey is to evaluate the frequency and the distribution of CVD and its risk factors, to evaluate trends and treatment effectiveness, to estimate distribution and prevalence of high risk conditions and to monitor prevention programmes and their effectiveness.
Focusing on the general population, surveys may provide a comprehensive picture of the disease in the community, highlight problem areas and suggest where treatment facilities and strategies are most in need of improvement. They may provide the information needed to plan healthcare services and to develop and test which methods are most useful as a basis for preventive and treatment action. These population-based surveys provide, as well, valuable additional information that can be linked with the information generated by other sources such as population-based registers.
Clinical and vital statistical studies have contributed notably to the understanding of causes and distribution of CVD, but their conclusions usually require verification by direct measurements on defined populations. Moreover, certain types of questions cannot be answered except through the conduct of specific CVD surveys.

CVD surveys are needed in order to understand the characteristics, the burden and the consequences of the disease in the population through:

- the monitoring of the occurrence of disease, i.e to assess the population differences and trends in disease prevalence over time;
- the understanding of the differences and changes in the natural disease dynamics between genders, age groups, social classes, ethnic groups etc.;
- the identification of vulnerable groups;
- the monitoring of the consequences of disease in the community;
- the monitoring of the utilisation of new diagnostic tools and treatments and their impact.

This is crucial in order to:

- develop health strategies and policies;
- plan health services and health expenditures;
- improve appropriate allocation of resources;
- evaluate the effectiveness of interventions.

Surveys must follow standardised procedures and methods in order to:

- avoid biases from diagnostic fashions;
- ensure data comparability (different populations and trends);
- ensure data comparability with other surveys within the country;
- ensure international comparability.

1.3 Historical Background

The modern era of cardiovascular epidemiology began after the Second World War with the establishment of a number of cohort studies. What follows is a brief description of some of the studies that have contributed to our understanding of CVD epidemiology.

The *Framingham Study*, the best-known study, and a model for many others, was launched in the early 1950s. Several thousand men and women of all ages in Framingham, a community near Boston, were examined for certain personal suspected risk factors and followed-up for many years for coronary heart disease (CHD). The most consistent and powerful of these in explaining coronary risk were cigarette smoking, hypertension, plasma lipids and overweight. The control

of these factors has occupied a central role in health promotion and public policy [3].

The *Seven Countries Study* was the first to compare CVD incidence and risk factors using a common protocol and standardised methodology in different international populations (USA, Finland, the Netherlands, Yugoslavia, Italy, Greece, Japan). That study, launched at the end of 1950s and following 12,000 men ages 40-59 years at baseline, found large differences in dietary fat intake, serum cholesterol and heart disease incidence (mortality and morbidity).

The study was unique for its time in standardisation of measurements of diet, risk factors and CVD, training its survey teams and central, blindfold coding, selecting diagnostic criteria for the identification of diseases and analysis of data [4].

The *Whitehall Study*, of almost 20,000 men ages 40-69 years examined in 1960s and followed-up at regular intervals, is still being carried out (and since 1985 women have also been included). This study produced important insight into the determinants of health, highlighting the importance of the social environment in disease causation and cautioning against using stress uncritically as an explanation [5].

The *MONItoring trends and determinants of CArdiovascular diseases* (*MONICA) Study*, from the mid-1980s to mid-1990s, monitored coronary events and classic risk factors for CHD in 38 populations from 21 countries. Population surveys to estimate trends in risk factors were carried out in men and women ages 35-64 years.

Risk factors were measured with standard procedures during two surveys based on independent probability samples of the population at the beginning and the end of the 10-year period, generally with a third survey in the middle [1].

1.4 Existing Surveys in EUROCISS member countries – a brief overview

Table 1 and 2 provide a description of the main surveys on CVD. Almost all these do not specifically focus on CVD but are general health surveys, where CVD is monitored as part of the overall health monitoring of the population (i.e. as part of the national health survey). As shown in Table 1, the HES periodicity varies among countries. Methods of data collection include specific questions and/or the London School of Hygiene and Tropical Medicine (LSHTM) questionnaire for the evaluation of symptoms, medical examination and Electrocardiogram (ECG).

HIS are included in Table 2; they usually report findings from general questions on health conditions elicited through the use of self-administered questionnaires. Therefore, some conditions such as the prevalence of hypertension and diabetes could be underestimated given that only a part of diabetics and hypertensives are aware of their condition [6].

The source of all information reported in these tables is the questionnaire filled in by each EUROCISS Project partner. Data have been last updated in 2006, therefore any change occurred after this time period is not reported.

2. OBJECTIVES

The purpose of the EUROCISS Project is to provide a general guide and updated methods for the surveillance of CVD to those EU countries which lack appropriate surveillance systems and therefore wish to perform a survey in order to produce comparable and reliable indicators.

This manual represents a useful tool to estimate CVD prevalence, a core indicator recommended by the EUROCISS Project research Group for inclusion in the short list of health indicators set up by the European Community Health Indicators Monitoring (ECHIM) Project. This Project was launched in 2005 with the aim of implementing health monitoring in EU [7].

The procedures illustrated in this manual are designed with the main goal of simplicity and ease of implementation. Starting from a minimum data set and following a step-wise procedure, a standardised model for the implementation of surveys is provided.

These Survey procedures are aimed at describing the prevalence of the following CVD conditions: Myocardial Infarction (MI); HF; Angina Pectoris (AP); Peripheral Arterial Disease (PAD); Stroke; and IHD.

More detailed surveys may collect information on risk factors, social and demographic variables of population.

3. STRATEGY FOR SURVEILLANCE

3.1 Surveillance methods and types of registers

Surveillance is the ongoing, systematic collection, analysis, interpretation and dissemination of health information to health professionals and policy makers. Surveillance, defined as a continuous, and not episodic or intermittent activity, differs from monitoring [8,9].

Disease surveillance in a population can be done using many different data sources (Table 3). Most countries have national databases on causes of death and on discharge diagnoses for hospitalised patients.

Mortality statistics have for many years been the main tool for monitoring CVD trends and comparing health, disease pattern and mortality within and between countries. Causes of death are coded according to the International Classification of Diseases (ICD) to make data comparable among countries but the different ICD versions adopted by countries and different methods of ascertainment have led to problems in comparison.

In recent years routine statistics have also included hospital discharge diagnoses which, in some countries, are coded according to the same ICD as the mortality data.

Many countries have also HIS/ HES. These surveys are primarily used for monitoring CVD prevalence, risk factors (health behaviour, social network, environmental risk factors) and disease consequences (disability, reduced physical function, unemployment).

Relationship between Registers and Surveys

HIS and HES were developed to supplement information collected from routine information systems with additional details on socio-demographic characteristics, data on risk factors and physical/biological measurements in order to develop consistent public health policies. Based on the self-reports (HIS) and with the added benefit of physical examinations (e.g. blood pressure) and/or biological measurements (e.g. serum cholesterol) (HES), surveys enable policy makers to set priorities and to monitor trends in the health of the population.

Data for health monitoring, including monitoring of CVD, can be obtained from both registers and surveys; these instruments complement each other, since one has limitations not present in the other.

In general, institutional-based registers such as hospital discharge or General Practitioner's (GP) register can provide an overview on treated morbidity and suggest hypotheses for further investigations. These types of registers are valuable for healthcare services evaluation, but are not sufficient for health monitoring purposes. There are two main reasons for this: firstly, registers are subject to selection bias, as health service users differ from the general population. Secondly, estimates of prevalence are difficult to obtain, as the denominator (i.e. total number of patients seen within a particular time period) remains unclear or must be approximated; in addition, the numerator is sometimes also questionable due to the lack of exhaustivity of the registration process. Population-based register can partly overcome this problem, but coverage remains a major concern.

