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Presenting complaint and mortality in non-surgical emergency medicine patients

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Abstract
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In 1995 and 2000 a total of 29 886 non surgical ED visits at Uppsala University Hospital were registered. Presenting complaint, admittance to a ward, length of stay, in-hospital mortality, discharge diagnoses, 30-day and long-term mortality were registered. The presenting complaints were sorted into 33 presenting complaint groups (PCGs).

For different PCGs there was different in-hospital fatality rate. Compared to the largest PCG, chest pain, the gender and age adjusted OR was 2.12 (95% CI 1.01 – 4.44) for the miscellaneous complaint group and 2.04 (95 % CI 1.35 – 3.08) for the stroke–like symptom group. Within a given PCG the in-hospital mortality could vary depending on discharge diagnoses. By relating PCG and long term mortality to the expected mortality in the population, the Standardized Mortality Ratio (SMR) could be calculated. The SMR was found to be highest in seizure 2.62 (95 % CI 2.13 – 3.22), intoxication 2.51 (95% CI 2.11-2.98) and symptoms of asthma 1.8 (1.65 – 2.06). For the same discharge diagnoses the long term mortality could differ considerably depending on PCG at ED arrival ($p<0.001$).

Between 1995 and 2000 there was a 30 % increase in ED visits at the non surgical ED. PCGs representing lesser severe conditions had increased. Demographic changes could account for 45 % of the increment and the remaining increase could be ascribed to change in visiting pattern.

In the 2000 cohort 41.0 % of all visits were performed by re-visitors. The number of revisits and five-year mortality had an inversed u-shaped relationship were patients with three re-visits within the same year had an increased mortality compared to patients with more or less visits.

Conclusion: It is possible to define presenting complaint groups (PCGs) that are robust and consistent over time and useful as a tool for epidemiological studies in the ED.

Keywords: Presenting complaint, Emergency Department, long-term mortality, Standardized Mortality Ratio, frequent attenders

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List of Papers

This thesis is based on the following papers, which will be referred to by their roman numerals:

I Safwenberg U, Terént A, Lind L. The ED Presenting Complaint as Predictor of In-Hospital Fatality. European Journal of Emergency medicine 2007; 14:324-331.

II Safwenberg U, Terént A, Lind L. Differences in long-term mortality for different ED presenting complaints. Academic Emergency Medicine 2008; 15:1-10.

III Safwenberg U, Terént A, Lind L. A lower threshold for seeking emergent care, the reason for increasing ED utilization. Submitted.

IV Safwenberg U, Terént A, Lind L. Increased long-term mortality in patients with repeated visits to the ED. Submitted.

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Contents

Abbreviations

ACS	Acute Coronary Syndrome
APACHE II	Acute Physiology And Chronic Health Evaluation II
ATLS	Acute Trauma Life Support
BAAEM	The British Association for Accident and Emergency Medicine
CEM	The College of Emergency Medicine
CI	Confidence Interval
ED	Emergency Department
EMRS	Emergency Medicine Research Society (British)
EMS	Emergency Medical Services
EpC	Epidemiologic Center
ER	Emergency Room
FAEM	The Faculty of Accident & Emergency Medicine
HR	Hazard Ratio
IFEM	The International Federation for Emergency Medicine
LOS	Length Of Stay (in hospital)
OR	Odds Ratio
PC	Presenting Complaint
PCG	Presenting Complaint Group
PYAR	Person Years At Risk
RAPS	Rapid Acute Physiology Score
REMS	Rapid Emergency Medical Score
SAEM	The Society of Academic Emergency Medicine
SMR	Standardized Mortality Ratio
STEM	The Society of Teachers of Emergency Medicine
SWESEM	Swedish Society for Emergency Medicine
UAEM	The University Association for Emergency Medicine

Introduction

Emergency department

The history of Emergency Departments (EDs) is relatively brief. An increasing population after World War II, overloaded general with work and the practice of making house calls had to decline, thus patients turned to the local hospital for treatment instead. World War II also saw the development of blood transfusions, resuscitation, rapid transport of injured patients to field hospitals and advances in the surgical care of injuries[1]. These new medical advances led both to the start of the emergency departments as we know them today as well as to the development of the emergency medical services (EMS)[2].

Coinciding with developments in the treatment of injuries were advances in the treatment of acute coronary syndrome (ACS). In Belfast, Ireland Pantridge and Geddes, 1966, demonstrated that patients with an out-of-hospital sudden cardiac arrest could be resuscitated with a mobile coronary care unit[3]. Following their lead, several medical centers in the United States and elsewhere began programs to deliver rapid emergency care to cardiac patients.

The emergency room (ER) had turned from a dedicated area in an outpatient surgical clinic into a well equipped and fully staffed emergency department.

Emergency medicine

As a result of the evolving of the Emergency department and the development of the EMS a need for a medical specialization in emergency medicine arose. Two different approaches were used to meet this demand, the Anglo-American and the Franco-German approach[4].

The first has especially skilled ED physicians and a pre-hospital emergency medical service utilizing paramedics; the second has a developed pre-hospital emergency physician service, but only a basic organization of hospital-based emergency medicine[5]. The latter form, in most countries, does not have emergency medicine as its own speciality but a supra-speciality usually with anaesthesiology.

The hospital-based emergency medicine developed parallel in the UK and the US during the 1960s and was recognized as its own speciality in the 1970s and 1980s[6]. Other English-speaking countries such as Canada, Australia, Malta and New Zeeland soon followed. The International Federation for Emergency Medicine (IFEM) was founded in 1991 growing from the association of emergency physicians in Britain, Australia, Canada and the United States. The European society for emergency medicine was founded in 1994 and the Swedish Society for Emergency Medicine (SWESEM) was founded in Uppsala 1999[7].

Today more than 11 European countries recognize hospital-based emergency medicine as a speciality. Sweden has a system where hospital-based emergency care is provided by an interdisciplinary ED, occasionally staffed with surgeons and/or internists and a pre-hospital emergency medical service utilizing only paramedics.

However, since July 1, 2006 hospital-based emergency medicine (akutsjukvård) is recognized as a supra-specialty in Sweden and today (January 2008) more than 150 physicians are enrolled in residency training programs for the specialty[8].

Triage

When the needs or demands for medical treatment significantly outstrip the available resources, decisions must be made about how to distribute these resources, recognizing that not all needs will be satisfied immediately. Terms like "rationing," "allocation," and "triage" are used to refer to the distribution of scarce resources in different health care contexts.

The term triage is used for the sorting of patients for treatment priority in ED's, in multi casualty incidents, disasters or battlefield settings[9]. The term is derived from the French word *trier*, to sort, and was originally used to describe the sorting of agricultural products. Triage is now used almost exclusively in health care contexts.

Triage was originally developed in 18th century military medicine and further advanced during World Wars I and II, the Korean and the Vietnam War[10].

The concept of using an algorithm to determine a specific treatment priority in hospital EDs was first developed in Ipswich, Australia, in the 1970s and spread from there to the rest of the world[11]. Today the use of modern triage systems is not only to determine in what priority order a patient should have care but also to estimate the time a patient can safely wait with minimum risk of medical deterioration, before start of treatment.

The following two conditions must be satisfied for an ED triage system:

1. A health care worker assesses each patient's medical needs, usually based on a brief examination.

2. The health care worker uses an established system or plan, usually based on an algorithm or a set of criteria, to determine a specific treatment priority or treatment for each patient.

Modern ED Triage systems also fulfill the following conditions:

3. In the assessment, both vital signs and presenting complaint are assessed.
4. The special algorithm or set of criteria which determine treatment priority are based on both vital signs and presenting complaint.
5. The use of a five level priority scale.
6. The Health care worker undertaking the triage has special training in triage, "triage- nurses".
7. The special algorithms or sets of criteria have a low inter-individual variability, giving an acceptable reproducibility regardless of the triage- nurse in charge.

These conditions also distinguish triage from purely arbitrary decision about distribution of health care resources[12].

The presenting complaint and the vital signs are the keystones in all modern ED triage systems as all algorithms depend on them.

Vital signs

All animals are dependent on the same basic biochemical conditions: energy derived from carbohydrates, lipids and proteins, oxygen to enable the oxidation of reduced coenzymes yielding ATP to make chemically bound energy, and a transport system to deliver energy, oxygen and building materials as well as for excretion of waste products from the cell metabolism. Finally the organism requires a stable environmental cell milieu regarding temperature and protection[13].

To maintain these basic conditions organisms have developed certain fundamental life sustaining systems. The respiratory system delivers oxygen to the circulation system which enables the blood transportation of oxygen and nutritients (such as energy) within the organism. Finally the central nervous system enables the organism to maintain a stable body temperature and body protection. Cessation of any of these systems is not consistent with life and the organism will die.

The word "Vital sign" is derived from the Latin words *vītālis* meaning life and *signum* meaning indication – "indication of life". In medical literature the term has come to mean measurable, easily reproducible physiological findings or values, obtained by physical examination, to assess the most basic body functions. Vital signs are, so to say, the mesaurable indicators of the life sustaining systems mentioned above. Four indicators

are generally accepted as such indicators, namely; respiratory rate, pulse rate, blood pressure and body temperature.

With the development of emergency medicine, the introduction of concepts such as the Acute Trauma and Life Support (ATLS™), MedicALS and general advancements in intensive care, more indicators have been proposed to become "vital signs". Pulse oximetry[14], pain[15], blood-glucose, end-tidal CO_2[16], pupil size and reactivity to light, functional status and skin signs have all been proposed.

For the ED settings some vital signs can be of more use than others. T. Olsson has validated different vital signs as to what extent they can predict in hospital, as well as long-term, mortality for non-surgical patients[17].

In his paper[18] he demonstrated, by multivariate logistic regression, for different physiological parameters registered on 12 006 consecutive non-surgical ED visitors, peripheral saturation, respiratory frequency, pulse rate and level of consciousness to be independent predictors of in hospital mortality. Body temperature and blood pressure did predict mortality in uni- but not multi-variate analysis. But as these vital signs are such basic physiological parameters he decided to keep these signs in the construction of a new score system called Rapid Emergency Medicine Score (REMS).

In the following papers Olsson compared this score system with the APACHE II score system[19], to long-term mortality (5-year)[20] and after adjusting for co morbidity[21] found the parameters to be consistent.

Thus, these six physiological parameters are easily obtained and reproducible "vital signs" which in the ED-settings are prognostic indicators for in-hospital as well as long-term mortality.

Presenting complaints

The purpose of a patient's visit to an ED is called the Presenting Complaint (UK) or Chief Complaint (US). The purpose for attending the ED is not generally driven by diagnosis knowledge but rather by the severity of a symptom or a sign.

A presenting complaint is the individual's presentation of his or her symptoms and/or signs of bodily malfunction and/or the anxiety there of. It may also be an interpretation of the patient's circumstances by a third party as in patients who are referred by the EMS, by other health care institutions or patients referred by bystanders.

A sign (lat. Signum) is any *objective* evidence of a disease, i.e., such evidence as is perceptible to the examining physician; a symptom (Gr. Symptōma) is any *subjective* perception as perceived by the patient of a noticeable change in her/his condition indicative of some bodily or mental state. Thus, the presenting complaint inevitably contains a subjective and therefore, in a scientific sense, difficult measurable component.

For the ED the presenting complaint can be more useful than a diagnosis since diagnoses in many cases are not known at the time in the ED. The presenting complaint is also the keystone in the triage system so a scientific approach to the term is desired.

In contrast to diagnoses there is no general acceptance in how presenting complaints should be categorized. However, analogous to the ICD nomenclature for diagnoses, it is possible to make a uniform nomenclature and definitions of presenting complaints equally accurate.

In the present thesis we examine this possibility of using presenting complaints as indicators for in-hospital as well as long-term mortality.

Changing perception of health in the population and new demands on ED

WHO's definition of good Health is; "a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity".

The perception of health determines, together with components as socio-economics, ethnic, hereditary, environmental, etc., the individual's appraisal of life Satisfaction[22].

The cognitive evaluation, appraisal of the meaning of good health means that we compare our perceived ideas of good health with the perceived environmental expectations, and decide on the basis of our previous experiences whether we are in good health or not[23]. Man's concept of perceived health has thus evolved. In the pre-antibiotic era, for example, premature death and/or chronic deteriorated health due to infections were seen in a majority of the population in Europe. However, the appraisal of health could have been generally good as there was no knowledge of any better health. With developing medical possibilities the perception of good health changed accordingly. In other words, the 19th century European could have been in bad health compared to today's expectations, but his apprehension of his own health could have been good.

What is less well known is that inferior life satisfaction in itself is a strong predictor of perceived poor health[24]. This means that our perception of health changes with changed life satisfaction. In other words, a healthy individual not satisfied with his life might perceive himself in poor health.

Al-Windi, Elmfeldt and Svärdsudd showed that health care consumption, especially out-patient care, appears also to be linked to perceived bad health[25] and not only to the presence of disease. The utilization of health care and especially emergency care is therefore also dependant on this expectation of health. The western world's paradox of an increasing demand for emergency medical care, despite the objective fact of a decreasing preva-

lence of serious diseases and accidents, can probably be explained by this phenomenon[26].

If our apprehension of health is an underlying reason for us to seek ED care and the presenting complaint is the way the individual describes this deterioration, presenting complaints can thus be used in studying changes in the ED demand in relation to our apprehension of health.

In the present thesis we are using presenting complaint in the investigation of the changing utilization of the ED.

Conditions for epidemiological research in emergency medicine

Although interest in medical emergencies and accidents has been present as long as medicine has been practiced, emergency medicine as a research field is young. The formation of academic emergency medicine defining, promoting and funding research has just started.

In the UK the Emergency Medicine Research Society (EMRS) was established in 1983, the first professorial appointment (Prof. D. W. Yates) and the formation of the British Association for Accident and Emergency Medicine (BAAEM) took place in 1990. The Faculty of Accident & Emergency Medicine (FAEM) was established in 1993 and in 2005 the College of Emergency Medicine (CEM) was formed by merging FAEM and the British Association for Emergency Medicine (former BAAEM) into one organization.

Emergency medicine in the US had a similar development, the University Association for Emergency Medicine (UAEM) and the Society of Teachers of Emergency Medicine (STEM) was established in the 1970s. The Society of Academic Emergency Medicine (SAEM) was formed in 1989 from the amalgamation of (UAEM) and (STEM). In 1999, ten years from the establishment of the society, more than 50 academic emergency departments had started in the US.

In 1994 a conference, "The Research Directions in Emergency Medicine Conference" was held to establish the scope in Emergency medicine research. A task group representing the American College of Emergency Physicians (ACEP) and the Society for Academic Emergency Medicine (SAEM) presented a research agenda for emergency medicine and devised strategies to implement it. The task force stated: ...A key priority for emergency medicine research includes the elucidation of basic mechanisms, pathophysiology, and treatments … New research methods are needed to assess healthcare outcomes, quality of care, and costs[27].