Population health surveys can overcome much of the selection bias affecting register data, provided that participation rates are high in all population subgroups. The added value of a population-based survey is the horizontal approach of data collection, enabling the collection of a wealth of information on health and its determinants: health status, health determinants, personal characteristics, uptake of services, etc. The simultaneous collection of these elements from the same person makes it possible to produce a global picture of the health of the population, identifying priority areas for treatment and prevention. In addition, when data are periodically gathered over time, changes in health and effects of health policies and interventions can be monitored.

The population health survey brings together the arguments for an increased investment in health promotion and prevention, and rationalisation on healthcare and expenditure. This information thus provides a powerful framework for a rational policy decision-making process.

On the other hand, the results of health surveys have to be interpreted with caution as compared with more objective data coming from registers or routine statistics. Selection bias may result from non-response due to those who refuse to participate or could not be reached. As data are collected in a sample of the

population, statistical methods have to be applied taking into account the sampling design in order to interpret the results adequately. In addition, due to the relatively small sample size, health surveys are usually not suitable for health monitoring in small geographic areas. For these purposes, particular surveys targeted to special populations or applying small-area methodology are more appropriate techniques.

Health Information Surveys and Health Examination Surveys

HIS may be part of a permanent system of data collection at a national or regional level. They can be repeated periodically, in a new sample of the population, or follow up over time all or a subgroup of those recruited at baseline. One of the main characteristics of a survey is that most of the information gathered is provided by the individuals themselves, with all the potential subjectivity involved. Their experience and how they feel in relation to their own health status plays a major role, as well as the level of knowledge they have about it. Medical diagnoses refer to the declaration of a person answering the question: 'Has a doctor ever told you that you have …?' without any objective verification of the diagnosis by medical records; in some instances the self-reported information may not be sufficient to assess CVD morbidity. On the other hand, not only the conditions are considered, but there is also the possibility of investigating their impact on the functional status of the respondent; hence functionality and disability related to the disease are also important issues that can be investigated by a survey.

Self-reported information on disease can be more reliable if integrated with questions on drug specific consumption.

HES are designed to investigate health issues: data are collected using survey questionnaires; in addition, physical examination and/or biological testing are carried out to obtain objective measurements to complement the subjective reporting of individuals.

A HIS/HES can vary in size and complexity, from an interview with a few measurements and/or blood assay to a comprehensive health examination taking several hours to complete. Some CVD risk factors can only be identified by

clinical measurements such as blood pressure, blood lipids, blood glucose. ECG is also an important tool to assess CVD, in particular to detect an old myocardial infarction, atrioventricular conduction defects, arrythmias and left ventricular hypertrophy. It can be read according to the Minnesota Code, that changes qualitative diagnoses into quantitative results; in fact, Minnesota Code allows researchers to measure waves magnitude and duration and to transform them into numerical measures [10]. More clinical information can be obtained by clinical examinations carried out by nurses and doctors, which enables the actual prevalence of many CVD conditions to be assessed. Hand–held echocardiography is recommended to make a reliable diagnosis of HF [11].

High costs of clinical examination make HES difficult to carry out; only few HIS and HES use properly standardised and sensitive methods to assess CVD morbidity.

Ad hoc CVD surveys provide important information on risk factors and disease prevalence but are seldom representative of the whole country. They are usually conducted on adults and often have some age cut-off (e.g. exclude subjects older than 70 years). Their reliability depends greatly on the participation rate and methodologies adopted. If conducted in representative population samples, *ad hoc* CVD surveys may provide a reliable estimation of CVD prevalence. Standardised procedures and methods are available, such as the questionnaires from the LSHTM used to identify effort AP, old MI and intermittent claudication (IC). These have been used for many years in population studies and are available in different languages. They may evaluate the presence of symptoms, of great importance for the health system when evaluating the burden of disease, because they record not only the acute manifestations of a previous disease (for example old MI), but also the symptoms (for example chest pain) which contribute to the use of health services and to health costs.

4. MINIMUM SET OF QUESTIONS FOR HEALTH INTERVIEW SURVEYS

Detailed guidelines about population health survey design and methods are provided in other publications [12]. A document produced by the Statistical Office of the European Communities (EUROSTAT) Task Force 2 is available on the website europa.eu.int/comm/eurostat [13]. This manual provides further indications specific for HIS on CVD questions.

Self-completed questionnaires, direct interviewer-administered questions and telephone interviews are common methods used to collect information from individuals enrolled. Questionnaire design depends on the method of administration and questionnaires need to be validated.

As a general recommendation, a strategy for surveillance would be to use a national population health survey as the instrument of choice to collect information on CVD risk factors and prevalence. A minimum set of questions should be included (short module), together with a longer and more detailed module to be administered periodically, for example every 5-10 years.

Essential items to be recorded in any survey are: full name, gender, marital status, date of birth, area of residence, identification number, date of interview and identity of the interviewer. In order to respect privacy and confidentiality of respondent, full name, area of residence, identification number and exact day of birth are never disclosed; even if the respondent gives informed consent, the anonymity is preserved (especially in the case of sensitive health data). Recording the Personal Identification Number (PIN), which is used by the national health service, makes it possible to link data collected with hospital discharge records (HDR) or death certificate, eventually for the follow-up. Educational level (expressed as years of education) and occupational classification are important because CVD recognises a Socioeconomic Position (SEP) influence (See also Section 6.3) [14].

The most important outcome measures in surveys are estimates of the prevalence of CVD (old MI, AP, IC, HF, Stroke). These can be obtained by asking directly about each condition, or can be measured indirectly through questions to assess symptoms. When designing a questionnaire to obtain such estimates, it is

important to consider that all current techniques for measuring the prevalence of CVD have some limitations, for example symptom questionnaires have poor specificity for IHD and cannot be relied upon for cross-cultural comparisons of prevalence. The comparison of prevalence estimates based on a history of diagnosed heart disease may be biased by differences in access to medical care and diagnostic facilities. If HIS can be combined with HES, the addition of clinical examinations can improve on the estimates. For example, ECG criteria for prevalence of IHD (standardised through use of Minnesota coding) are more likely to yield unbiased comparisons of prevalence than questionnaire alone.

The minimum set of questions and recommendations for each condition are reported below. Irrespective of presence of symptoms, the presence of the condition diagnosed by a doctor, together with the use of medication to treat the condition, should be considered indicative of the presence of the disease. Moreover, questions like "Have you ever told by a doctor that you had …heart disease?" can be followed by questions about the diagnostic and therapeutic procedures performed (Percutaneous Transluminal Coronary Angioplasty -PTCA-; Coronary Artery Bypass Grafting -CABG-; specific medication).

4.1 Angina Pectoris

AP is the commonest symptom of IHD. To assess angina, a minimum set of standard questions (A. Recommended Questions) or the standard WHO (World Health Organization)/LSHTM questionnaire (B: Recommended Questionnaire) can be used. The standard questionnaire of the LSHTM (see Appendix I for the original version including diagnostic criteria) has been widely used; it was originally validated in men against clinical diagnoses, but it is a questionnaire that records symptoms in a standardised manner (chest pain relieved by rest) rather than the presence of disease. Especially in women, the questionnaire fails to distinguish coronary from non-coronary symptoms [15]. The questionnaire is also not recommended for use in older people [16]. Anyway, presently it represents the standardised tool translated in all languages.

A. Recommended questions

Have you ever been told by a doctor that you had angina pectoris?

If Yes: [How old were you when you had the first attack?]

[Have you had an attack in the past 12 months?]

Are you currently (in the last 2 week) taking any medicines, tablets or pills because of your angina pectoris?

If Yes: [Name the medicines you are taking]

Interventions (CABG, PTCA):

Have you ever undergone any surgery procedure because of your condition?

If Yes: [How long ago was it?]

[What type of surgery did you undergo?]

Angioplasty (balloon treatment for angina pectoris)

CABG

Other_____]

B. Recommended Questionnaire

Chest Pain on Effort - LSHTM questionnaire

Note: please do not proceed to next question if your answer is marked with asterisk (*)

- *Have you ever had any pain or discomfort in your chest?*
  - Yes (ask next question)
  - No *
- *Do you get it when you walk uphill or hurry?*
  - Yes
  - No *
  - Never hurry
- *Do you get it when you walk at an ordinary pace at the level?*
  - Yes
  - No
- *What do you do if you get it while you are walking?*
  - Stop or slow down
  - Carry on *

Record 'Stop or slow down' if subject carries on after taking nitroglycerine

- *If you stand still, what happens to it?*
  - Relieved
  - Not relieved *

If relieved:

- *How soon?*
  - 10 minutes or less
  - More than 10 minutes *
- *Will you show me where it was?*
  - Sternum (upper or middle)
  - Sternum (lower)
  - Left anterior chest
  - Left arm
  - Other
- *Do you feel it anywhere else?*
  - Yes
  - No
- *Did you see a doctor because of this pain (or discomfort)?*
  - Yes
  - No

  If yes, what did he say it was?

4.2 Myocardial Infarction

To assess an old MI standard questions (A. Recommended Questions) or the Rose questionnaire (B: Recommended Questionnaire) can be used as well.

A. Recommended questions

Have you ever been told by a doctor that you had myocardial infarction (heart attack)?

If Yes: [How old were you when you had the first attack?]

[Have you had an attack in the past 12 months?]

Are you currently (in the last 2 week) taking any medicines, tablets or pills because of your myocardial infarction?

If Yes: [Name the medicines you are taking]

Interventions (CABG, PTCA):

Have you ever undergone any surgery or operation because of your condition?

If Yes: [How long ago was it?]

[What type of surgery did you undergo?]

[Angioplasty (balloon treatment for angina)

CABG

Other]

B. Recommended Questionnaire

Possible Infarction - LSHTM questionnaire

- Have you ever had a severe pain across the front of your chest lasting for half an hour and more?

– Yes

– No

- Did you see a doctor because of this pain?

– Yes

– No

If Yes: [What did he say it was?]

[How many of these attacks have you had?]

1st attack: date_____ duration of pain_____

2nd attack date_____ duration of pain_____

3rd attack date_____ duration of pain _____

4th attack date _____ duration of pain _____

4.3 Stroke

It is difficult to use a questionnaire survey to measure the prevalence of an old cerebrovascular accident: many patients with stroke are unable to participate (they are not able to reach the place of screening or are hospitalised/in a long-term care home or are too impaired). For these reasons, if the institutionalised population is not included in the survey, stroke registers are more likely to yield valid data.

Recommended questions

Have you ever been told by a doctor that you had a stroke?

If Yes: [How old were you when you had your stroke?]

[Have you had a stroke in the past 12 months?]

Are you currently (in the last 2 weeks) taking any medicines, tablets or pills because of your stroke?

If Yes: [Name the medicines you are taking]

4.4 Heart Failure

No validated set of questions to assess symptoms of HF exists, since symptoms are not sufficiently specific for the disease. The European Society of Cardiology provided guidelines for the diagnosis of heart failure for use in clinical practice and epidemiological surveys [17]. According to these guidelines, objective evidence of cardiac dysfunction has to be present to establish the presence of heart failure, in particular: presence of symptoms of HF (at rest or during exercise), objective evidence (preferably by echocardiography) of systolic and/or diastolic cardiac dysfunction (at rest) and, in cases where the diagnosis is in doubt, response to treatment directed towards HF. The presence of shortness of breath or fatigue can be assessed by means of the WHO questionnaire [12], but a clinical examination is required to verify the presence of ankle swelling and pulmonary crepitations or rhonchi.

Recommended questions

Have you ever been told by a doctor that you had heart failure?

If Yes: [How old were you when you suffered from heart failure?]

[Have you suffered from heart failure in the past 12 months?]

Are you currently (in the last 2 weeks) taking any medicines, tablets or pills because of your heart failure?

If Yes: [Name the medicines you are taking]

4.5 Intermittent Claudication

IC is the commonest symptom of PAD. To assess PAD, LSHTM questionnaire is recommended.

Recommended questionnaire

Intermittent Claudication - LSHTM questionnaire

Note: please do not proceed to next question if your answer is marked with asterisk (*)

- Do you get pain in either leg on walking?
– Yes
– No *
- Does this pain ever begin when you are standing still or sitting?
– Yes *
– No
- In what part of your leg do you feel it?

– Pain includes calf/calves

– Pain does not include calf/calves*

If calves not mentioned, ask: Anywhere else?

If calves not mentioned, ask: Anywhere else?

- *Do you get it if you walk uphill or hurry?*

– Yes

– No *

– Never hurries or walks uphill

- *Do you get it if you walk at an ordinary pace on the level?*

– Yes

– No

Does the pain ever disappear while you are walking?

– Yes *

– No

- *What do you do if you get it when you are walking?*

– Stop or slow down

– Carry on*

- *What happens to it if you stand still?*

– Relieved

– Not relieved*

- *How soon?*

– 10 minutes or less

– More than 10 minutes

The set of questions asking about each doctor-diagnosed condition is further summarised in Table 4A.

4.6 Other relevant topics

Measurement of ***Quality of Life (QoL)*** and disability are relevant for health policy and disease burden in the population. Various standard questionnaires are available for measuring quality of life and functional capacity (e.g. SF36/SF12, EUROQOL).

Family history asks whether a first-degree relative (parent, sibling or offspring) was ever diagnosed with a premature (<55 years in men, <65 years in women)

coronary or stroke event. It is also important to specify the number of cases and the number of brothers/sisters and sons.

The minimum information to be collected on ***medical history*** should include diagnoses of hypertension, dislipidemia, diabetes and medications currently used. It is helpful to ask participants to bring medication with them at the screening so that names can be accurately recorded.

Recommended questions suggested by the European Health Risk Monitoring (EHRM) [18] are:

Hypertension

When was your blood pressure last measured by a health professional?

-Within the past 12 months

-1-5 years ago

-Not within the past 5 years

Have you been told by a health professional in the past year (12 months) that you have elevated blood pressure or hypertension?

-Yes

-No

-Uncertain

Are you currently taking medication prescribed by a doctor to lower your blood pressure?

-Yes

-No

-Uncertain

Has a doctor in the past year ordered you to change your way of life, in order to lower your blood pressure?

-Yes

-No

-Uncertain

Cholesterol

When was your blood cholesterol last measured?

-Within the past 12 months

-1-5 years ago

-Not within the past 5 years

Have you been told by a health professional in the past year (12 months) that you have raised (elevated) blood cholesterol?

-Yes

-No

-Uncertain

Are you currently taking medication prescribed by a doctor to lower your blood cholesterol level?

-Yes

-No

-Uncertain

Has a doctor in the past year ordered you to change your lifestyle in order to lower your total blood cholesterol?

-Yes

-No

-Uncertain

Diabetes

Have you ever been told by a doctor that you have diabetes?

-Yes

-No

-Uncertain

Are you currently taking insulin or pills to control diabetes?