In Sweden the first professorial appointment in Emergency medicine (Prof. Maaret Castrén) took place at Karolinska Institutet in 2007.

As the discipline of emergency medicine encompasses the reception, resuscitation, initial assessment and management of undifferentiated urgent and emergency cases and the timely onward referral of those patients who are considered to require admission under the in-patient specialist teams or further specialist assessment and/or follow up, emergency medicine research comprise an equivalent broad field. A key task is therefore, as stated in 1994, the elucidation of the basic mechanisms to assess healthcare outcomes. The use of an epidemiological approach to this is probably useful. Indicators as mortality- and morbidity- rates, proportion in-hospitalized, procedures and treatments performed etc. might be more applicable if related to presenting complaint than to diagnosis in the ED setting. For this there must be more research and clear definitions of presenting complaints. We are investigating the possibility of this approach, in this thesis.

Aims of the study

Overall aim

The general aim of this study was to investigate the potentials for defining presenting complaint groups (PCGs), if they were robust and consistent over time and if they were useful as a tool for epidemiological studies of the ED population.

Specific aims

- To study the relationship between the presenting complaint at the Emergency Department (ED) and in-hospital fatality. (Paper I.)

- To study the relationship between the presenting complaint and long-term mortality expressed as Standard Mortality Ratio (SMR) to the population of Uppland. (Paper II.)

- To study the use of presenting complaint groups as a tool in investigating the reason for the increased utilization of the ED. (Paper III.)

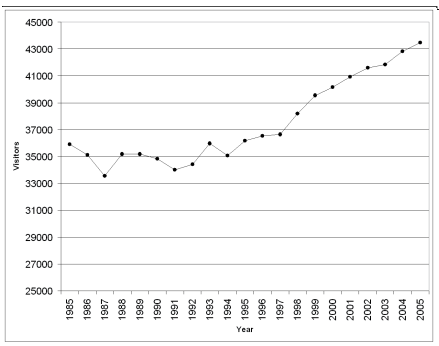
- To study if the number of ED visits, during one year, for an individual affects long-term mortality and, if the impact of the number of revisits on mortality, was dependant on the presenting complaint group. (Paper IV.)

Methods

The cohorts

Over two twelve month periods, April 1, 1995 to March 31, 1996 and January 1 to December 31, 2000, data was consecutively collected from the 12 995 and 16 891 entries, respectively, to the non- surgical ED for adults (i.e. over 18 years) at the University Hospital of Uppsala, Sweden.

The hospital had, at the time of the study, a 1200 bed capacity. The catchment area for the ED had a population of 186 800 inhabitants over 18 years of age (51. 5% female) in 1995 and 193 100 inhabitants over 18 years of age (51. 5% female) in 2000. Changes in utilization of the ED and the proportion of non- surgical visitors at the ED between 1985 and 2005 are seen in Figs. 1 and 2



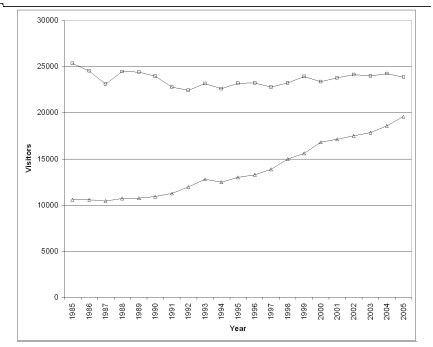


Figure 1. Changes in total ED visits at Uppsala University Hospital between 1985 and 2005. (Left figure)

Figure 2. Changes in ED-visits for Non-surgical (Δ) and surgical (□) visits between 1985 and 2005 at Uppsala University Hospital. (Right figure)

For the first period data regarding presenting complaints was registered manually by the triage nurse in a specially created database. In the second period all data was registered in, and later extracted from, the new computerized administrative system[28]. In both periods, trained ED-staff members sorted the patient to either the surgical/ orthopaedic or the non-surgical part of the ED and registered the presenting complaint. Information regarding

length of stay in hospital (LOS), in-hospital fatality rate and discharge diagnosis was collected from the hospital discharge records.

All Swedish citizens have an unique civic registration number which is used in all contacts with health care and in the Swedish national death registry (dödsorsaksregistret) providing a link between contact in health care and mortality data. After permission from the national date inspection committee all data from the study cohorts were matched to the death registry and long term mortality data was obtained.

Proportion of obtained data, admission reasons, matched mortality data and missing data is listed in table 1.

Table 1. Data obtained for the two cohorts. (%)
**= Presenting complaint ** = Administrative or equivalent reasons.*

	1995/96	**2000**
Total ED visits	**36 166**	**40 173**
Non-surgical visits	**12 995** (35.9)	**16 891** (42.0)
Allocated to specific PC*-group	12 445 (95.8)	14 850 (87.9)
Non-specific PC-group	471 (3.6)	983 (5.8)
Non-PC derived reason **	74 (0.7)	84 (0.5)
Missing Data	89 (0.7)	974 (5.8)
Mortality data obtained	**12 891 (99.2)**	**16 126 (99.0)**

Registering and sorting the presenting complaints (PC) into groups.

The patient's presentation of her reason for seeking the ED, as interpreted by the receiving nurse, before any major diagnostic procedures were performed, was defined as the PC and recorded. When applicable, the referring institution's complaints in the referral note were used. If the patients were brought in by the EMS, the complaints as interpreted by the EMS staff in the ambulance report were used as the PC. Only the main complaint was recorded if the patient presented more then one complaint.

After each studied period the recorded PCs were sorted into the predefined presenting complaint groups (PCGs) by a physician (U.S.) and revised by a senior physician (L.L.).

Presenting complaint groups (PCGs)

The PCG and its definition can be seen in table 2.

Table 2. Definitions of the 32 different PCGs and their corresponding classification in International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)

Presenting complaint (PCG)	Definition	Classification in ICD 10
Alcohol abuse related states	Drunkenness but no signs of intoxication as above or referred from an institution stating alcohol related conditions with no signs of alarming intoxication.	R78.0
Allergic reaction	Onset of skin rashes, hives or weal's such as contact dermatitis or eczema with or without symptoms from respiratory organs. Or sudden onset of wheezing or other symptoms from respiratory organs after intake of drugs or food with or without symptoms on the skin. Circulatory chock after ingestion of known allergen.	R21, L53.9,, T78.2, T78.0,T80.0, T88.6, 88.7
Anaemia	Self diagnosed anaemia or any referral stating anaemia unregarding actual hamatocrite later registered at the ED	D64,9
Bite or sting from animals, insects or snakes	Bite or stings or suspicion thereof from insects, snakes or other animals	X20-X29
Bleeding/ hematuria/ melena	Ongoing bleeding, melena or hematuria of any kind and not considered surgical ED patient	R31, R58, R04, K92.0, K92,1
Cardiac arrest	Unconscious patient with cessation of the action of the heart	I46.9
Chest pain	Pain or discomfort from thorax not only localized to spine	R07
Coma	A state of deep and prolonged unconsciousness with no history of convulsions	R40.2
Cough/ pneumonia	Symptoms of or reporting cough with or without fever and/ or general decline of health	R05, R09.3 J18.9
Diarrhoea	Self reported or referred with a history of passage of excessively liquid or excessively frequent stools.	K52.9, K59.1, A09, F45.3
Dyspnoea	The patient's own experience of lack of breath.	R06.0
Electric chock	Passage of electric current through the body either domestic current, high voltage current or lightning	T75.4, T75.0, X33,
Fatigue	self reported fatigue with no report of altered mental or physical decline	R40.0, R53
Fever	A rise in the temperature of the body but no focal symptom suggesting its cause	R50
General disability	A conscious patient's own (or referring institutions) experience of rapid decline of physical and/or mental condition but no signs or symptoms from a specific organ and no knowledge of ongoing fever.	R69, R41.0, R63.0, R63.4, R64, R69
Headache	Pain or severe discomfort from head	R51
Hyperglycaemia	Self diagnosed or suspicion of hyperglycaemia, hyperglycaemia detected by the EMS personnel or any referral stating hyperglycaemia unregarding actual blood glucose level later registered at the ED	R73, R81
Hypertension	Self diagnosed elevated blood pressure or a referral stating hypertension unregarding actual blood pressure later registered at the ED	R03.0
Hypoglycaemia	Self diagnosed hypoglycaemia, hypoglycaemia detected by the EMS personnel or any referral stating hypoglycaemia unregarding actual blood glucose level later registered at the ED	E16.2
Intoxication	Suspicion of or report of deliberate or accidental intake, inhalation, overdose or injection of medical drugs, illegal drugs, chemicals, fire smoke or combustions with or without symptoms thereof or a person with alcohol abuse in such a state that he/she needed medical or technical assistance to secure vital functions.	T36-T65, X00-X09, X40-49
Miscellaneous	complaints not fitting into any other complaint group	
Nausea	Self reported unpleasant sensation in the stomach usually accompanied by the urge to vomit with or without vomiting.	R11
Not symptom derived reason	Entries considered as non-symptom derived (i.e. administrative or non-medical reasons)	Z02
Oedema	symmetrical swelling of extremities, face or trunk but no rush or exanthemas suggesting allergic reactions	R60.9
One swollen leg	One or asymmetrically swelling of the legs with or without adjunct pain, discomfort or rush	R60.0, M79.6
Palpitation (arrhythmia)	Sensation of an alteration in the rhythm of the heartbeat either in time or force of functional or organic origin	R00, I49.9
Psychiatric symptoms	Referred or self reported with altered personality, aggressively, hearing voices, bizarre behavior and no other physical symptoms or signs and no suspicion of drug or alcohol abuse.	F44.8, R44, 45.4, R45.8, R46.2, R46.8, F09
Seizure	Witnessed or self reported signs of a convulsion with or without following unconsciousness	G40, G41, R56
Stroke-like symptoms	Either history of transient loss of strength in face, arm or leg. Or transient loss of speech, vision or dysphasia or presenting ED with loss of strength in one or more extremities, facial paralysis, loss of speech, own experience of loss of sensibility in a part of the body or sudden loss of vision field or sight.	R20.0, R27.0, R29.8, R47, I69.3

Syncope	Sudden and transient episode of unconsciousness but no convulsions.	R55
Unspecified ache	Self reported experience of pain not from chest or head	R52
Vertigo/ dizziness	The patients own experience of discomfort in form of a sense of spatial disorientation, motion of the environment or light headedness.	R42

Follow-up

By linking the patient's civic number as registered in the data bases for the two investigated periods to the national death registry it was possible to get mortality data for 99.2 % and 99.0 %, respectively, of the patients up to September 15, 2005. For the 869 subjects with missing mortality data the age distribution, gender and PCG did not differ from the group with mortality data.

Five and ten-year mortality, respectively, was defined as dead or alive on the date five, respectively, ten years from the day in the middle of the investigated interval and not five or ten years from the actual date of the visit. This is a technique commonly used, for example, by EpC (the Epidemiologic Center of the National Board of Health and Welfare, Sweden). This technique is easier to use and does not differ in results when measuring the time span for each individual, assuming the group to be large enough and the survival time to be far enough away. For calculating 30-day mortality, for Cox Proportional Hazard and Kaplan-Meier cumulative survival curves, the actual survival in days from the visit were used.

Statistical analyses

Differences between groups for normally distributed variables

Student's unpaired t-test was used only in calculating differences between groups for normally distributed variables such as age. Relationships between categorical variables, such as gender, PCG and diagnosis, were evaluated by chi-square test or by logistic regression analysis. For differences in continuous variables between groups, ANOVA or Kruskal-Walli's test was used.

Differences in mortalities between groups

For differences in mortalities between groups' univariate or multivariate logistic regression models were performed to calculate Odds Ratios (OR), likelihood ratios, 95% CI and p-values.

Survival analysis

For differences in survival, Cox Proportional Hazard was used as the regression model to calculate Hazard Ratios (HR) and Kaplan-Meier as the non parametric model to calculate cumulative survival curves.

Statistical analyses as above were performed using the StatView® for Windows version 5.0.1 package (SAS institute Inc. Cary, North Carolina 27513, USA.).

Standardized Mortality Ratio

Standardized Mortality Ratio (SMR) was calculated from the observed death divided by the expected death adjusted for age-group, calendar period and gender[29].

We decided to use the population of Uppland as the reference population instead of the total Swedish population for two reasons;

1. Uppland has a somewhat lower standardized mortality rate than most other areas in Sweden[30,31,32].This is probably due to a higher level of education and high income.

2. By using Uppland both as the reference population and catchment area for the studied samples we created the same exposure for unadjusted risk factors and thereby minimizing risk of bias[33 34].

Information of age- and gender- adjusted mortality for the county of Uppland was obtained from Statistics Sweden (SCB)[35].

Statistical analyses of SMR were created by programming algorithms in Microsoft excel®.

P-values below 0.05 were considered as significant.

Approval of Ethics committee

The study was approved by the Institutional Review Board (Local Ethics Committee) at Uppsala University. (Local Ethics Committee Akademiska sjukhuset Dnr; 00-463)

Results

The ED Presenting Complaint as Predictor of In-Hospital Fatality. (Paper I)

Of the 12 995 admissions to the non-surgical ED, 12 445 (95.8%) were allocated to one of the defined complaint groups and 5216 (40.1%) of the admissions were treated as in-hospital patients with a death rate of 6.3 %.

Age was the most powerful predictor of death in in-hospitalized patients (OR 1.03, 95%CI 1.02-1.04, $p<0.0001$). Gender as such was not a significant predictor for in-hospital fatality in crude analysis, but after adjustment for age the female gender was found to be protective (OR 0.73, 95% CI 0.58-0.92, $p=0.007$).

In-hospital fatality rates differed between presenting complaint groups ($p<0.0001$). This finding was valid for both men and women. The highest in-hospital fatality rates, among complaint groups with more than 200 entries, were seen in those with general disability (7.6%), dyspnoea (7.0%) and stroke-like symptoms (6.9%), while no fatalities were seen in patients presenting with seizure, palpitation (arrhythmia) or allergic reactions. (See table 3, p 23).

In-hospitalized patients with the PCG of chest pain were given a large number of diagnoses at discharge. Only 17.5% in those admitted with chest pain received a diagnosis of acute myocardial infarction and 16.4% a diagnosis of angina pectoris.

In the PCG of dyspnoea patients were also given various diagnoses at discharge. 4% of these patients received a diagnosis of acute myocardial infarction. In that small group, in-hospital fatality rate was markedly high, 20.8%, twice as high as for the PCG of chest pain receiving discharge diagnosis of myocardial infarction. However, taken together, no significant difference was found between different discharge diagnoses in patients admitted with dyspnoea ($p=0.425$).