-Yes

-No

-Uncertain

Medications taken by participants should be coded according to the pharmacological classification. See Anatomical Therapeutic Chemical (ATC) classification for Cardiovascular System at the following website: http://www.whocc.no.

The set of recommended questions for CVD risk factors are further summarised in Table 4B.

Standard questions on **smoking**, **drinking**, **physical activity**, **diet** exist and can be found in several HIS/HES [19].

Already existing questions should be reviewed and used when possible, before starting to create new questions. Other Health Monitoring Projects, in particular the EHRM Project [18], reviewed the measurement protocols of national health surveys in Europe and provided recommendations for the measurement of major chronic disease risk factors

5. MINIMUM SET OF EXAMINATIONS FOR HEALTH EXAMINATION SURVEYS

A step by step approach is recommended, taking into account time and budgetary restraints. Priorities on a minimum set of questions and examinations to include should be based on public health criteria, starting from a basic set of questions/examinations and building up layers of complexity on the basis of user needs and available resources. A stepwise approach is proposed in Table 5.

Measurements based on physical examination are generally difficult to standardise. For example, a clinical examination is less accurate than an ECG for a diagnosis of arrhythmias. However, special equipment may be difficult and cumbersome to use, specialised personnel may need to be employed and the procedure may be costly, time consuming and demanding for the respondent. Hence, when cheap and quick measurements exist they should be the first choice. Where a method exists, but is expensive, it can be used in a sub-sample to validate estimates obtained from less costly techniques (e.g. waist and hip circumference for visceral fat distribution instead of a tomography).

Each measurement should be standardised and ethically approved, which means easy to perform, not expensive and without risk of harm to the patient.

5.1 Risk factors

The minimum set of measurements should include indicators for risk factors, in particular: arterial blood pressure, anthropometric measurements (height, weight and waist circumference) and a blood sample (for lipid and glucose measurements).

Protocols and operational guidelines for these measurements have been published as part of the EHRM Project [18]. A brief summary of methods to measure major risk factors follows below:

Arterial blood pressure – Blood pressure should be measured by a qualified nurse or physician, before drawing blood, applying the appropriate cuff (normal of for obese persons) on the right arm, with a mercury sphygmomanometer, or a validated automated device, with the participant sitting, after 4 minutes rest. Three

consecutive measurements should be performed and their mean (or the mean of the second and third) used in the analysis.

Anthropometric measurements – These should be measured with subjects wearing light clothing. ***Height and weight.*** A wall height ruler and a standard electronic scale should be used for height and weight respectively. Data should be computed in the body mass index (BMI = weight in kg divided by the square of the height in metres). ***Waist circumference*** – should be measured in cm by means of an insertion tape passed around the waist, defined as the mid point between the iliac crest and the costal margin. The subject should be in the standing position.

Laboratory tests – Total cholesterol and HDL-Cholesterol levels should be assayed on non-fasting blood samples into a laboratory certified for lipid tests by the Cholesterol Reference Method Laboratory Network. Glycemia should be assessed taking a blood sample after eight hours fasting.

Recommended procedures for more specialised CVD-specific tests are detailed below. The selection of these measurements will depend on the specific questions the survey is designed to answer, the overall burden on the respondent, cost and time considerations. The minimum required is to perform an ECG.

5.2 Electrocardiogram

The ECG is a graphic time-based record of voltage change produced on the body surface by electrical events in the heart muscle. It is employed in CVD survey for the following reasons: provide information on rate, rhythm, conduction and state of myocardium; it is useful in diagnosing manifestations of IHD (myocardial infarction, hypertrophy, angina pectoris); the information contained in the ECG is additional to and independent of that obtained by medical history and physical examination; it is of value in establishing categories of risk for future cardiac events and mortality and is an objective quantitative record of a bioelectrical signal characteristic of the individual. The participant should lie supine and the arms rest comfortably along the trunk. The position of the chest electrodes should be: V_1 fourth intercostals space, right sternal edge; V_2 fourth intercostals space, left sternal edge; V_3 midway between V_2 and V_4; V_4 fifth intercostals space where it is crossed by the midclavicular line; V_5 left anterior axillary line with the

horizontal position of position 4; V_6 same horizontal level but at the left midaxillary line.

The recording of at least five technically good complex per lead is suggested to facilitate the reading by Minnesota code.

Recommended procedures for Minnesota code

The recommended procedure for recording a resting ECG and the technical requirements for a suitable electrocardiograph are described in detail in the reference manual for the Minnesota code [10]. Minnesota code is a score to classify Q waves (item 1), ST junction (item 4) and segment depression and T waves (item 5), A-V conduction defect (item 6), ventricular conduction defect (item 7) and arrythmias (item 8). This does not need to be performed by a cardiologists; it is possible to train any observer who has a good basic technical education.

Minnesota coded major Q waves (codes 1.1 or 1.2) are recommended as the standard criterion for IHD in prevalence surveys. Use of more specific criteria including stand T-Wave changes as a measure of prevalence in epidemiological surveys is to be discouraged. In women especially, these ECG signs have poor specificity for IHD [12].

5.3 Ankle-Brachial Index (ABI) [12]

The ankle- brachial index, a ratio of ankle systolic blood pressure to arm blood pressure, is used in clinical practice to assess the patency of the lower extremity arterial system and to screen for the presence of occlusive PAD. Because of its good reliability and validity, non-invasive nature, and ease of use, the ABI has been used in epidemiologic studies to estimate the prevalence of PAD. Reports indicate that low ABI values (e.g. ≤ 0.9) are strongly associated with CVD risk factors, preclinical and clinical CVD, and CVD mortality, thus can be considered a marker for generalised atherosclerotic disease.

However, there is uncertainty regarding the lower normal limit of the ABI, with published abnormal cut-off points ranging from 0.80 to 0.98. Varying the value defining an abnormal ABI can markedly affect estimates of PAD prevalence, yet adequate studies have not been conducted in healthy population to determine the

normal ranges and lower abnormal cut-off point values of the ABI. A resting ankle-brachial blood pressure ration of less than 0.9 or a fall in ankle blood pressure of 30 mmHg or more in one or both legs is taken as evidence of PAD.

To measure the ABI, the participant should assume a supine position and rest comfortably for at least 5 minutes before the pressure is measured. This ensures that any changes in pressure that might have occurred due to previous walking have a chance to stabilise. Right and left arms and both legs should be measured. Blood pressures will be obtained in the following order: right arm, right ankle, then left arm, left ankle or simultaneously bilateral brachial artery and ankle.

5.4 Echocardiography *[20, 21, 22] (to be performed only in a subgroup)*

Echocardiography is a powerful diagnostic tool that provides immediate access for the evaluation of cardiac and vascular structures and assessment of heart function. However, echocardiography is best used after a careful history, physical examination, appropriate ECG, and chest radiograph have been obtained so that the appropriate questions can be asked. Indiscriminate use of echocardiography or its use for "screening" is not indicated.

Two-dimensional imaging can accurately quantify cardiac chamber sizes, wall thickness, ventricular function, valvular anatomy, and great vessel size.

Furthermore, echocardiography should be performed by laboratories with adequately trained physicians. Echocardiography is useful for assessing the presence of HF.

5.5 Ultrasound of peripheral arteries (carotides and femoral arteries) *[23]*

The Doppler principle states that the frequency of reflected ultrasound is altered by a moving target, such as red blood cells. The magnitude of this Doppler shift relates to the velocity of the blood cells.

Doppler ultrasonography shows the direction and velocity of blood flow and thus can detect turbulent flow due to narrowing or blockage of blood vessels. Color Doppler ultrasonography shows the different rates of blood flow in different colours. Doppler ultrasonography and color Doppler ultrasonography are

commonly used to help diagnose disorders affecting heart, arteries and veins in the neck, trunk, legs, and arms.

Currently, Doppler echocardiography consists of three modalities: Pulsed Wave (PW) Doppler, Continuous Wave (CW) Doppler, and color Doppler imaging.

PW Doppler measures flow velocity within a specific site (or sample volume) and is used in combination with the 2-dimensional (2D) image to record flow velocities within discrete regions of the heart and great vessels.

CW Doppler, on the other hand, can record very high blood flow velocities but cannot localise the site of origin of these velocities along the pathway of the sound beam.

Colour flow Doppler uses PW Doppler technology but with the addition of multiple gates or regions of interest within the path of the sound beam. In each of these regions, a flow velocity estimate is superimposed on the 2D image with a colour scale based on flow direction, mean velocity, and sometimes velocity variance.

6. POPULATION

Before planning a survey, a detailed description of the characteristics of the target population under surveillance is necessary, in particular: age range, gender distribution, socio-cultural characteristics, including ethnic origin and migration level; whether institutionalised people should be included or not; moreover geographic and/or administrative area and differences between urban and rural areas need to be identified.

When selecting the target population, a number of decisions need to be made. For example, whether or not to boost populations of interest (such as minority ethnic groups) or age groups of interest (such as older age groups for specific conditions).

6.1. Age range

For CVD surveys the age range is one of the most important criteria for selection of the respondents.

The EUROCISS Project suggests a wide age-range, that is 35+ years. The choice of the upper limit will depend on the condition of interest.

In the case of some pathologies (i.e. HF), surveys conducted among very old individuals are limited in their ability to detect different concomitant pathologies. It is therefore advisable to establish the upper age limit to 75-80 years. Young people (younger than 50 years), might be excluded from a survey of HF since they rarely have such disease, except in relation to congenital heart disease.

Similarly, if the survey is conducted to assess the prevalence of individuals who have experienced stroke, it is necessary to increase the age limit up to 84 years and to exclude young people, thus restricting the age range to 55-84 years.

As for surveys conducted among individuals with IHD or previous MI, the suggested age range is 35-80 years, thus excluding the age range 80-84 years, whose individuals are at higher risk of stroke rather than MI, and including IHD in young people.

Therefore, for the most exhaustive CVD survey the recommended age range to cover all the above-mentioned conditions is 35-84 years.

6.2. Gender

Population has to involve both genders. If an estimation of prevalence of some CVD is required, larger samples of women have to be selected because of the lower prevalence of the disease in this group.

6.3. Socio-cultural characteristics

Social classification is important because rates of ill-health display marked social gradients in most societies. Understanding the causes of these gradients is a key area of research into the epidemiology and control of CVD.

Occupational status, rate of school attendance and revenue could be used to classify socioeconomic status.

Education could be assessed asking about the highest level attained (compulsory education, higher education, university), and the number of studying years. Because differences are evident among countries with respect to school systems, it could be useful to obtain both data.

In some countries a national classification of occupational status exists. For instance, the system traditionally used by the Registrar-General for England and Wales assigned occupations to one of six classes: professional (I), managerial (Il), skilled non-manual (III-N), skilled manual (III-M), semi-skilled manual (IV), and unskilled manual (V). If no official classification exists, it should at least be possible to classify occupations as manual ("blue-collar") or non-manual ("white-collar"), or as manual work, clerical work, free profession.

Most countries use the international classification CISCO 88, in which the first digit defines the ten main occupational classes.

Income could be useful to define the socio-economic status. While this information may be obtained without difficulties in some countries (e.g. UK where these data are routinely collected) in others countries people may be unwilling to declare their earned income.

6.4. Ethnic origin and migration level

Data on ethnic groups, defined by parentage, religious and cultural characteristics are important but very sensitive.

Assessing ethnic origin is important given that CVD prevalence usually differs between ethnic groups. Considering the large number of migrants coming into Europe, the migration level is now crucial to evaluate CVD morbidity. For instance, the prevalence of some CVD, i.e. those CVD derived from rheumatic diseases, differs largely between European and extra European countries.

6.5. Geographic and/or administrative area

Geographical or administrative borders of the surveillance area must be clearly defined.

Administrative borders do not necessarily identify an homogeneous ethnic group. As a consequence, in some areas the CVD prevalence cannot be representative of the whole country. To evaluate the environmental impact on CVD prevalence, it is necessary to specify if the area is urban or rural.

7. POPULATION SAMPLING

Samples of population with the aforementioned characteristics could be chosen from the general population, or from the GP patients' list or else through opportunistic screenings.

The results yielded from the sample may be generalised to the general population from which it has been selected with a degree of precision, but only on the grounds that:

1. the sample must be representative of the parent population;
2. the sample must be sufficiently large;
3. there must be adequate participation.

In determining sample size it is often useful to seek the assistance of a statistician. The kind of information needed to determine sample size includes:

l. the objectives of the study including the plan for statistical analysis;
2. the accuracy of the measurements to be made;
3. the degree of precision required by the investigator when generalisations from a sample to the population are made;
4. if the groups are to be compared, the magnitude of the differences which the investigator regards as meaningful;
5. the investigator's resources.

The larger the sampling size, the less the sampling variation: roughly the usefulness of a sample is proportional to the square root of its size. The recommended method of sampling is probability sampling, where each individual unit in the total population has the same probability or likelihood of being selected.

The first requirement is a nominal roll or sampling frame identifying each individual member or unit of the population from which the sample is to be drawn (e.g. population census lists, voter lists, tax lists, household registers, lists of employees).

7.1. Random national samples

Random national samples could be used in questionnaire study both interviewer-conducted and self-distributed. Physical examination of a random national sample

is expensive to undertake and some cluster samples may be much easier to identify and examine. International comparisons are easily based on studies of restricted samples within each country. It is important to have representative samples from different geographical areas (North, Centre, South).

Random national samples have the advantage to be representative of the population, but their limitations lie in the fact that they may be spread across different areas too far from each other and their examination is usually expensive.

7.2. General Practitioner's network

From a GP's network samples could be selected from randomly recruited patients and from volunteer recruited patients. It is recommended that patients be randomly selected from GP's lists. This kind of selected sample, being very heterogeneous, is more representative of the general population. Samples from GP's network are also relatively easy to enrol.

7.3. Opportunistic screenings

Medical examinations not directly related to CVD, such as business checkups, voluntary blood donation, prevention initiatives (including free health visits), occasional checkups for pathologies are different from CVD surveys which provide data on population samples. These samples are not representative of the whole population.

8. RESPONSE RATE

A high response rate is extremely important, since non-respondents tend to have different health characteristics from the rest of the sample, and their omission therefore results in bias. Unfortunately, the direction and extent of the bias are often unpredictable: some subjects refuse to come for examination because they feel fit and cannot be bothered, others because they feel ill and afraid. The amount of bias introduced depends on the frequency of the condition in the sample as a whole, the proportion of non-respondents, and the extent to which the non-respondents are atypical.

With a high-prevalence condition a poor response rate is less likely to be serious, provided that non-respondents are not different from those who respond (e.g. younger, of lower socio-economic status etc).

Unfortunately most cardiovascular conditions have low prevalence rates. In a study of the ECG changes of infarction in a population with a true prevalence of 2%, failure to examine 20% of the sample among whom the prevalence was 5% would lead to a prevalence estimate among respondents of 1.25%, a proportionately serious error.