Among patients hospitalized due to the PCG of stroke-like symptoms, 60% received a discharge diagnosis of stroke, while infections counted for 7% and syncope for 5% of the cases. There was no significant difference in the fatality rate with regard to discharge diagnoses for patients with stroke-like symptoms ($p=0.21$).

Table 3. In-hospital fatality rate in relation to Presenting Complaint Group (PCG) with more than 200 entries among non – surgical emergency patients. (p< 0.0001 for differences in hospital fatality between presenting complaints). LOS = length of stay in hospital.

Presenting Complaint Group (PCG)	Number of entries	Age (median)	% females	% admitted to in-hospital care	LOS (median) (Days)	**In- hospital fatality (%)**	Odds ratio*	95% CI*	P value*
General disability	719	82.0	55.6	78.2	6.0	**7.46**	1.81	1.17-2.79	0.0077
Dyspnoea	1056	75.0	50.0	57.0	5.0	**6.97**	1.95	1.27-3.00	0.0024
Stroke-like symptoms	946	77.0	50.7	73.8	6.0	**6.86**	2.04	1.35-3.08	0.0007
Miscellaneous	471	53.0	50.1	41.8	5.0	**4.57**	2.12	1.01-4.44	0.046
unspecified ache	240	57.5	59.2	24.2	6.5	**3.45**	1.21	0.28-5.14	0.80
One swollen leg	797	67.0	60.0	27.6	6.0	**2.73**	0.92	0.38-2.17	0.84
Chest pain	3339	67.0	46.6	57.8	3.0	**2.54**	*		
Headache	483	42.0	62.7	21.7	4.0	**1.90**	1.12	0.26-4.77	0.87
Intoxication	614	38.5	52.4	32.4	1.0	**1.51**	1.88	0.56-6.28	0.31
Symp. of Asthma	680	62.0	56.9	10.6	5.0	**1.39**	0.43	0.06-3.15	0.40
Vertigo/dizziness	617	67.0	60.8	43.4	4.0	**1.12**	0.36	0.11-1.17	0.090
Hyperglycaemia	297	65.0	54.2	66.3	7.0	**1.02**	0.39	0.09-1.62	0.19
Syncope	327	67.0	51.1	50.2	3.0	**0.61**	0.21	0.03-1.52	0.12
Allergic reaction	424	36.5	62.0	4.7	1.0	**0.00**	-		
Palpitation (arrhythmia)	325	62.0	53.5	51.5	2.0	**0.00**	-		
Seizure	289	46.0	38.8	28.7	3.0	**0.00**	-		
All entries	**12995**	**66.0**	**52.2**	**48.2**	**4.0**	**5.17**			

* = calculated with PCG of chest pain as the reference group.

In the in-hospitalized group of patients with the PCG of general disability, various infections counted for 24% of all discharge diagnoses, with respiratory and urinary tract infections being dominant. Within this group cancer and congestive heart failure had the highest in-hospital fatality rates with 27.8 and 15.6%, respectively. The fatality rate between different discharge diagnosis groups was significant for patients from the PCG of general disability ($p = 0.0023$).

A significant difference in hospital fatality was seen between different discharge diagnoses ($p<0.0001$). This finding was valid for both men and women. The highest risk of dying was seen among those with a diagnosis of

acute myocardial infarction. In this group the in-hospital fatality rate was 8.3%.

Conclusion

The presenting complaint at the ED carries valuable information of the risk for in-hospital fatality in non-surgical patients. This knowledge can be valuable in the prioritization between different patient groups in the process of initiating diagnostics and treatment procedures at the ED.

Differences in long-term mortality for different ED presenting complaints. (Paper II)

Of the 12 995 correctly registered admissions to the non-surgical ED, 12 450 (95.8%) were allocated to one of the defined complaint groups. Ten year mortality data was obtained for 12 890 (99.2%) patients. The median follow – up time was 9.6 years (range 0.0-10.6 years), during which 5727 deaths occurred resulting in a mortality rate of 6.6 per 100 person years at risk (PYAR). In the region, age and gender- adjusted population would have given an expected mortality of 4.0 per 100 PYAR resulting in 4290 expected deaths. This gives a Standardized Mortality Ratio (SMR) of 1.33 (95% CI 1.30 – 1.37, $p< 0.001$) for our ED sample.

Age was a powerful predictor of long term mortality (HR 1.08, 95%CI 1.08-1.08, $p<0.0001$).

Male sex was a significant predictor for long- term mortality even after adjustment for age with an HR of 1.35 (95% CI 1.28-1.42, $p<0.0001$) for males. Compared to the reference population males had an SMR of 1.45 (95% CI 1.40-1.51, $p< 0.001$) and females 1.24 (95% CI 1.19-1.28, $p<0.001$).

Long-term mortality differed between different PCG in unadjusted analysis ($p<0.0001$). The highest long-term mortality (ten year) rates, in crude analysis among complaint groups with more than 200 entries, were seen in those with general disability (84.2%), stroke-like symptoms (67.4%) and dyspnoea (63.1%); while the mortality rates were lowest in those presenting with allergic reactions (6.7%), head ache (15.2%) and intoxications (21.7%). (figure 3)

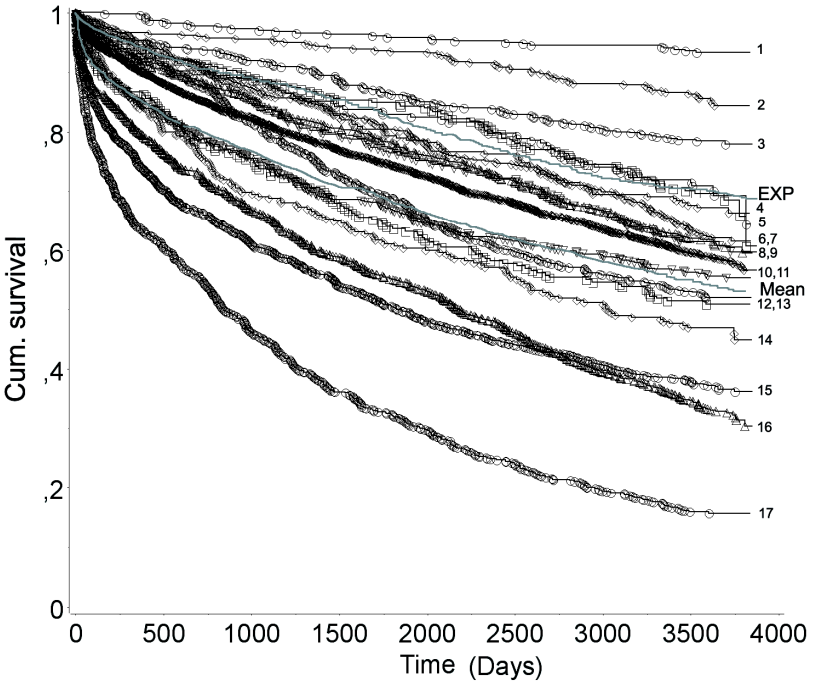


Figure 3. Cumulative survival for different PCGs. Allergic reaction (1), Head ache (2), Intoxication (3), Unspecified ache (4), Seizure (5),Vertigo/Dizziness (6), Symptoms of arrhythmia (7), Syncope (8), One swollen leg (9), Chest pain (10), Miscellaneous (11), Symptoms for asthma (12), Cough/pneumonia (13), Hyperglycaemia (14), Dyspnoea (15), Stroke-like symptoms (16) and General disability (17). EXP is the expected survival for the region. Mean is the cumulative survival for the whole ED population. Follow-up time is 3650 days (10 years).

However, by adjusting for age and gender another picture emerges. When analyzing SMR, the highest long-term mortality risk was seen in PCG of seizures (SMR 2.62), intoxications (SMR 2.51) and symptoms of asthma (SMR 1.84) (Table 4).

Table 4. *Standardized Mortality Ratio (SMR) over ten years for different PCGs compared to the age and gender-adjusted reference population. This list includes only the 17 PCGs with at least 200 entries.*

Presenting Complaint Group (PCG)	Number of entries	Age at ED visit (median)	% female	10 years mortality (%)	SMR	95% CI	P
Allergic reaction	424	36.5	62.0	6.7	0.96	0.67-1.38	ns.
Vertigo/dizziness	617	67.0	60.8	38.2	1.11	0.98-1.27	ns.
Syncope	327	67.0	51.1	38.9	1.14	0.95-1.36	ns.
Palpitation (arrhythmia)	325	62.0	53.5	31.3	1.16	0.95-1.41	ns.
unspecified ache	240	57.5	59.2	30.1	1.19	0.94-1.51	ns.
Chest pain	3339	67.0	46.6	41.9	1.20	1.13-1.26	<0.001
One swollen leg	797	67.0	60.0	39.3	1.22	1.09-1.37	<0.001
Headache	483	42.0	62.7	15.1	1.24	0.99-1.57	ns.
General disability	719	82.0	55.6	84.2	1.25	1.15-1.36	<0.001
Stroke-like symptoms	946	77.0	50.7	67.4	1.26	1.17-1.37	<0.001
Cough / Pneumonia	266	65.0	50.0	48.5	1.33	1.11-1.58	<0.01
Dyspnoea	1056	75.0	50.0	63.1	1.37	1.27-1.47	<0.001
Miscellaneous	471	53.0	50.1	44.4	1.62	1.44-1.82	<0.001
Hyperglycemia	297	65.0	54.2	53.5	1.67	1.42-1.95	<0.001
Symptoms of Asthma	680	62.0	56.9	48.1	1.84	1.65-2.06	<0.001
Intoxication	614	38.5	52.4	21.7	2.51	2.11-2.98	<0.001
Seizure	289	46.0	38.8	33.7	2.62	2.13-3.22	<0.001
All entries	***12885***	***61.6***	***52.2***	***44.4***	***1.33***	***1.30-1.37***	***<0.001***

For patients from the PCG of chest pain there was a difference in mortality between the different discharge diagnoses ($p<0.001$). An increased mortality was seen in patients discharged with a diagnosis of myocardial infarction (SMR 1.18) but a more pronounced mortality was seen in patients discharged with the diagnosis of congestive heart failure (SMR 1.34) or a pulmonary disease (SMR 1.84).

Also patients from the PCG of dyspnoea admitted to a ward showed different mortality rates according to the different discharge diagnoses ($p<0.0001$). Patients discharged with a diabetes, endocrine or inflammatory

related diagnosis had an SMR of 2.29, while those with congestive heart failure diagnosis had an SMR of 1.31.

Even for patients admitted from the PCG of general disability the differences in mortality between discharge diagnoses had a p value < 0.001. Those with a cancer diagnosis or gastrointestinal diagnosis had the highest SMR whereas patients with a discharge diagnosis of intoxications, psychiatric diagnosis, infections, arrhythmias and symptom diagnosis did not show significantly different mortality rates compared to the expected long term mortality in the region.

For the PCG of stroke-like symptoms there was an elevated SMR for those with cancer (SMR 2.30, 95% CI 1.43 – 3.70, p<0.001) and stroke (SMR 1.32, 95% CI 1.17- 1.49, p<0.001) discharge diagnosis but not for other patients in this group.

There was a higher mortality for patients discharged with the diagnosis of myocardial infarction if they had not been admitted from the PCG of chest pain (HR 1.70, 95% CI 1.150 – 2.422. p=0.007) compared to patients from the PCG of chest pain.

In contrast to above observations, patients receiving stroke as the discharge diagnosis had a higher mortality if they were admitted from the PCG of stroke-like symptoms, than in those not from this group. (HR 0.76. 95% CI 0.59 – 0.98. p=0.033).

Conclusion

Long-term age and gender adjusted mortality is the highest with seizures out of 33 PCG and differs markedly between the different PCGs. Furthermore, depending on the PCG, long term mortality differs within the same discharge diagnosis. Hence, the PCG adds unique information to the discharge diagnosis regarding long- term mortality in non-surgical patients.

A lower threshold for seeking emergent care - the reason for increasing ED utilization. (Paper III)

Of the 12 995 admissions to the non-surgical ED in 1995, 12 485 (95.8%) were allocated to one of the defined PCGs. Thirty-day and 5-year mortality data were obtained for 12 890 patients (99.2%). 9 903 unique individuals produced the 12 995 visits in 1995. Thus, 19.3 % of all visits consisted of re-visitors.

For the 16 891 admissions to the non-surgical ED in 2000, 16 294 (96.5%) were allocated to one of the defined PCGs. Thirty-day and 5- year mortality data were obtained for 16 126 patients (99.0%). 12 709 unique individuals produced the 16 891 visits and 22.1% of the visits were done by re-visitors.

The mean age for the non-surgical ED visitors decreased from 61.3 to 60.9 years ($p< 0.005$), while the age of those admitted to a ward increased from 70.4 to 72.8 years ($p< 0.005$). The proportion of patients admitted to a ward decreased both in relative (- 37.4%) and in absolute (-1148) numbers, but the mean length of the hospital stay (LOS) increased with 1.1 days ($p< 0.005$). A decrease of ward admittance was seen in all PCGs except for that of dyspnoea.

Among the presenting complaint groups with more than 200 entries, the largest increases were seen in those with symptoms of arrhythmia (105.0%), miscellaneous complaints (59.0%), unspecified ache (41.8%) and vertigo/dizziness (17.6%). The largest decreases were seen in those with cough/pneumonia (-44.3%), dyspnoea (-26.4), hyperglycaemia (-19.2%), chest pain (-15.1%) and general disability (-15%).

Thirty-day mortality for all non-surgical visitors at the ED decreased between the studied periods from 4.4% to 3.5% ($p=0.007$). However, for the patients that were admitted to a ward there was no difference in the 30-day mortality ($p=0.31$).

Five-year mortality decreased from 31.1% to 29.2% ($p= 0.008$) in the total sample. The lowest 5-year mortality was seen in those with allergic reaction (4.0%), headache (7.8%), intoxication (10.2) and symptoms of arrhythmia (14.1%), while the highest 5-year mortality was found in patients presenting with general disability (62.7%), dyspnoea (48.0%), stroke-like symptoms (42.8%) and cough/ pneumonia (36.5%). After adjustment for age and gender there were no differences in the 5-year mortality, between the two periods, for a given PCG.

Thirty-day and 5-year mortality for the different PCGs and for patients admitted to a ward can be seen in table 5.

Table 5. 30-day and 5-year mortality for non-surgical ED-visitors according to presenting complaint groups (PCG).