The primary aim must therefore be to obtain a response rate such that serious bias will not occur even if the non-respondents are unrepresentative. In practice this cannot always be achieved, and one must then try to assess the bias resulting from the omission of non-respondents on the basis of such information as is available for the whole sample – e.g., age, gender, and residence.

Since the likelihood of bias depends on the cause of non-response, the investigator should report the numbers that fall into various categories – for example, removed since census, on holiday, ill, dead, or refused to take part. Direct assessment of bias may sometimes be possible by making a special effort to interview or examine a sub-sample of the non-respondents.

A protocol should specify the sequence of efforts to follow up non-responders and a record keeping system to document and monitor this.

Personal contact (by nurse, physician or key local figure or the senior investigator) and convenient appointments, arrangements for time off from work, transportation, etc. may help elicit cooperation and overcome resistance to

response.

Populations with the following characteristics may have a low response rate, which may vary among countries:

- ethnic minorities;
- elderly;
- low education and occupational status;
- poorer classes;
- illness - U-shaped curve - lower response in the most sick and the most well;
- mental illness;
- institutionalised people often not included unless specifically sampled for;
- feeble memory.

9. REPORTING

The purpose of a HIS/HES is to present a picture of disease in a population at a particular point in time. The survey provides estimates of the disease prevalence, that is the number of patients who have experienced AP, HF, MI, stroke, IC and with high risk conditions (hypertension, hyperlipidaemia, diabetes). The prevalence is one of the indicators included in the ECHIM short list [7], together with attack rate and incidence which can be obtained through population-based registers.

The prevalence should be presented for the age ranges 35 to 44 years, 45 to 54 years, 55 to 64 years, 65 to 74 years, 75 to 84 years, 85 years and over (if included), according to EUROCISS recommendations, and provided for men and women separately. Indicators should be directly standardised by age (35 to 74 years) and gender using the European population as a reference [24].

10. QUALITY CONTROL

Standardisation of measurements, training of personnel and quality control are essential to assure reliable data. Manuals of operations containing detailed procedures and methods on standardisation, training and quality controls are already available [13]. It is recommended to use survey instruments whose sensitivity and specificity have already been assessed. Such questionnaires, laboratory techniques, diagnostic criteria and procedures for measurements are already available in literature. For example, the EHRM Project produced recommendations, protocols and manual of operations for chronic disease risk factors surveys, including CVD risk factors [19].

Personnel assigned to screening should be properly trained and quality control should be assured for the whole collection period. To perform a survey many medical personnel may be needed and their activities should be under regular quality control for the whole collection period in order to ensure validity and comparability of data.

To reduce measure variability it is important:

- season of year (continuous survey takes care of this);
- time of day (morning/afternoon);
- setting;
- time of last meal or last cigarette (counting at least 12 hours from the end of the last meal if laboratory analysis includes lipids).

A pilot test of the entire set of procedures and methods is needed before starting screening procedures to:

- rehearse the main investigation;
- identify problems with methods; practicality, reliability and validity;
- familiarise staff with practical problems;
- result in refinement of techniques before going into the field;
- to make observations on respondents reactions;
- record time to do interview and study procedures;
- test appropriateness of arrangement of the questionnaire- and "flow" of procedures;
- allow better estimates of space, personnel, supply and equipment needs.

11. ETHICAL ISSUES

The Helsinki declaration requires that biomedical research with human subjects must conform to generally accepted scientific principles.

The "Recommendation n. R (97)5 of the committee of ministers to EU member states on the protection of medical data" [25] gives guidelines to how medical data can be registered, stored and used in a way that ensure the rights and the fundamental freedoms of the individual and in particular the right to privacy. *(Adopted by the Committee of Ministers on 13 February 1997at the 584th meeting of the Ministers' Deputies).*

In the following the most important recommendations are presented:

"*Medical data should be collected and processed only by health-care professionals, or by individuals or bodies working on behalf of health-care professionals. Individuals or bodies working on behalf of health-care professionals who collect and process medical data should be subject to the same rules of confidentiality incumbent on health-care professionals, or to comparable rules of confidentiality.*"

"*Medical data shall be collected and processed fairly and lawfully and only for specified purposes."*

"Medical data may be collected and processed:

a. if provided for by law for:
   - *i. public health reasons; or*
   - *ii. subject to Principle 4.8[*], the prevention of a real danger or the suppression of a specific criminal offence; or*
   - *iii. another important public interest; or*

b. if permitted by law:

[*] Processing of genetic data for the purpose of a judicial procedure or a criminal investigation should be the subject of a specific law offering appropriate safeguards.

i. *for preventive medical purposes or for diagnostic or for therapeutic purposes with regard to the data subject or a relative in the genetic line; or*

ii. *to safeguard the vital interests of the data subject or of a third person; or*

iii. *for the fulfilment of specific contractual obligations; or*

iv. *to establish, exercise or defend a legal claim; or*

c. *if the data subject or his/her legal representative or an authority or any person or body provided for by law has given his/her consent for one or more purposes, and in so far as domestic law does not provide otherwise."*

'Whenever possible, medical data used for scientific research purposes should be anonymous. Professional and scientific organisations as well as public authorities should promote the development of techniques and procedures securing anonymity.

However, if such anonymisation would make a scientific research project impossible, and the project is to be carried out for legitimate purposes, it could be carried out with personal data on condition that:

a. *the data subject has given his/her informed consent for one or more research purposes; or*

b. *when the data subject is a legally incapacitated person incapable of free decision, and domestic law does not permit the data subject to act on his/her own behalf, his/her legal representative or an authority, or any person or body provided for by law, has given his/her consent in the framework of a research project related to the medical condition or illness of the data subject; or*

c. *disclosure of data for the purpose of a defined scientific research project concerning an important public interest has been authorised by the body or bodies designated by domestic law, but only if:*

i. the data subject has not expressly opposed disclosure; and

ii. despite reasonable efforts, it would be impracticable to contact the data subject to seek his consent; and

iii. the interests of the research project justify the authorisation; or

d. the scientific research is provided for by law and constitutes a necessary measure for public health reasons.'

In 1985 the International Statistical Institute (ISI) formed a Declaration on Professional Ethics, which most national statistical agencies have agreed on. The declaration can be found at http://isi.cbs.nl/ethics.htm. In short, the declaration covers obligations to society (considering conflicting interests), obligations to founders and employers (clarifying obligations and roles, guarding privileged information), obligations to colleagues (maintaining confidence in statistics, communicating ethical principles) and obligations to subjects (refers to human subjects, including individuals, households and corporate entities: in particular, avoiding undue intrusion, obtaining informed consent, modifications to informed consent, protecting the interest of persons, maintaining confidentiality of records, inhibiting disclosure of identities).

In CVD surveys it is important to obtain informed consent, to respect privacy and confidentiality, to avoid harm and to maintain well-being of the respondent.

Before conducting a CVD survey, it is important to find out if there are any national ethical restrictions to be considered.

A specific ethical issue to be considered relative to HIS/HES is related to how to deal with suspected, previously undiagnosed, pathological findings (e.g. hypertension) because of the implications e.g. with insurance policies.

12. RECOMMENDATIONS

The following ‘steps’ are recommended when planning and implementing CVD Surveys.

They are in some ways arbitrary and not purely sequential. Many “steps” take place simultaneously and recurrently throughout the conduct of a survey.

1. Definition of objectives

The aims should be specified in precise as well as general terms.

The definition of specific aims should be based on the current state of knowledge in the country and on a thorough review of the literature.

2. Choice of study population

The choice of a study population depends on a subtle balance of a number of issues:

- suitability - adequate numbers of persons at risk;
- feasibility - logistic and cost considerations;
- availability - accessibility, likelihood of cooperation.

3. Selection of variables to be measured

The characteristics to be measured are referred to as variables whether measured numerically (age, blood pressure, height, weight, cholesterol) or categorically (gender, education level, presence of CVD).

During the planning of a study it is necessary to select and define variables which will be measured (refer to Table 5).

4. Selection of measurement instruments

Methods of collecting information should be selected and applied for the following:

1. questionnaires - interview or self-administered;
2. physical examination - clinical examination by a physician (e.g. pulse rate)
3. special investigations - ECG, blood tests, weight, height etc.

5. Definition of diseases

It is also important to have clear operational definitions of CVD. Clinician establishes diagnosis by clinical judgement – avoiding rigid rules.

In a survey, unless standard working definitions are used, the findings will not be reproducible. This means that only a person who answers positively to all questions of LSHTM questionnaire for effort angina will be classified as having angina symptoms.

6. Planning the records

The types of records to be prepared include: the lists of persons to be examined; the appointment books and the letters of introduction and invitation; informed consent according to local legislation.

7. Planning the analysis and coding

Decisions on Statistical Techniques to be used in analysis, if statistician consulted, should be outlined in the planning stage.

8. Planning for time, personnel, space, supplies and equipment

To implement a survey, it is necessary to prepare budget and obtain funds; to set the time line of stages and activities; to provide a list of the numbers and types of personnel needed and for what periods (clerks, technicians, editors-and data staff, physicians, nurses, interviewers, field coordinator, etc.); to establish the amounts and types of space needed and for-what periods; to arrange personnel recruitment and training.

In addition, forms should be printed, maps and census materials should be available, sampling frames should be prepared and types of equipment and supplies needed at each stage should be provided.

Population surveys do not require highly trained clinicians or highly-skilled personnel, usually trained nurses can conduct the study.

9. Incorporation of plans in a written protocol

It is necessary to specify in writing the detailed plans as they relate to aims,

methods of procedure and plans for data analysis.

10. Recruitment of the population

Successful recruitment of a study population requires careful preparation through personal contacts and an educational campaign. In this way individuals will be motivated to join the study and community leaders will be supportive and have pride in their association with the project.

The contacts and campaigns must be made with the interests of the different groups in mind. The population or community should be understood in terms of organisations, political and cultural make up and interests in planning these contacts.

Institutional human studies or ethics committees may need to approve.

11. Recruitment and training of staff

It is recommended that interviewers and others in contact with the community are carefully selected, capable, personable and interested.

Criteria procedures for selection should take into account special needs and characteristics of the study population and the procedures to be employed.

Regular meetings for feedback and reinforcement, ongoing surveillance of techniques and results, periodic re-standardisation and quality control are required.

12. Field organisation

If a survey includes a number of procedures each done by a different worker, it is necessary to design a “line of flow” where participants pass from one station to another. A precise knowledge of staffing needs on basis of pre-tests and pilots, of the numbers of interviewers, clerks, technicians, physicians, nurses, administrative staff, of routine work done in regular working hours and of regular meeting for in-service education and problem solving is required. Persons undergoing examinations must be notified with results.

TABLE 1. HES SURVEYS -- DISEASE: ALL IHD

Country	Time period covered by surveys	Periodicity	Age range	Population recruited x 1000	Methods of data collection (last survey)			
					LSHTM	Other quest	Exam	ECG
Denmark Copenhagen City Heart Study	1976-2003	Performed in: 1976-78; 81-83; 91-93, 2001-03	20+	19,7	√	-	√	√
Denmark 2 Surveys at the Research Centre for Prevention and Health in Copenhagen	1964-2005	7 cohorts out of 11 examined 2 or more times	35-85+	41	√	√	√	√
Finland FINRISK/Health 2000	1972-2002	every 5 yrs (FINRISK); every 15 yrs (Health 2000)	30+ (Health 2000)	8 (Health 2000) 10 (FINRISK 2002)	-	√	√	√**
France (ENNS)	2006-2007	every 5 yrs	3-74	6	-	-	b)	-
France (MONICA)	1986-2006	every 10 yrs	35-64 35-74 (2006/2007)	4.800	-	√	b)	√ only in Toulouse
Germany	1997-1999	every 5-6 yrs	18-79	7,1	-	√	√	-
Greece	1994-2006	every 3-4yrs	Adult population	29	-	√	√	-
Hungary	2001	Only once	55-64	8,4	-	√	√	-
Iceland	1967-2005	continuously	All together	30	-	√	√	√
Italy	1998-2002	Performed once Next in 2007	35-74	10	√	√	√	√
The Netherlands	1998-2001	continuously	12+	5	-	√	√	-
Norway 1	1974-2003	discontinuously	30,40,45,60,75	35	√	√	b)	-
Norway 2	1984-86 - 1995-97	Next in 2006-8	20+	80	-	√	b)	-
Poland	2004-2005	Performed once	20-74	19,2	√	√	√	-
Spain (MONICA)	1986-96	every 4 yrs	25-64	1.100	√	-	-	√
Northern Sweden	1985-2004	every 5 yrs	25-64	2,5				
UK	1994-2006	every year	16+	14	-	√	√	-

** only for Health 2000 b) risk factor

TABLE 2. HIS SURVEYS -- DISEASE: ALL IHDCOUNTRY

Country	Time period covered by surveys	Periodicity	Age range	Population interviewed x 1000	Questions included (last year)
Belgium	1997-2004	every 4 yrs	35-85+/all t.	12	AMI, Percutaneous Coronary Intervention (PCI)
Czech Republic	1993-2002	every 3 yrs	15+, 5yrs ranges	25	Stroke, IHD, hypertension
Denmark	1987-2005	Performed in 1987, 91, 94, 97, 2000, 2005	15+	22	AP and all heart diseases
Finland	1978-2004	every year	15-64 (in 2003)	5	AMI, AP, HF
France (ESPS)	1988-2006	every 2 yrs	all	22	Hypertension, AMI, AP, HF, Stroke, Arteritis
Germany	1997-1999	5-6 yrs	18-79	7	AMI, AP, HF, IC, Stroke
Hungary	2000-2003	every 3 yrs	18+	7	AMI, stroke
Italy	1999-2000	every 5 years	20-79	14	AMI, Stroke
The Netherlands	1997-ongoing	continuously	0+	10	AMI, ACS, AP, Stroke
Norway	1968-2005	every 3 year	16+	3	all CVD (ICD-X Q20-28)
Poland	1996 and 2004	Performed twice	All ages	26	IHD
Portugal	1987-1998/99	every 5 yrs	35-75+/all together	49	AMI, Stroke
Spain	1987-2003	Performed in 1987, 95, 97, 2003	0-4, 5-74 (10-year grp), 75+	40	IHD, Hypertension
UK	1994-2004	every year	16+	14	AMI, ACS, HF, AP, Stroke

TABLE 3. TOOLS FOR MONITORING CVD

Data sources	Type of registers/health surveys	Data collection	Main indicators
Routine databases	Mortality Hospital registers Drug dispensing registers	National routine databases	Mortality Hospital Discharges Length of stay (Prescribed medication)
Surveys	HIS/HES	Survey based on random samples of the population Surveys representing cohorts	Prevalence
CVD registers (AMI/ACS and Stroke)	Population based	Record linkage between routine databases including cases occurring outside hospital (mortality + HDR)	Attack rate Incidence Prevalence Case fatality Treatment
		Disease-specific collection of data including cases outside hospital	Attack rate Incidence Prevalence Case fatality Treatment Years of life lived with disability (YLDS) Estimate of long-term care needs