Presenting Complaint Group (PCG)	Year	Number of visitors (no)	30 day mortality (no)	30 day mortality (%)	Age and gender adjusted p-value for differences in 30 d mortality	30 day mortality of patients admitted to a ward (no)	30 day mortality of patients admitted to a ward (%)	Age and gender adjusted p-value for differences in 30 d mortality	5 year mortality (no)	5 year mortality (%)	Age and gender adjusted p-value for differences in 5-year mortality
Allergic reaction	1995	404	0	0.0		0	0.0		19	4.7	
	2000	501	1	0.2	-	1	10.0	ns.	20	4.0	0.40
Chest pain	1995	3310	94	3.0		88	4.6		866	26.2	
	2000	3668	81	2.2	0.16	58	4.5	ns.	881	24.0	0.10
Cough /pneumonia	1995	264	14	5.3		11	8.5		95	36.0	
	2000	192	11	5.7	0.79	7	11.3	ns.	70	36.5	0.95
Dyspnoea	1995	1781	100	5.6		75	10.7		764	42.9	
	2000	1711	121	7.1	0.45	95	12.6	ns.	821	48.0	0.21
General disability	1995	713	80	11.2		71	12.6		484	67.9	
	2000	791	76	9.6	0.66	56	12.5	ns.	496	62.7	0.61
Head ache	1995	479	5	1.0		5	4.8		32	6.7	
	2000	601	3	0.5	0.23	2	3.8	ns.	47	7.8	0.62
Hyper -glycaemia	1995	292	4	1.4		4	2.0		113	38.7	
	2000	308	9	2.9	0.20	5	3.1	ns.	111	36.0	0.12
Intoxi-cation	1995	611	5	0.8		5	2.5		84	13.7	
	2000	743	6	0.8	0.86	3	6.4	ns.	76	10.2	0.20
Miscell-aneous	1995	469	19	4.1		15	7.6		158	33.7	
	2000	973	38	3.9	0.33	15	4.9	ns.	355	36.5	0.37
One swol-len leg	1995	789	12	1.5		8	3.7		178	22.6	
	2000	895	1	0.1	0.01	0	0.0	ns.	214	23.9	0.25
Seizure	1995	285	2	0.7		1	1.2		58	20.4	
	2000	364	2	0.5	0.27	0	0.0	ns.	89	24.5	0.06
Stroke like symptoms	1995	939	69	7.3		60	8.6		427	45.5	
	2000	1155	73	6.3	0.55	63	9.8	ns.	494	42.8	0.63
Symptoms of arrhyth-mia	1995	324	3	0.9		2	1.2		51	15.7	
	2000	867	8	0.9	0.94	4	1.8	ns.	122	14.1	0.25

Cont. **Presenting Complaint Group (PCG)**	Year	Number of visitors (no)	30 day mortality (no)	30 day mortality (%)	Age and gender adjusted p-value for differences in 30 d mortality	30 day mortality of patients admitted to a ward (no)	30 day mortality of patients admitted to a ward (%)	Age and gender adjusted p-value for differences in 30 d mortality	5 year mortality (no)	5 year mortality (%)	Age and gender adjusted p-value for differences in 5-year mortality
Syncope	1995	326	5	1.5		4	2.4		76	23.3	
	2000	434	5	1.2	0.96	4	3.4	ns.	86	19.8	0.97
Unspecified ache	1995	235	2	0.9		2	3.4		40	17.0	
	2000	435	3	0.7	0.84	1	1.9	ns.	81	18.6	0.30
Vertigo/ dizziness	1995	613	5	0.8		4	1.5		127	20.7	
	2000	941	8	0.9	0.95	7	3.1	ns.	182	19.3	0.37
Total	1995	12485	545	4.4		473	7.6		4015	31.1	
	2000	16294	576	3.5	0.007	433	8.5	0.310	4713	29.2	0.008

The relative proportion of ED visits for the population in the catchment area was separately calculated, in 5-year age strata, for the two periods. An increase of ED utilization could be seen in all age strata except in the very old (90-95 years).

When calculating the expected increment in visits due to demographic changes there was a calculated expected increase in the amount of visits by 1767 (+13.6 %). The actual increase was 3896 (+30.0 %.)

Conclusions

By using PCG as a variable it was possible to demonstrate that the major part of the increased ED utilization seen between 1995 and 2000 was not due to an increase in the severity of diseases among ED visitors or demographic changes but rather to a change in the visiting pattern among the inhabitants.

Increased long-term mortality in patients with repeated visits to the ED. (Paper IV)

For 15 607 admissions to the non-surgical ED in 2000, 15 246 (97.7%) were allocated to one of the defined PCGs. One-year and five-year mortality data were obtained for 15 588 patients (99.7%). The 15 607 ED admissions were made by 11 522 different individuals, of whom 2318 (20.1%) made two or more visits.

Approximately 80% of all visits were made by visitors appering once (59.0%) or twice (20.2%). The remaining 20.8% of all visits were due to 6.4% patients appearing three or more times. The 53 patients with more than six visits to the non-surgical ED constituted 0.5% of the visitors but were responsible for 5.1% of all visits. They had an average of 15 visits each.

The age- and gender-adjusted long-term mortality was dependent on the number of re-visits in an inverse U-shaped fashion. Compared to single-visitors, patients with three visits had an increased age-and gender-adjusted 5-year mortality (HR 1.85, 95% CI 1.58 – 2.16, <0.0001). In patients with four or five visits, the 5-year mortality decreased (HR 1.80, 95% CI 1.47 – 2.19, $p < 0.0001$), and patients with six and more visits per year had a long-term mortality not significantly different from age-and gender-adjusted single-visitors (HR 1.29, 95% CI 0.87 – 1.91, p=0.21). (Figure 4)

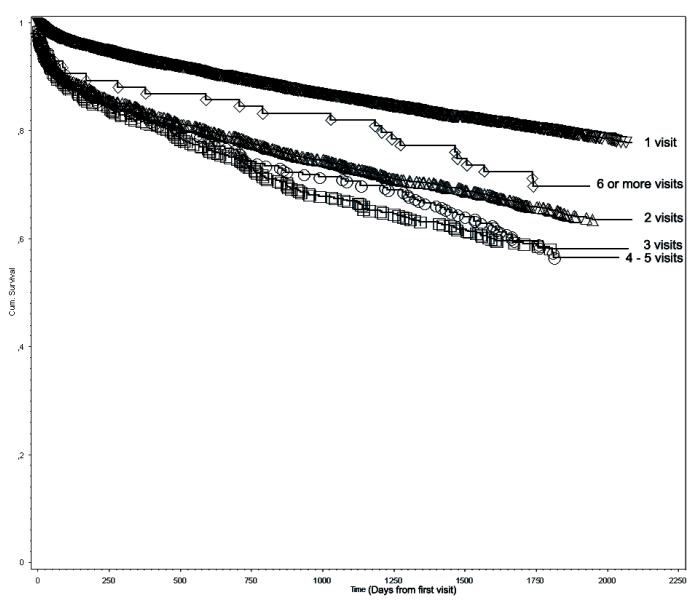


Figure 4. Differences in cumulative survival (Kaplan –Meier curve) depending on number of visits at the non-surgical ED during the year 2000.Five years follow-up time.

Also the time between two adjacent visits influenced the long-term mortality in an inverse U-shaped fashion.

One-year mortality increased with time between the re-visits up to seven days, and declined thereafter for patients admitted to a ward at the first visit. A revisit on the seventh day from last visit had increased one-year mortality more than six times (HR 6.34, 95% CI 3.27 – 12.29, p< 0.0001) compared to age- and gender-adjusted in-hospitalized patients with only one visit. If the time between the revisits increased to more than 14 days, the hazard ratio decreased (HR 2.10, 95% CI 1.75 – 2.52, p< 0.0001).

For re-visiting patients not admitted to a ward at the first ED-visit, there was also a different pattern of long-term mortality compared to matched non-admitted single-visitors (p<0.0001). Patients with a revisit on the second or third day from the first visit had an increased mortality (HR 1.89, 95% CI 1.06 – 3.35, p= 0.03), as had patients re-visiting later than two weeks (HR 1.42, 5% CI 1.15 – 1.75, p=0.0009).

One-thousand and forty-six of the 6403 (16.4%) revisits had an adjacent visit with the same PCG. This sub-sample was used for calculating the impact of revisits for long-term mortality for specific PCGs. Chest pain was the largest presenting complaint group (2771 visits) and had most revisitors (315 patients, 11.4%), while arrhythmia was the PCG with the largest proportion of revisitors (19.8%), followed by seizure (16.1%).

Arrhythmia (3.1%), intoxication (2.6%) and seizure (1.8%) had the largest proportion patients with six or more visits to the ED.

For patients revisiting the ED with the same adjacent presenting complaint, both one-and 5-year mortality differed depending on the presenting complaint (p<0.0001). The 35 patients visiting the ED more than once, with seizure as the PC, had an one-year mortality more than three times higher (HR 3.15, 95% CI 1.00- 9.73, p=0.049) and a five-year mortality almost four times higher (HR 3.95, 95% CI 2.03 – 7.54, p< 0.0001) compared to age-and gender-adjusted single-visitors. On the contrary, the 102 re-visitors due to arrhythmia had a reduced 5-year mortality (HR 0.38, 95% CI 0.19 – 0.76, p=0.006) compared to the age- and gender-adjusted single-visitors (table 6)

Table 6. One and five-year mortality for re-visitors depending on PCG at readmission compared to single-visitors. Adjusted for age and gender. Number of single-visitors=8960.

Presenting complaint group (PCG)	Number of re-visiting patients with the complaint	Odds Ratio one year mortality compared to single-visitor	p value	95% CI	Odds Ratio five year mortality compared to single-visitor	p value	95% CI
Seizure	35	3.1	0.049	1.00 - 9.73	3.9	<0.0001	2.03 - 7.54
Dyspnoea	115	3.9	<0.0001	2.83 - 5.34	2.9	<0.0001	2.32 - 3.67
General disability	42	3.9	<0.0001	2.42 - 6.36	2.7	<0.0001	1.86 - 3.88
Miscellaneous	21	4.9	0.0004	2.03 - 11.79	2.6	0.006	1.32 - 5.30
Stroke-like symptoms	48	2.6	0.001	1.48 - 4.64	2.1	0.0002	1.43 - 3.15
Chest pain	315	1.0	ns.		1.0	ns.	
Intoxication	61	2.0	ns.		1.1	ns.	
Vertigo/ Dizziness	35	0.71	ns.		0.62	ns.	
Headace	31	0.93	ns.		0.54	ns.	
arrhythmias	102	0.24	ns.		0.38	0.006	0.19 - 0.76
Allergic reaction	34	1.1	ns.		0.34	ns.	

Different PCGs showed different long term-mortality depending on the amount of revisits ($p<0.0001$). For patients with revisits because dyspnoea there was a marked increase in the 5-year mortality for patients visiting three times (HR 2.79, 95% CI 1.78 – 4.35, $p< 0.0001$), but thereafter the risk of dying decreased substantially. On the contrary, in patients with revisits in the chest pain PCG the highest long-term mortality was seen in the patients with the most visits (HR 2.62, 95% CI 1.43 – 4.65, $p= 0.001$)

Conclusions

In non-surgical patients revisiting the ED, long-term mortality was dependent on both the number of revisits, as well as the time between two visits in an inverse U-shaped fashion. Also, by using PCG as a variable, it is possible to demonstrate a transition level between appropriate medical utilization and inappropriate frequent ED use among non-surgical ED visitors.

Discussion

General discussion

The process of forming PCGs

In the process of forming PCGs there are some important issues to look into. First there is the diversity of the nature of the presenting complaints (PCs), secondly the statistical inference of such diversity.

PC consists of a varying proportion of (measurable) objective *signs* and (non-measurable) subjective *symptoms* (Figure 5). Depending on the proportion of symptoms forming the specific PC there are different proportions of inter individual variability within the PCs (figure 6). Because of this difference the risk of interpretation bias from the triage nurse varies between different PCGs (figure 7). This means that the consistency of the definition of each PCG varies depending on the nature of the PC forming the group. This might affect the calculations concerning comparisons between groups.

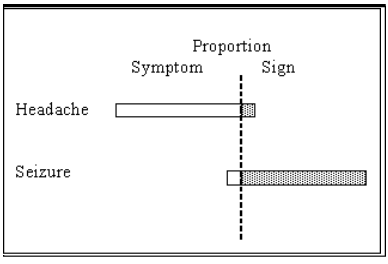


Figure 5. A theoretical model showing different proportions of subjective symptoms and objective signs building up two different PCs.

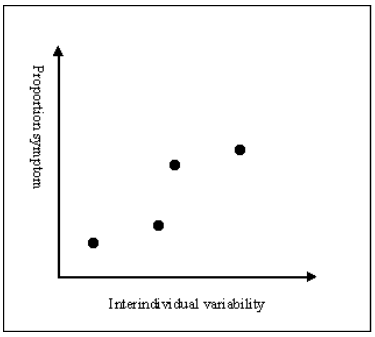


Figure 6. A theoretical model showing the relationship between proportions of (non-measurable) subjective symptoms building up the presenting complaint and proportion inter-individual variability within the complaint.

Figure 7. A theoretical model showing different risks of sorting a patient into the wrong presenting complaint group depending on the proportion variability within the complaint.

Statistically this means that PCGs are categorical variables expressing qualitative[36] and not quantitative findings and because of the inherited differences, as described above, there are different sensitivity, specificity, reproducibility and therefore different statistical powers for different PCGs[37].

By using previous years presenting reasons (1994, approximately 12 000 entries) a task force of four physicians and one triage-nurse studied how these could be sorted into easily definable groups with possibilities to demarcate from adjacent complaints. They could initially define 38 groups describing the actual population visiting the ED. After the above considerations of risk for interpretation bias and low reproducibility the number was reduced to 33 PCGs.

In forming a PCG both the uniqueness and the frequency of the reason were considered. For example, because of its uniqueness' and consistency in definition, cardiac arrest was decided to be a PCG although only just over

100 entries per year was registered. Entries considered as non-symptom derived (i.e. administrative or non-medical reasons, for example renewal of a prescription, administration of an injection, etc.) were assigned to a common separate group. Patients reporting symptoms not fitting into any PCG were allocated into a separate (miscellaneous) PCG.

By applying the groups on different populations, i.e. different years, 1995 and 2000, we had an opportunity to test the consistency over time.

Over the five years, 32 of the 33 groups were found to be consistent. The 33rd group, asthma-like symptoms ("the patient's own experience of lack of breath and having history of asthma and typical wheezing at expire"), could not be sufficiently well separated from the dyspnoea group in 2000. The most plausible explanation for this is that in 1995 there was a specialist in respiratory diseases seeing all the asthma patients and the triage nurses were supposed to sort the asthma-patients to that specialist. In 2000 there was no such specialist and the generalist was seeing both groups. The sorting into two groups was therefore not necessary and the accuracy in the division between asthma-like symptoms and dyspnoea as presenting complaints fell.

This shows the importance of having well defined PCGs especially if the groups are to be compared between different hospitals or time periods where different medical settings might affect the interpretations of the patient's symptoms and signs.

PCG and mortality prediction

In the first part of our study we were able to demonstrate that a PCG, developed after the above considerations, could predict in-hospital as well as long-term mortality for non-surgical patients.

By adding a PCG to the discharge diagnoses we could also improve the predictive accuracy concerning long-term mortality for many diagnoses. It was striking that for some diagnoses the mortality risk increased, while for other it decreased when a PCG was added. To our knowledge, this has only been described previously for one presenting complaint (chest pain)[38].

Previous studies have mostly been retrospective chart reviews[39 40 41]. Our study design with registering a PCG disregarding the following diagnosis has made it possible to compare both different PCGs and different diagnoses with each other.

In general, presenting complaints have been used mostly in comparing a single complaint to a specific diagnosis. Chest pain and myocardial infarction is the most common linkage[42,43,44,45]. One reason for that is probably the fact that chest pain is considered to be one of the chief symptoms in myocardial infarction, a potentially lethal condition if not treated promptly. By the introduction of trombolysis and later percutan coronary intervention (PCI) the scoop became even more obvious and the interest in the presenting complaint chest pain increased.

In analogy, the interest for the presenting complaint (group) of stroke-like symptoms increased markedly with the introduction of early thrombolysis for ischemic stroke[46,47,48].

With the development of new diagnostic techniques, biochemical markers or new treatments the interest for various other presenting complaint groups will probably increase.

Comparing different PCGs

By relating the mortality for different PCGs to the mortality in the region of Uppland we could create SMRs making it possible to compare different PCGs with each other. Comparing different SMRs has been claimed to be impaired by low statistical reliability[49 50]. By using the same area for the reference population as for the sample groups studied, both groups were exposed to the same unadjusted risk factors minimizing the "healthy worker effect[51]" making it possible to compare mortality risks between the groups.

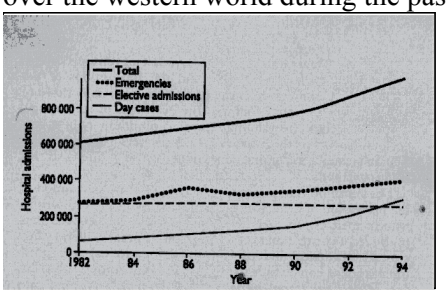
By expressing mortality for different PCGs in terms of SMR we have demonstrated this to be a powerful tool in epidemiological ED studies.

When testing our reference population by applying the Swedish population as a reference population we found a small (< 10%) difference in the upper age strata. This is to be expected if the difference was due to the different mortality rate for Uppland compared to Sweden as a whole.

If the difference was due to statistical error, because of low age strata mortality in the reference sample, the difference would have been in the age strata with the low expected mortality, i.e. the lower age strata.

Describing the increasing ED utilization

The demand of emergency medical care (ED utilization) has increased all over the western world during the past decades[52 53 54 55 56].



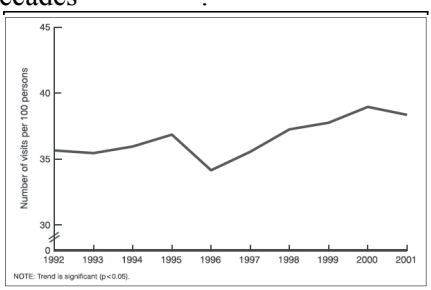


Figure 8. Trends in elective and emergency admissions in Scotland. (From; Capewell, S. BMJ 1996;312:991-992) (Left figure)
Figure 9. Trend in emergency department visit rates: United States, 1992–2001 (from; McCaig LF, Burt CW. Adv Data. 2003 Jun 4; (335):1-29.) (Right figure)

The ageing of the populations has been suggested to be a major cause for this but it accounts only for a part of the rise[57 58].

Increased levels of social deprivation and insufficient primary health care[59 60] are also plausible explanations but results from studies are contradictive. Hansagi et al has, for example, shown that high ED utilization also was indicative for high use of primary care [61]. In the national study of the relation of primary care shortages to emergency department utilization by Richman et al[62] not all areas with low primary care density had high ED utilization.

The explanation of the increasing ED utilization is complex and non-medical related factors such as higher expectations from a more urban population and a changing concept of the concept of health must be taken into account.

The Andersen and Newman model[63] is a behavioral model trying to describe this complexity. This model proposes that the use of health services is the consequence of three sets of factors: (1) *predisposing factors* such as age, sex, race/ethnic group and concept of health etc.; (2) *enabling factors* such as insurance coverage and income; and, (3) *need, or health status, factors*. i.e. the recognition of a health problem Although this model has been criticized for not taking into account the interactions between the factors[64], it does provide a conceptual framework for organizing the factors that have been found to affect ED use for especially non-life-threatening reasons.

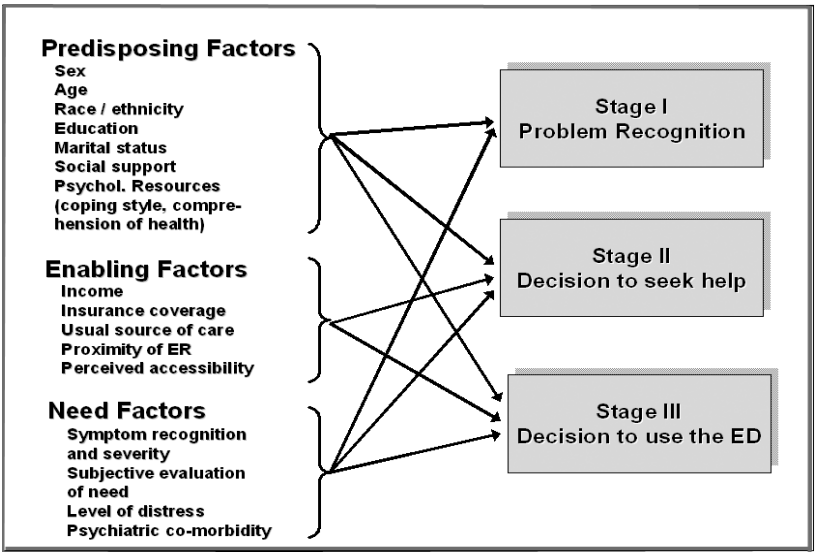


Figure 10. The Andersen and Newman behavioral model for decision making to seek ED care. (Reproduced from; Padgett and Brodsky. Soc Sci Med. 1992 Nov;35(9):1189-97) [65]

When exploring the reason for the change in ED utilization, all these factors must be taken into account. Although the need factors are the overwhelming reasons for seeking the ED[66], predisposing and enabling factors play a major part when comparing changes over time.

Coleman, Irons and Nicholl have interviewed non-urgent ED visitors why they chose the ED instead of other healthcare resources. Using objective criteria, it was estimated that 55% (95% CI 50%, 62%) of the health problems presented by the non-urgent population were suitable for treatment elsewhere. But, taking into account the reasons *as perceived by the patient*, it was estimated that as few as 7% (95% CI 3%, 10%) of the non-urgent ED population are expected to visit providers other than the ED with similar problems in the future. Thus, 93% of the non-urgent patients believed they actually had a proper reason to seek emergency department care[67].

Therefore the reason for an urgent ED visit is not merely the result of the severity of a complaint but also depends on how predisposing and enabling factors interact with the need factors and change our concept of need.

Understanding of how much this change in predisposing factors and enabling factors is attributable to the increase in less severe cases at the ED is crucial and implications for health care planners are far reaching. According to these studies, the spending of resources on developing primary care may not be a way to reduce the load of emergency care utilization.

Applying PCG for understanding the increasing ED utilization

In the second part of this thesis we have been applying the PCG as a tool in investigating the above considerations.

Despite the regional increased expenditure on primary care by 47% (from 1700 SEK/inhabitant to 2500 SEK/ inhabitant per year)[68] between 1996 and 2000, the number of non - surgical ED visits increased to the non-surgical ED with 30%. After adjustment for age and gender there was still an increase of 16.5 % not explained by demographics.

By studying the distribution of visitors to the PCGs between the studied periods and by linking these to short- as well as long-term mortality we found an increase in the PCGs associated to less severe medical conditions and a decrease in the PCGs correlating to severe conditions.

The increase can not only be explained by changing demographics, increasing prevalence of serious illnesses or decreasing primary health care resources. Most likely the increasing use of the ED is due to changing apprehension of the “need factors”.

Using PCG and mortality for studying frequent ED attenders

All over the world EDs are experiencing utilization of the ED for non-emergency health care or sometimes not health care related visits at all[69 70 71].

The visitors constituting this phenomenon are called frequent users or frequent attenders. When should a visitor be categorized as a frequent attender or which criteria will make a re-visitor a frequent attender and after how many re-visits is it appropriate to name a visitor a frequent attender? This, however, is not clear[72 73].

The frequent attenders constitute only a small fraction of all visitors but they consume a considerable amount of the ED recourses. The nature of the phenomenon seems to be transient and 2 out of 3 frequent attenders stop using the ED within 2 years[74 75]. Frequent use of the hospital emergency department is also indicative of a high use of other health care services [76 77 78]

Definitions in the literature of when frequent ED use becomes inappropriate, range from as few as after two visits annually to 12 or more visits, often without a clear rationale for the choice[79 80 81].

Hunt et al, using the US nationwide Community Tracking Study Household Survey[82] as a source for studying frequent ED attenders, could not find a natural transition level based on medical criteria for after how many visits a patient became a frequent visitor. Nor have any other investigators defined such a cut-off limit.

On an individual level this is, of course, not possible as an individual might have emergent medical reasons for even a large number of ED visits. On a statistic level, however, there might be a possibility to define a level where the amounts of visits no longer correlate to the severity of a disease.

In the last part of the thesis we are using short- and long-term mortality together with PCGs as a tool to investigate the possibility of discriminating between appropriate medical revisits to the non-surgical ED and inappropriate use.

We tested the hypothesis that if the number of visits to the ED, performed by an individual patient, correlates to worsened health, the number of visits also correlates to an increased mortality risk. But as some chronic diseases have frequent exacerbations needing ED care but not necessarily life threatening and giving high mortality risk, fore example asthma and head ache, considerations to PCGs must be taken.

By linking a PCG and mortality data to the number of visits for the individual during one year we could demonstrate a transition level from where the mortality risk decreased with increasing visits. We could also demonstrate that this pattern differed for different PCGs and some PCGs had no such transition level.

We have been interpreting this transition level of mortality risk as the statistical number of visits after which inappropriate ED visits occur. This knowledge might be of great importance as the frequent attenders probably need a different approach in their issues than the standard emergency patient.

Strengths and limitations

The strength of this thesis was the design of the study, which used large samples of patients (12 995 and 16 891 respectively) consecutively included during two twelve month periods. The large amount of subjects, the few missed data and the long sampling periods result in the samples as true representatives for the periods investigated. By using periods of one year for each sampling period, variations due to time of the year could be avoided. A strength was also the time between the two sampled periods making it possible to detect changes in small tendencies in the population.

The long follow up time for the studied cohorts (ten and five years, respectively) and the few subjects lost in follow-up also increase the strength of this study.

The use of only non-surgical ED patients only and a single teaching hospital is, of course, a limitation in our study. One should therefore be cautious in generalizing to other hospitals or areas without repeating the study.

The forming of presenting complaint groups was done by retrospective evaluation of earlier reasons for ED visits. These reasons can to some degree be dependent on local circumstances, such as the education of interpreting nurse, environmental circumstances, etc.

The PCG and its consistency were tested in different years but not in different hospitals which is a weakness in this study.

Another limitation of long term cohort studies is the reduced possibilities to adjust for confounding variables.

In our study we have only investigated the influence of age, gender and diagnoses on PCGs and not vital signs or co-morbidity which also has been shown to influence on mortality for ED-populations[83 84].

Future perspectives

The importance of the reliable triage of patients visiting the ED is more obvious as the demand of ED-care is exceeding the capacity. When developing tools for sorting patients it is important to stand on solid scientific ground.

Presenting complaints are, together with vital signs, the foundation that the triage-systems are built upon and therefore important to validate. In this thesis we have validated a system to form presenting complaint groups and found this possible.

By implementing Triage systems built on systems of validated presenting complaints as well as vital signs and co-morbidity, it will be possible to compare different hospital EDs and form reliable national (and international) databases for ED comparisons. This has been the ambition for emergency medicine research since the forming of the agenda in 1994 at the Research Directions in Emergency Medicine Conference in Williamsburg, VA, USA.[85]

The perspective for having solid presenting complaint groups in the ED is waste. Once the groups are determined there is a possibility to test, by logistic regression models, what tests or procedures that are useful in diagnosing crucial diagnoses from the different PCGs. Even for the health planner and health economists an improved triage system built on validated PCG and Vital signs will be equal valuable.

Conclusions

Overall aim

The present study revels that it is possible to define presenting complaint groups (PCGs) that are robust and consistent over time and useful as a tool for epidemiological studies in the ED.

Secondary aims

I The presenting complaint at the ED carries valuable information of the risk for in-hospital fatality in non-surgical patients. This knowledge can be valuable in the prioritization between different patient groups in the process of initiating diagnostics and treatment procedures at the ED.

II Long-term age and gender adjusted mortality differs markedly between different PCG. Furthermore, depending on the PCG, long term mortality differs within the same discharge diagnosis. Hence, the PCG adds unique information to the discharge diagnosis regarding long- term mortality in non-surgical patients.

III By using the PCG it is possible to demonstrate that the major part of the increased ED utilization seen between 1995 and 2000 was not due to an increase in the severity of diseases among ED visitors or demographic changes but rather to a change in the visiting pattern among the inhabitants.

IV In non-surgical patients revisiting the ED, long-term mortality was dependent on both the number of revisits, as well as time between two visits in an inverse U-shaped fashion.

Sammanfattning på svenska

Bakgrund

Akutmottagningar som vi känner dem idag började utvecklas efter andra världskriget. Erfarenheter från krigssjukvård, hjärtsjukvård och traumasjukvård förvandlade akutmottagningarna från tidigare vanligtvis ett rum på någon av sjukhusens kirurgmottagningar till en egen enhet med dedicerad personal under -50 och -60 talet.

Under 60 och 70-talet utvecklades den medicinska professionen akutsjukvård enligt två modeller, den Franco-Germana och den Anglo-Amerikanska. I den första modellen bemannas den prehospitala sjukvården med särskilt utbildade (ambulans-) läkare medan akutmottagningen bemannas av sidotjänstgörande läkare från moderklinikerna medicin, kirurgi eller ortopedi. I den senare modellen bemannas ambulanserna av ambulanssjukvårdare medan det på akutmottagningarna finns särskilt utbildade heltidsanställda s.k. akutläkare. Sverige utvecklade en blandmodell med ambulanssjukvårdare i ambulanserna och sidotjänstgörande läkare på akutmottagningarna.

Specialiteten Akutläkare, ”Emergency Physichians”, blev godkänd basspecialitet i USA och England under 70- respektive 80-talet. Ett stort antal länder följde snart efter och nu finns akutläkare som godkänd basspecialitet i flertalet länder. Sedan juli 2006 är specialiteten akutsjukvård en godkänd tilläggsspecialitet i Sverige.

Under 70-talet utvecklades sorteringsprinciperna för akuta besökare vid akutmottagningar och begreppet TRIAGE infördes. Triage bygger på, att utifrån algoritmer baserande sig på patientens vitalparametrar och vitalhistoria kopplat till patientens sökorsak, ”Presenting Complaint”, kunna rangordna patienter i akuticitetshänseende oavsett sökorsak.

T. Olsson har i sin avhandling, Risk prediction at the emergency department, visat vilka vitalparametrar som på en akutmottagning korrelerar till sjukhus- och långtids- mortalitet.

I denna avhandling har vi studerat sökorsak, ”Presenting complaint”, den andra huvudkomponenten som ingår i Triagesystem. Väl definierade och över tid stabila sökorsaksgrupper är en förutsättning för att relationer mellan sökorsak och sjukdom eller död ska kunna studeras.

I den första delen har vi studerat relationen mellan sökorsak och mortalitet för medicinpatienter som söker på akutmottagningen. Vi har indelat sök-

orsakerna i s.k. ”Presenting Complaint Groups”, PCGs, för att få väl definierade grupper som går att jämföra och som är stabila över tid. Dessa PCG har vi sedan validerat mot såväl risk för död som för stabilitet över tid och funnit detta möjligt.

I den senare halvan av avhandlingen har vi studerat användandet av dessa PCG i olika epidemiologiska tillämpningar.

Delarbete I

The ED presenting complaint as predictor of in-hospital fatality

För 12 995 patienter som sökte den medicinska delen av akutmottagningen vid akademiska sjukhuset under tolv månader 1995/96 registrerades besöksorsaksgrupp (PCG), slutdiagnos, inläggningsfrekvens samt sjukhusdödlighet. Av de 5 216 inlagda patienterna avled 6, 3 % på sjukhuset. Sjukhusdödlighet varierade beroende av sökorsaksgrupp ($p< 0,0001$). Bland sökorsaksgrupper med fler än 200 patienter var sjukhusdödligheten högst för sökorsaksgrupperna nedsatt allmäntillstånd (7,6%), andnöd (7,0%) och stroke liknande symtom (6,9%).

Vi fann också att inom samma sökorsaksgrupp varierade dödligheten beroende på slutdiagnos.
Beroende på vilken sökorsaksgrupp patienten tillhört på akutmottagningen kunde dödligheten för en och samma slutdiagnos variera betydligt.

Slutsats: Sökorsaksgrupper tillför värdefull information om risk för sjukhusdödlighet för medicinpatienter.

Delarbete II

Differences in long-term mortality for different ED presenting complaints.

De 12 995 patienterna från delarbete I följdes under tio år. Under uppföljningstiden avled 5727 patienter vilket gav en median-uppföljningstid på 9,6 år (Spridning; 0,0 -10,6 år) och som resulterade i en mortalitet på 6,6 per 100 personår (PYAR). En ålders- och köns- justerad referens population i Uppland hade under motsvarande period en mortalitet på 4,0 per 100 personår, vilket ger den studerade akutmottagningspopulationen ett Standardiserat Mortalitets Ratio (SMR) på 1,33 (95 % CI 1,30 – 1,37, $p< 0,001$).

Vid en jämförelse ej ålders- eller köns- justerade var tioårsmortalitet högst för besöksorsaksgrupperna nedsatt allmäntillstånd (84,2 %), stroke-liknande symtom (67,4 %) och andnöd (63,1 %) medan allergisk reaktion (6,7 %), huvudvärk (15,2 %), och förgiftning (21,7 %), hade de lägsta tioårsmortaliteterna.

När vi ålders- och köns- justerade samt korrelerade till förväntad mortalitet i Uppland framkom en helt annan bild av långtidsmortalitet. Besöksorsaksgrupperna kramp (SMR 2,62), förgiftning (SMR 2,51) samt symtom på astma (SMR 1,84) hade den största överdödligheten medan sökorsaksgrupper som allergisk reaktion, yrsel, svimning och oregelbunden hjärtrytm inte hade någon signifikant överdödlighet jämfört med kontrollpopulationen.

För patienter som fått diagnosen hjärtinfarkt fanns en överdödlighet för patienter som inte hade bröstsmärta som sökorsak vid ankomst med 1,70 ggr jämfört med gruppen hjärtinfarktpatienter som hade bröstsmärta vid akutmottagningsbesöket (HR 1.70, 95 % CI 1.150 – 2.422. p=0.007).

För patienter som fick slutdiagnosen stroke gällde det omvända där patienter som fått diagnosen, men inte haft de typiska symtomen på stroke, hade lägre långtidsmortalitet än patienter som sökte med typiska strokesymtom (HR 0.76. 95 % CI 0.59 – 0.98. p=0.033).

Slutsats. Långtidsmortaliteten varierar betydligt beroende på besöksorsaksgrupp. Vidare kan långtidsmortaliteten variera för en och samma slutdiagnos beroende på vilken besöksorsaksgrupp patienten tillhörde vid akutmottagningsbesöket. Detta innebär att Besöksorsaksgrupp tillför unik information om långtidsmortalitet för medicinpatienter.

Delarbete III

A lower threshold for seeking emergent care - the reason for increasing ED utilization.

De 9903 besökare som gjorde de 12 995 besöken vid den medicinska akutmottagningen under tolv månader 1995/1996 samt de 12 709 besökare som gjorde de 16 891 besöken på medicinakuten år 2000 registrerades. Sökorsaksgrupp (PCG), inläggningsfrekvens, slutdiagnos samt 30-dagars och 5-års dödlighet registrerades. Data från 99,2 % respektive 99,0 % av besökarna från respektive period erhölls för databearbetning.

Medelåldern för besökare till akutmottagningen sjönk från 61,3 år till 60,9 år ($p< 0,005$) medan medelåldern för inlagda steg från 70,4 till 72,8 ($p< 0,005$). Andelen inlagda patienter sjönk både i relativa (-37,4 %) och i absoluta tal (-1148 inläggningar). Vårdtiden ökade med 1,1 dagar ($p< 0,005$). Inläggningsfrekvensen sjönk för samtliga PCG förutom andnöd där inläggningsfrekvensen ökade.

Bland PCG med fler än 200 besök sågs de största ökningarna i PCG associerade till mindre allvarliga tillstånd så som Hjärtklappning (arytmi) (+ 105,0 %) "övriga besöksorsaker" (+59,0 %), ospecificerad värk (+41,8 %) och yrsel (+17,6 %) medan de största minskningarna sågs i PCG associerade till allvarliga tillstånd så som hosta/lunginflammation (-44,3 %), Andnöd (-26,4 %) hyperglykemi (-19,2 %) och bröstsmärta (-15,1 %)

Femårs mortalitet sjönk från 31,1 % till 29,2 % mellan de studerade perioderna (p=0,008) men efter köns och åldersjustering fanns ingen skillnad i 5-årsmortalitet för en och samma PCG mellan de två perioderna. Vi kunde i vårat material således inte härleda ökningen av antalet besökare till en ökad prevalens av allvarliga sjukdomar i samhället

När vi beräknade den proportionella förändringen i besök mellan de studerade perioderna fann vi, något överraskande, att ökningen skett i alla åldersgrupper utom i de allra äldsta grupperna. Den beräknade ökningen av besök till akutmottagningen orsakad av epidemiologiska förändringar i population beräknades till att kunna förklara endast 1767 av ökningen på 3896 besök.

Slutsats: Genom att använda PCG som en variabel har vi visat att ökningen av antalet besökare till den medicinska akutmottagningen inte kan härledas till vare sig en ökad sjuklighet i befolkningen eller befolkningsförändringar som gett upphov till fler besök, utan förändringen kan sannolikt förklaras av förändring i sökmönster i befolkningen.

Delarbete IV

Increased long-term mortality in patients with repeated visits to the ED. (Paper IV)

För 15 607 patienter som sökte medicinakuten 2000 registrerades PCG, inläggningsfrekvens, slutdiagnos samt ett- och femårsdödlighet. Data erhölls för 99,7 % av alla registrerade.

Elvatusenfemhundratjugotvå individer gjorde besöken varav 2318 (20,8 %) gjorde fler än ett besök. De 6,4 % av besökarna som gjorde tre eller fler besök svarade för 20,8 % av alla besök och de 53 patienter som gjorde fler än sex besök utgjorde 0,5 % av alla besökare men svarade för 5,1 % av alla besök vid medicinakuten. De gjorde i snitt 15 besök vardera

Den ålders- och köns-korrigerade långtidsöverlevnaden var beroende av antalet besök på akutmottagningen i ett inverst u-format mönster. Jämfört med engångsbesökare hade patienter som besökte akutmottagningen tre gånger (under år 2000) en ökad femårsmortalitet (HR 1,85, 95 % CI 1,58 – 2,16, <0.0001). För patienter som besökte medicinakuten fyra eller fem gånger sjönk 5-års mortaliteten (HR 1,80, 95 % CI 1,47 – 2,19, $p < 0.0001$), och för patienter med 6 eller fler besök fanns ingen överdödlighet jämfört med engångsbesökare

Även tiden mellan två på varandra följande besök vid akutmottagningen uppvisade ett inverst u-format mönster för långtidsmortalitet.

För 1046 av de 6403 återbesöken hade nästkommande besök samma PCG som besöket innan. Denna subgrupp användes för att beräkna enskilda PCGs inverkan på långtidsmortalitet vid flerbesök på akutmottagningen.

Både ettårs- och femårsdödligheten varierade beroende på PCG (p<0,0001). För de 35 patienter som besökte akutmottagningen mer än en gång på grund av kramp var ettårsdödligheten 3 gånger högre än för engångsbesökare med kramp (HR 3,15, 95 % CI 1,00- 9,73, p=0.049) och femårsdödligheten nästan fyra gånger högre (HR 3,95, 95 % CI 2,03 – 7,54, p< 0,0001). Ett motsatt mönster uppvisade de 102 flergångsbesökare som sökte för hjärtklappning, dessa hade en minskad femårsdödlighet jämfört med ålders och könskorrigerade engångsbesökare (HR 0,38, 95, % CI 0,19 – 0,76, p=0.006)

Relationen mellan antalet besök och femårsmortaliteten för olika PCG varierade (p< 0,0001). För flergångsbesökare pga. dyspne fanns en ökning av femårsmortaliteten upp till 3 gånger (HR 2,79, 95 % CI 1,78 – 4,35, p< 0,0001), men som därefter minskade betydligt. För patienter med besöksorsak bröstsmärta sågs ett annorlunda mönster där den högsta femårsmortaliteten sågs hos patienter med flest besök (HR 2,62, 95 % CI 1,43 – 4,65, p= 0,001)

Slutsats: För medicinpatienter som besökte akutmottagningen varierade långtidsdödligheten med både antalet besök och tiden mellan påföljande besök i ett inverst u-format mönster. Genom att korrelera besöksfrekvens med PCG kan en brytpunkt mellan medicinskt indicerat akutmottagningsutnyttjande och ej indicerat utnyttjande påvisas.

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References

[1] Guly H. A history of accident and emergency medicine, 1948–2004. Basingstoke, Palgrave Macmillan. 2005; ISBN 1403947155

[2] Committee on the Future of Emergency Care in the United States Health System. Hospital-Based Emergency Care: At the Breaking Point. The National Academic Press; 2007. ISBN-13: 978-0-309-10173-8

[3] Pantridge JF, Geddes JS. A mobile intensive-care unit in the management of myocardial infarction. Lancet. 1967 Aug 5;2(7510):271-3.

[4] Fleischmann T, Fulde G. Emergency medicine in modern Europe. Emerg Med Australas. 2007 Aug; 19(4):300-2.

[5] Dykstra EH. International models for the practice of emergency care. Am J Emerg Med 1997;15:208–9.

[6] McHugh DF, Driscoll PA. Accident and emergency medicine in the United Kingdom. Ann Emerg Med 1999; 33:702–9.

[7] Lind L, Terént A.[Does Sweden need emergency medicine specialists? Yes, but there are conditions] Läkartidningen. 2000 Aug 30; 97(35):3785-6.

[8] Safwenberg U. Akutläkare är på frammarsch i Sverige. Läkartidningen 2008; 105(4):205 -6

[9] Göransson KE, Ehrenberg A, Ehnfors M. Triage in emergency departments: national survey. J Clin Nurs. 2005 Oct;14(9):1067-74.

[10] Iserson K, Moskop J. Triage in Medicine, Part I: Concept, History, and Types. Ann Emerg Med. 2007;49:275-281.

[11] Yousif K, Bebbington J, Foley B. Impact on patients triage distribution utilizing the Australasian Triage Scale compared with its predecessor the National Triage Scale. Emergency Medicine Australasia 2005; 17: 429–433.

[12] Iserson K, Moskop J. Triage in Medicine, Part I: Concept, History, and Types. Ann Emerg Med. 2007;49:275-281.

[13] Branth S. Energy metabolic Stress Syndrome. Impact of Physical Activity of Different Intensity and Duration. Acta Universitatis Upsaliensis. Uppsala. Dissertations from the faculty of Medicine 209. Uppsala. 2006; ISBN 91-554-6741-5.

[14] Mower WR, Myers G, Nicklin EL, Kearin KT, Baraff LJ, Sachs C. Pulse oximetry as a fifth vital sign in emergency geriatric assessment. Acad Emerg Med. 1998 Sep;5(9):858-65.

[15] Rousseau P. Pain as the fifth vital sign. Arch Surg. 2008 Jan; 143(1):98

[16] Vardi A, Levin I, Paret G, Barzilay Z "The sixth vital sign: end-tidal CO2 in pediatric trauma patients during transport". Harefuah 2000; 139 (3-4): 85-7, 168.

[17] Olsson T. Risk prediction at the emergency department. Thesis. Acta Universitatis Upsaliensis. Uppsala (2004). ISBN 91-554-6070-4

[18] Olsson T, Terént A, Lind L. Rapid Emergency Medicine Score: a new prognostic tool for in-hospital mortality in non-surgical emergency department patients. J Itern Med. 2004 May; 255(5):579-87

[19]Olsson T, Lind L. Comparison of the rapid emergency medicine score and APACHE II in nonsurgical emergency department patients. Acad Emerg Med. 2003 Oct;10(10):1040-8.

[20]Olsson T, Terent A, Lind L. Rapid Emergency Medicine Score can predict long-term mortality in nonsurgical emergency department patients. Acad Emerg Med. 2004 Oct;11(10):1008-13.

[21] Olsson T, Terent A, Lind L. Charlson Comorbidity Index can add prognostic information to Rapid Emergency Medicine Score as a predictor of long-term mortality. Eur J Emerg Med. 2005 Oct; 12(5):220-4.

[22] Kaplan GA, Camacho T. Perceived health and mortality: a nine-year follow-up of the human population laboratory cohort. Am J Epidemiol. 1983 Mar;117(3):292-304.

[23] Kopp MS, Réthelyi J. Where psychology meets physiology: chronic stress and premature mortality—the Central-Eastern European health paradox. Brain Res Bull. 2004 Feb 1; 62(5):351-67.

[24] Al-Windi A. The relations between symptoms, somatic and psychiatric conditions, life satisfaction and perceived health. A primary care based study. Health Qual Life Outcomes. 2005 Apr 27;3:28.

[25] Al-Windi A, Dag E, Kurt S. The influence of perceived well-being and reported symptoms on health care utilization: a population-based study. J Clin Epidemiol. 2002 Jan;55(1):60-6.

[26] J. Coleman, Foundations of Social Theory, Harvard University Press, Cambridge, MA, 1990.

[27] Research directions in emergency medicine: 21-22 January 1995. J Emerg Med. 1996 Mar-Apr; 14(2):267-70.

[28] Imx, TitoEnator Corporation, Kutojantie 10, P.O.Box 33, 02631 Espoo, Finland

[29] Liddell FD. Simple exact analysis of the standardised mortality ratio. J Epidemiol Community Health. 1984 Mar;38(1):85-8.

[30] Vågerö D, Norell SE. Mortality and social class in Sweden--exploring a new epidemiological tool. Scand J Soc Med. 1989;17(1):49-58.

[31] Hammar N, Andersson T, Reuterwall C, Nilsson T, Knutsson A, Hallqvist J, Ahlbom A. Geographical differences in the incidence of acute myocardial infarction in Sweden. Analyses of possible causes using two parallel case-control studies. J Intern Med. 2001 Feb;249(2):137-44.

[32] Hammar N, Ahlbom A, Theorell T. Geographical differences in myocardial infarction incidence in eight Swedish counties, 1976-1981. Epidemiology. 1992 Jul;3(4):348-55.

[33] McMichael A J. Standardized mortality ratios and the healthy worker effect: scratching beneath the surface. J Occup Med 1976; 18: 165-8.

[34] Howe GR, Chiarelli AM, Lindsay JP. Components and modifiers of the healthy worker effect: evidence from three occupational cohorts and implications for industrial compensation. Am J Epidemiol. 1988 Dec;128(6):1364-75.

[35] Statistics from Statistics Sweden (SCB): http://www.ssd.scb.se/databaser (22 feb 2008)

[36] Bring J, Taube A. Introduktion till medicinsk statistik. p 15 -30. 2006. Studentlitteratur. ISBN 91-44-03748-1

[37] Wayne W D Biostatistics:a foundation for analysis in the health science. 7th ed. p 71-123. 1999, John Wiley & sons, Inc. ISBN 0-471-16386-4.

[38] Dorsch M F, Lawrance R A, Sapsford R J, et al. Poor prognosis of patients presenting with symptomatic myocardial infarction but without chest pain. Heart 2001;86:494-8.

[39] Brieger D, Eagle KA, Goodman SG, Steg PG, Budaj A, White K, Montalescot G; GRACE Investigators. Acute coronary syndromes without chest pain, an underdiagnosed and undertreated high-risk group: insights from the Global Registry of Acute Coronary Events. Chest. 2004 Aug;126(2):461-9.

[40] Canto J G, Shlipak M G, Rogers W J, et al. Prevalence, Clinical Characteristics, and Mortality Among Patients With Myocardial Infarction Presenting Without Chest Pain. JAMA 2000;283(24): 3223- 9.

[41] Hand PJ, Kwan J, Lindley RI, Dennis MS, Wardlaw JM. Distinguishing between stroke and mimic at the bedside: the brain attack study. Stroke. 2006 Mar; 37(3):769-75.

[42] Herlitz J, Karlson BW, Lindqvist J et al. Predictors and mode of death over 5 years amongst patients admitted to the emergency department with acute chest pain or other symptoms raising suspicion of acute myocardial infarction. J Intern Med 1998;243:41-48

[43] Karlson BW, Kalin B, Karlsson T, et al. Use of medical resources, complications and long-term outcome in patients Hospitalised with acute chest pain. A comparison between a city university hospital and a county hospital. Int. J Card. 85 (2002) 229–238.

[44] Gupta M, Tabas J A, Kohn M A. Presenting Complaint Among Patients With Myocardial Infarction Who Present to an Urban, Public Hospital Emergency Department. Ann Emerg Med; 2002:40(2) 180-6.

[45] Herlitz J, Karlsson B W, Richter A, Strombom U, Hjalmarson A. Prognosis for patients with initially suspected acute myocardial infarction in relation to presence of chest pain. Clin Cardiol 1992;15:570-6.

[46] Niewada M, Skowronska M, Ryglewicz D, et al. Acute ischemic stroke care and outcome in centers participating in the Polish National Stroke Prevention and Treatment Registry.Stroke. 2006 Jul;37(7):1837-43.

[47] Goldstein L B, Simel DL. Is This Patient Having a Stroke? JAMA. 2005; 293: 2391-2402.

[48] Libman RB,Wirkowski E, Alvir J, Rao TH. Conditions that mimic stroke in the emergency department. Implications for acute stroke trials. Arch Neurol 1995; 52:1119–1122.

[49] Tsai SP, Wen CP. The impact of competing risks on relative risks in occupational cohort studies. Int J Epidemiol. 1984 Dec; 13(4):518-25.

[50] Tsai SP, Wen CP. A review of methodological issues of the standardized mortality ratio (SMR) in occupational cohort studies. Int J Epidemiol. 1986 Mar; 15(1):8-21.

[51] Le Moual N, Kauffmann F, Eisen EA, Kennedy SM. The healthy worker effect in asthma: work may cause asthma, but asthma may also influence work. Am J Respir Crit Care Med. 2008 Jan 1; 177(1):4-10.

[52] Nawar EW, Niska RW, Xu J. National Hospital Ambulatory Medical Care Survey: 2005 emergency department summary. Adv Data. 2007 Jun 29;(386):1-32.

[53] McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2001 emergency department summary. Adv Data. 2003 Jun 4; (335):1-29.

[54] Santos-Eggimann B. Increasing use of the emergency department in a Swiss hospital: observational study based on measures of the severity of cases. BMJ 2002; 324; 1186-1187

[55] Kendrick S. The pattern of increase in emergency hospital admissions in Scotland. Health Bulletin 1996; 54:101-9.

[56] Derlet RW. Overcrowding in emergency departments: increased demand and decreased capacity. Ann Emerg Med. April 2002; 39:430-432.

[57] Kendrick S. The pattern of increase in emergency hospital admissions in Scotland. Health Bulletin 1996;54:101-9.

[58] National Association of Health Authorities and Trusts. Emergency admissions: managing the rising trend. Birmingham: NAHAT, 1994.

[59] Richman IB, Clark S, Sullivan AF, Camargo CA Jr. National study of the relation of primary care shortages to emergency department utilization. Acad Emerg Med. 2007 Mar;14(3):279-82. Epub 2007 Jan 22.

[60] Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, Verdon J, Pineault R. Continuity of primary care and emergency department utilization among elderly people. CMAJ. 2007 Nov 20; 177(11):1362-8.

[61] Hansagi H, Olsson M, Sjöberg S, Tomson Y, Göransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. Ann Emerg Med. 2001 Jun;37(6):561-7.

[62] Richman IB, Clark S, Sullivan AF, Camargo CA Jr. National study of the relation of primary care shortages to emergency department utilization. Acad Emerg Med. 2007 Mar;14(3):279-82. Epub 2007 Jan 22.

[63] Andersen R. and Newman J. Societal and individual determinants of medical care in the United States. Milbank Q. 51, 95-124, 1973.

[64] Wolinsky F. D. Assessing the effects of predisposing, enabling, and illness-morbidity characteristics on health service utilization. J. Hlth Ser. Behav. 19,384-396. 1978

[65] Padgett DK, Brodsky B. Psychosocial factors influencing non-urgent use of the emergency room: a review of the literature and recommendations for research and improved service delivery. Soc Sci Med. 1992 Nov;35(9):1189-97.

[66] Wolinsky F. D. Assessing the effects of predisposing, enabling, and illness-morbidity characteristics on health service utilization. J. Hlth Ser. Behav. 19,384-396. 1978

[67] Coleman P, Irons R, Nicholl J. Will alternative immediate care services reduce demands for non-urgent treatment at accident and emergency? Emerg Med J. 2001 Nov; 18(6):482-7.

[68] Statistics from the Swedish Association of Local Authorities and Regions (SALAR). http://sjvdata.skl.se/sif/start/ (20 feb 2008)

[69] Lowe RA, Bindman AB. Judging who needs emergency department care: a pre-requisite for policy-making. Am J Emerg Med. 1997;15:133-136.

[70] Lang T, Davido A, Logerot H, et al. Appropriateness of admissions: the French experience. Int J Qual Health Care. 1995; 7:233-238.

[71] Sempere-Selva T, Peiró S, Sendra-Pina P, Martínez-Espín C, López-Aguilera I. Inappropriate use of an accident and emergency department: magnitude, associated factors, and reasons-an approach with explicit criteria. Ann Emerg Med. 2001 Jun;37(6):568-79.

[72] Helliwell PE, Hider PN, Ardagh MW. Frequent attenders at Christchurch Hospital's emergency department. N Z Med J. 2001 Apr 13;114(1129):160-1.

[73] Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. Ann Emerg Med. 1998 Nov; 32(5):563-8.

[74] Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: a statewide analysis. Ann Emerg Med. 2006 Jul; 48(1):9-16

[75] Mandelberg JH, Kuhn RE, Kohn MA. Epidemiologic analysis of an urban, public emergency department's frequent users. Acad Emerg Med. 2000 Jun;7(6):637-46.

[76] Hansagi H, Olsson M, Sjoberg S, Tomson Y, Goransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. Ann Emerg Med. June 2001;37:561-567.

[77] Blank FS, Li H, Henneman PL, Smithline HA, Santoro JS, Provost D, Maynard AM. A descriptive study of heavy emergency department users at an academic emergency department reveals heavy ED users have better access to care than average users. J Emerg Nurs. 2005 Apr; 31(2):139-44.

[78] Chan BTB, Ovens HJ. Frequent users of emergency departments: do they also use family physicians' services? Can Fam Phys. 2002; 48:1654-1660.

[79] Salazar A, Bardés I, Juan A, Olona N, Sabido M, Corbella X. High mortality rates from medical problems of frequent emergency department users at a university hospital tertiary care centre. Eur J Emerg Med. 2005 Feb; 12(1):2-5.

[80] Blank FS, Li H, Henneman PL, Smithline HA, Santoro JS, Provost D, Maynard AM. A descriptive study of heavy emergency department users at an academic emergency department reveals heavy ED users have better access to care than average users. J Emerg Nurs. 2005 Apr;31(2):139-44.

[81] Zuckerman S, Shen YC. Characteristics of occasional and frequent emergency department users: do insurance coverage and access to care matter? Med Care. 2004;42:176-182.

[82] Hunt KA, Weber EJ, Showstack JA, Colby DC, Callaham ML. Characteristics of frequent users of emergency departments. Ann Emerg Med. 2006 Jul; 48(1):1-8.

[83] Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373-83.

[84] Olsson T. Risk prediction at the emergency department. Thesis. Acta Universitatis Upsaliensis. Uppsala (2004). ISBN 91-554-6070-4

[85] Research directions in emergency medicine: 21-22 January 1995. J Emerg Med. 1996 Mar-Apr; 14(2):267-70.

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Paper I

The Emergency Department presenting complaint as predictor of in-hospital fatality

Urban Safwenberg, Andreas Terént and Lars Lind

Background **The relationship between major discharge diagnoses and prediction of in-hospital death has been intensively studied. The relation between the presenting complaint at the Emergency Department (ED) and in-hospital fatality, however, is less well known.**

Objective **To investigate if presenting complaints add information regarding in-hospital fatality risk for nonsurgical ED patients.**

Methods **Investigating the relationship of in-hospital fatality rate and presenting complaint by comparing the presenting complaints, discharge diagnoses and in-hospital fatality for all nonsurgical patients visiting the ED during 1 year.**

Results **Of 12 995 nonsurgical admissions, 40% were treated as in-hospital patients. Among these, 328 in-hospital deaths occurred. Age was the most powerful predictor of death in hospitalized patients ($P<0.0001$). After adjustment for age, the female sex was found to be protective [odds ratio (OR) 0.73, 95% confidence interval (CI) 0.58–0.92, $P=0.007$)]. Compared with the largest complaint group, chest pain with an in-hospital fatality rate of 2.5%, there was a significantly increased risk of dying among those with stroke-like symptoms (OR 2.04, 95% CI 1.35–3.08, $P=0.0007$), dyspnoea (OR 1.95, 95% CI 1.27–3.00, $P=0.002$) or general disability (OR 1.81, 95% CI 1.17–2.79, $P=0.008$).**

Conclusions **The presenting complaint at the ED carries valuable information of the risk for in-hospital fatality in nonsurgical patients. This knowledge can be valuable in the prioritization between different patient groups in the process of initiating diagnostics and treatment procedures at the ED.** *European Journal of Emergency Medicine* **14:324–331 © 2007 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Keywords: emergency department, in-hospital fatality rate, nonsurgical patients, presenting complaint, risk prediction

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Introduction

A majority of all inhabitants in the Western world will, during their lifetime, visit an Emergency Department (ED) due to trauma or acute illness [Swedish Association of Local Authorities and Regions (SALAR), *www.skl.se*]. The reason for attending the ED is not generally driven by diagnosis knowledge but rather by the severity of a symptom. At the arrival to the ED, the symptoms and signs are presented as a complaint. The main task for the ED is thereafter to transform this presenting complaint into a plausible diagnosis and hence proper treatment. In accordance, at the ED, the knowledge of the presenting complaint and in-hospital fatality prediction may be as useful as the relationship between discharge diagnosis and in-hospital risk of death, which has been established previously [1–5].

Many investigations have studied the impact of different diagnoses on survival, expressed as in-hospital fatality rate [6–9]. A few of these have studied the predictive power of the presenting complaint at the ED for in-hospital fatality rate. At present, such data are scarce and available mostly for chest pain, dyspnoea and stroke-like symptoms [10–13]. We therefore investigated the impact of a broader spectrum of presenting complaints on in-hospital fatality in all nonsurgical patients attending an ED during a 12-month period. As a certain diagnosis could present with different complaints, a secondary aim of the study was to evaluate if the prognosis of a certain diagnosis might be affected by the presenting complaint.

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Material and methods

Patient population and data collection

A prospective study was conducted at the Uppsala University Hospital, Sweden. This hospital is the only emergency hospital in the catchment area, serving a population of 186 834 adult inhabitants (51.5% female). Over a 12-month period (1 April 1995 to 31 March 1996) 12 995 entries to the nonsurgical ED for adults (age 18 years and older) were registered in a database. Trained ED staff members sorted the patients to either the surgical/orthopaedic or the nonsurgical part of the ED and registered the presenting complaint. Information regarding length of stay in hospital, in-hospital fatality rate

and discharge diagnosis were collected from the hospital discharge records.

Definitions

Presenting complaints were defined as the patient's presentation of the reason for seeking the ED as interpreted and recorded by the receiving nurse before any major diagnostic procedures were performed. When applicable, the referring institution's complaints in the referral note were used. If the patients were brought in by the Emergency Medical System, the complaint as interpreted by the Emergency Medical System staff in the ambulance report was used as the presenting complaint. Only the main complaint was recorded if the patient presented more than one complaint. The presenting complaint was registered before any other diagnostic proceedings were done at the ED.

After the study the different recorded presenting complaints were sorted into predefined complaint groups by a physician (U.S.) and revised by a senior physician (L.L.).

Selection of the predefined complaint groups was done by investigating the previous year's records of unsorted presenting complaints and sorting these into easily separated complaint groups. The task group (four physicians) extracted 33 definable complaint groups (Table 1).

Entries considered as nonsymptom derived (i.e. administrative or nonmedical reasons, for example renewal of a prescription and administration of an injection, etc.) were assigned to a separate group. Patients reporting complaints not fitting into any of the complaint groups were allocated in a separate (miscellaneous) group.

In-hospital patients were defined as those staying more than 24 h in the hospital or dying within that time.

The study was approved by the Institutional Review Board (Local Ethics Committee) at Uppsala University.

Statistical methods

Relationships between categorical variables were evaluated by χ^2 test or by logistic regression analysis. For differences in continuous variables between groups, analysis of variance or Kruskal–Wallis' test were used. The StatView for Windows version 5.0.1 (SAS Institute Inc., Cary, North Carolina, USA) program was used for the calculations. A *P*-value < 0.05 was regarded as significant.

Results

Of the 12 995 admissions to the nonsurgical ED, 12 445 (95.8%) were allocated to one of the defined complaint groups. Among the other 550 admissions, 74 (0.7% of total) were nonsymptom derived and 471 (3.6%) were classified as miscellaneous. Eighty-nine (0.7%) of the entries were lacking notice of the presenting complaint. Of the 33 defined complaint groups, 16 received more than 200 entries. These 16 groups contained 89.5% of all entries.

A total of 5216 (40.1%) of the admissions were treated as in-hospital patients with a death rate of 6.3%. Ninety-eight patients were admitted to the emergency room with cardiac arrest, of which the in-hospital fatality rate was 86%. Owing to the extreme mortality rate in this group, these patients (median age 74 years and 66.3% of male sex) were excluded from further analysis.

Age was the most powerful predictor of death in hospitalized patients [odds ratio (OR) 1.03, 95% confidence interval (CI) 1.02–1.04, $P < 0.0001$ in a linear model)]. The relationship between age and hospital fatality rate was nonlinear, ranging from 1.33% in patients (20–39 years), 0.96% in middle-aged patients (50–59 years) to 6.5% in those aged 80–89 years ($P < 0.0001$ for differences between age groups, Fig. 1). Sex as such was not a significant predictor for in-hospital fatality in crude analysis, but after adjustment for age the female sex was found to be protective (OR 0.73, 95% CI 0.58–0.92, $P = 0.007$).

Admissions during the night (0.00 to 8.00 h) showed a higher in-hospital fatality rate than admissions during the day (9.8 vs. 5.7%, OR 1.88, 95% CI 1.38–2.56, $P < 0.0001$ after adjustment for age and sex).The weekday or month of admission were, however, not significant predictors for death.

As shown in Table 2, hospital fatality rates differed between complaint groups ($P < 0.0001$). This finding was valid in both men and women. The highest in-hospital fatality rates, among complaint groups with more than 200 entries, were seen in those with general disability (7.6%), dyspnoea (7.0%) and stroke-like symptoms (6.9%), whereas no fatalities were seen in patients presenting with seizure, palpitation (arrhythmia) or allergic reactions.

As shown in Table 3, hospital fatality rates also differed between discharge diagnosis groups ($P < 0.0001$). This finding was valid in both men and women.

Hospitalized patients with chest pain were given a large number of diagnoses at discharge (Table 4). Only 17.5% of those admitted with chest pain received a diagnosis of acute myocardial infarction and 16.4% a diagnosis of angina pectoris. A significant difference in hospital fatality was seen between different discharge diagnoses ($P < 0.0001$). The highest risk of dying was seen among

Table 1 Definition of the 33 different complaint groups and their corresponding classification in International statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)

Presenting complaint	Definition	Classification in ICD-10	Patients
Chest pain	Pain or discomfort from thorax not only localized to spine	R07	3339
Dyspnoea	The patient's own experience of lack of breath but no known history of asthma and no wheezing at expire	R06.0	1057
Stroke-like symptoms	Either history of transient loss of strength in face, arm or leg or transient loss of speech, vision or dysphasia or presenting ED with loss of strength in one or more extremities, facial paralysis, loss of speech own experience of loss of sensibility in a part of the body or sudden loss of vision field or sight	R20.0, R27.0, R29.8, R47, I69.3	946
One swollen leg	Asymmetrical swelling of the legs with or without adjunct pain, discomfort or rush	R60.0, M79.6	797
General disability	A conscious patient's own (or referring institution's) experience of rapid decline of physical and/or mental condition but no signs or symptoms from a specific organ and no knowledge of ongoing fever.	R69, R41.0, R63.0, R63.4, R64, R69	719
Symptoms of asthma	The patient's own experience of lack of breath and having history of asthma and typical wheezing at expire	R06.2, J45, J46	680
Vertigo/dizziness	The patient's own experience of discomfort in the form of a sense of spatial disorientation, motion of the environment, or light-headedness.	R42	617
Intoxication	Suspicion of or report of deliberate or accidental intake, inhalation, overdose or injection of medical drugs, illegal drugs, alcohol, chemicals, fire smoke or combustions with or without symptoms thereof	T36-T65, X00-X09, X40-49	614
Headache	Pain or severe discomfort from head	R51	483
Miscellaneous	Complaints not fitting into any other complaint groups		471
Allergic reaction	Onset of skin rashes, hives or weals such as contact dermatitis or eczema with or without symptoms from respiratory organs. Or sudden onset of wheezing or other symptoms from respiratory organs after intake of drugs or food with or without symptoms from the skin. Circulatory choke after ingestion of known allergen	R21, L53.9, T78.2, T78.0,T80.0, T88.6, 88.7	424
Syncope	Sudden and transient episode of unconsciousness but no convulsions	R55	327
Palpitation (arrhythmia)	Sensation of an alteration in the rhythm of the heartbeat either in time or force, either of functional or organic origin	R00, I49.9	325
Hyperglycaemia	Self-diagnosed or suspicion of hyperglycaemia, hyperglycaemia detected by the EMS personnel or any referral stating hyperglycaemia without considering actual blood glucose level later registered at the ED	R73, R81	297
Seizure	Witnessed or self-reported signs of a convulsions with or without following unconsciousness	G40, G41, R56	289
Cough/pneumonia	Symptoms of or reporting cough with or without fever and/or general decline of health	R05, R09.3, J18.9	266
Unspecified ache	Self-reported experience of pain not originating from chest or head	R52	240
Fever	A rise in the temperature of the body but no focal symptom suggesting its cause	R50	169
Hypoglycaemia	Self-diagnosed hypoglycaemia, hypoglycaemia detected by the EMS personnel or any referral stating hypoglycaemia without considering actual blood glucose level later registered at the ED	E16.2	110
Oedema	Symmetrical swelling of extremities, face or trunk but no rush or exanthemas suggesting allergic reactions	R60.9	107
Cardiac arrest	Unconscious patient with cessation of the action of the heart	I46.9	98
Anaemia	Self-diagnosed anaemia or any referral stating anaemia without considering actual hematocrit later registered at the ED	D64,9	94
Hypertension	Self-diagnosed elevated blood pressure or an referral stating hypertension without considering actual blood pressure later registered at the ED	R03.0	83
Non-symptom-derived reason	Entries considered as non-symptom derived (i.e. administrative or nonmedical reasons)	Z02	74
Psychiatric symptoms	Referred or self-reported with altered personality, aggressively, hearing voices, bizarre behaviour and no other physical symptoms or signs and no suspicion of drug or alcohol abuse.	F44.8, R44, 45.4, R45.8, R46.2, R46.8, F09	44
Coma	A state of deep and prolonged unconsciousness with no history of convulsions	R40.2	43
Diarrhoea	Self-reported or referred with a history of passage of excessively liquid or excessively frequent stools.	K52.9, K59.1, A09, F45.3	33
Fatigue	Self-reported fatigue with no report of altered mental or physical decline	R40.0, R53	32
Bite or sting from animals, insects or snakes	Bite or stings or suspicion thereof from insects, snakes or other animals	X20-X29	31
Bleeding/haematuria/ melaena	Ongoing bleeding, melaena or haematuria of any kind not being considered an surgical ED patient	R31, R58, R04, K92.0, K92,1	28
Nausea	Self-reported unpleasant sensation in the stomach usually accompanied by the urge to vomit with or without vomiting.	R11	27
Electric shock	Passage of electric current through the body; domestic current, high-voltage current or lightning	T75.4, T75.0, X33,	24
Alcohol-abuse-related states	Drunkenness but no signs of alarming intoxication or referred from an institution stating alcohol-related conditions with no signs of alarming intoxication	R78.0	18

ED, Emergency Department; EMS, Emergency Medical System.

those with a diagnosis of acute myocardial infarction. In this group the in-hospital fatality rate was 8.3%.

Hospitalized dyspnoea patients were also given various diagnoses at discharge (Table 5). A total of 4% of these patients received a diagnosis of acute myocardial infarction. In this small group, in-hospital fatality rate was markedly high, 20.8%, twice the rate in the complaint group 'chest pain' who received the discharge diagnosis of myocardial infarction. Taken together, however, no

significant difference was found between different discharge diagnoses in patients admitted with dyspnoea ($P = 0.425$).

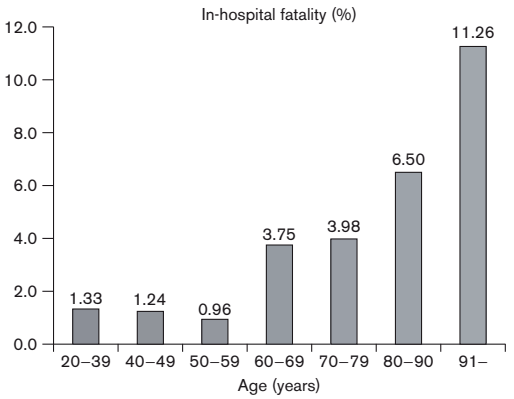
Among patients hospitalized due to stroke-like symptoms, 60% received a discharge diagnosis of stroke, whereas infections counted for 7% and syncope for 5% of the cases (Table 6). No significant difference in fatality rate with regard to discharge diagnoses for patients with stroke-like symptoms was found ($P = 0.21$).

In the hospitalized group of patients with general disability, various infections counted for 24% of all discharge diagnoses, with respiratory and urinary tract infections being dominant (Table 7). Within this group, cancer and congestive heart failure had the highest in-hospital fatality rates with 27.8 and 15.6%, respectively. The difference in fatality rate between the diagnostic groups was significant among patients with general disability ($P = 0.0023$).

Discussion

As might be expected, the presenting complaint predicts the mortality during the hospital stay in ED patients. To the best of our knowledge, our study is the first to show this in a large cohort of unselected nonsurgical patients. The finding is valid in both men and women, independent of age. High fatality rates were seen in patients admitted with general disability, dyspnoea and stroke-like symptoms, whereas no risk of dying was seen among presenting complaints such as seizures, palpitation

Fig. 1



In-hospital fatalities in different age groups, $N = 5130$. Total number of deaths 245 ($P < 0.001$ for differences between age groups).

Table 3 In-hospital fatality for different discharge diagnoses admitted to the non-surgical emergency department

Diagnostic group	No.	% of patients admitted to ward	Fatality risk in diagnostic group %	% of all in-hospital fatalities
Myocardial infarction	375	7.7	11.2	18.6
Stroke	471	9.6	8.7	18.1
Congestive heart failure	454	9.3	6.8	13.7
Respiratory tract infection	318	6.5	8.8	12.4
Cancer	155	3.2	16.8	11.5
Infections other than respiratory tract infection or urinary tract infections	139	2.8	4.3	2.7
Pulmonary emboli	58	1.2	8.6	2.2
Respiratory organ diagnoses other than infections	67	1.4	6.0	1.8
Intestinal diseases	52	1.0	7.7	1.8
Arhythmias	260	5.3	1.2	1.3
Total/mean	2349	47.9	4.6	84.1

The 10 diagnostic groups containing the highest number of in-hospital deaths are given ($P < 0.0001$ for differences in the in-hospital fatality rate between groups).

Table 2 In-hospital fatality rate in relation to presenting complaint with more than 200 entries among nonsurgical emergency patients

Presenting complaint	No. of entries	Age (median)	% Women	% Admitted to in-hospital care	LOS (median) (days)	In-hospital fatality (%)	Odds ratio[a]	95% Confidence interval[a]	*P* value[a]
General disability	719	82.0	55.6	78.2	6.0	7.46	1.81	1.17–2.79	0.0077
Dyspnoea	1056	75.0	50.0	57.0	5.0	6.97	1.95	1.27–3.00	0.0024
Stroke-like symptoms	946	77.0	50.7	73.8	6.0	6.86	2.04	1.35–3.08	0.0007
Miscellaneous	471	53.0	50.1	41.8	5.0	4.57	2.12	1.01–4.44	0.046
Unspecified ache	240	57.5	59.2	24.2	6.5	3.45	1.21	0.28–5.14	0.80
One swollen leg	797	67.0	60.0	27.6	6.0	2.73	0.92	0.38–2.17	0.84
Chest pain	3339	67.0	46.6	57.8	3.0	2.54	1.0		
Headache	483	42.0	62.7	21.7	4