TABLE 4A. MINIMUM SET OF RECOMMENDED QUESTIONS FOR CVD/HIS

ANSWERS: 1= YES 2= NO 8= DO NOT KNOW 9 =REFUSAL; IF "YES" GOTO NEXT QUESTION ELSE GO TO NEXT DISEASE

Question	CVD			
	Angina Pectoris	**Myocardial Infarction**	**Heart Failure**	**Stroke**
FILTR ON AGE:	35-84	35-84	50-84	50-84
1. Have you ever been told by doctor that you had …? **If yes:** 1a. How old were you when you had the first "attack"? 1b. Have you had this condition (health problem) in the past 12 months?				
2. Are you currently (in the last 2 weeks) taking any medicine (pills, drops, inj.) for this condition?				
(If "Yes" name of medicine)*				

3. Have you ever undergone any intervention (CABG, PTCA) because of your problems with your heart?

YES	1
NO	2
Do not know	8
Refusal	9

4. How old were you when you had the last intervention?

…… years old

5. What type of procedure did you undergo?

Angioplasty (balloon treatment for angina)	1
Coronary Artery Bypass Graft (CABG)	2
Other	3
Do not know	8
Refuse	9

TABLE 4 B. MINIMUM SET OF RECOMMENDED QUESTIONS FOR CVD RISK FACTORS/HIS

ANSWERS: 1= YES 2= NO 8= DO NOT KNOW 9 =REFUSAL; IF "YES" GOTO NEXT QUESTION ELSE GO TO NEXT DISEASE

Question	Risk factors	
	Blood pressure	**Cholesterol**
FILTR ON AGE:	ALL	ALL
1. When was your ….last measured by a health professional? **a. within the past 12 months** **b. 1-5 years ago** **c. NOT within the past 5 years**		
2. Have you been told by a health professional in the past year that you have elevated …?		
3. Are you currently (in the last 2 weeks) taking medications prescribed by a doctor to lower….?		
4. Has a doctor in the past year ordered you to change your lifestyle to lower your….?		
(If "Yes" name of medicine)*		

*The list of medicine should be showed by interviewed patients during questionnaire.

TABLE 5. STEP-WISE APPROACH FOR CVD HIS/HES

Level of recommendation	Health Examination Survey (HES)	Health Interview Survey (HIS)
Minimum data collection	• Height • Weight • Blood pressure • Waist circumference • Non-fasting blood sample (Total cholesterol, HDL cholesterol, glucose)	• Age • Gender • Ethnicity • Social class indicator (income, education, occupation) • Smoking • Angina questions • Previous MI questions • Previous stroke questions • Diabetes • Medication use
Minimum + 1	The above plus • Fasting blood sample (e.g. for glucose) • ECG • Ankle/ brachial index • Clinical examination for HF	The above plus • Physical activity • Diet • Alcohol • Heart Failure questions • Rose questionnaire
Minimum + 2	The above plus • Echocardiography	The above plus • Family history • Quality of life • Use of health services
Minimum + 3	The above plus • Ultrasound of peripheral arteries • Other items pertaining to research question	The above plus • PAD questions • Parity • Other items pertaining to research questions

REFERENCES

1. Kuulasmaa K, Tunstall-Pedoe H, Dobson A, Fortmann S, Sans S, Tolonen H et al. Estimation of contribution of changes in classic risk factors to trends in coronary-event rates across the WHO MONICA Project populations. Lancet 2000; 355:675-87.
2. Strong K, Mathers C, Leeder S, Beaglehole R. Preventing chronic diseases: how many lives can we save? Lancet 2005; 366: 1578-82.
3. Friedman GD, Kannel WB, Dawber TR, McNamara PM. An evaluation of follow-up methods in the Framingham Heart Study. Am J Public Health 1967; 57 (6): 1015-1024.
4. Keys A. Seven Countries. A Multivariate Analysis of Death and Coronary Heart Disease. Harvard University Press Cambridge, Massachusetts and London, England 1980.
5. Bosma A, Marmot MG, Hemingway H, Nicholson AC, Brunner E, Stansfeld SA. Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. BMJ 1997; 314:558.
6. Goldman N, Lin I-f, Weinstein M, Lin Yu-H. Evaluating the Quality of Self-Reports of Hypertension and Diabetes. Office of Population Research Princeton University. Working paper No.2002-3.
7. European Community Health Indicators Monitoring (ECHIM) Project. http://www.echim.org/ (accessed 06 July 2007).
8. The WHO STEPwise approach to stroke surveillance http://www.who.int/chp/steps/Manual.pdf.
9. Federici A. Le parole della nuova Sanità. Il Pensiero Scientifico Editore 2002.
10. Prineas RJ, Crow RS, Blackburn H. The Minnesota Code Manual of Electrocardiographic Findings. John Wright PSG Inc, 1982.
11. Galasko GWI, Barnes SC, Collinson P, lahiri A, Senior R. What is the most cost-effective strategy to screen for left ventricular systolic dysfunction: natriuretic peptides, the electrocardiogram, hand-held echocardiography, traditional echocardiography, or their combination? Eur Heart J 2006; 27: 193-200.
12. Luepker RV, Evans A, McKeigue P, K Srinath R. Cardiovascular Survey methods. World Health Organization 2002. Third Edition.
13. EUROSTAT website europa.eu.int/comm/eurostat (accessed 09 July 2007)

14. Task Force on Core Social Variables. Final Report. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-07-006/EN/KS-RA-07-006-EN.PDF (accessed 09 July 2007).
15. Harris R, Weissfeld L. Gender differences in the reliability of reporting symptoms of angina pectoris. J Clin Epidemiol 1991;44:1071–78.
16. Lawlor DA, Adamson J, Ebrahim S. Performance of the WHO Rose angina questionnaire in post-menopausal women: are all of the questions necessary? J Epidemiol Community Health. 2003;57(7):538-41.
17. Swedberg K, Hull JC, Glasgow HD, et al. Guidelines for the diagnosis and treatment of chronic heart failure: executive summary (update 2005).Eur Heart J; 2005 (26): 1115-1140.
18. EHRM project http://www.ktl.fi/ehrm/ (accessed 09 July 2007).
19. HIS/HES database https://www.iph.be/hishes/ (accessed 09 July 2007).
20. ACC/AHA Guidelines for the clinical application of echocardiography. A report of the ACC/AHA Task Force on practice guidelines. Circulation 1997; 95: 1686-744.
21. Cheitlin et al. 2003, ACC/AHA/ASE 2003 Guideline Update for the Clinical Application of Echocardiography - American College of Cardiology (www.acc.org), American Heart Association (www.americanheart.org), American Society of Echocardiography (www.asecho.org).
22. Galasko GIW, Barnes SC, Collinson P. et al. What is the most cost-effective strategy to screen for left ventricular systolic dysfunction: natriuretic, peptides, the electrocardiogram, hand-held echocardiography, traditional echocardiography, or their combination? Eur Heart J 2006; 27:193-200.
23. Quiñones MA, Otto CM, Stoddard M, Waggoner A, Zoghbi WA. Recommendations for Quantification of Doppler Echocardiography: A Report From the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography. J Am Soc Echocardiogr 2002;15:167-84.
24. Eurociss Project Report 2003–updated may 2006 http://www.cuore.iss.it/eurociss/en/rapporto03/rapporto2003.asp (accessed 09 July 2007).
25. Recommendation no. R (97) 5 of the Committee of Ministers to Member States on the protection of medical data (Adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting.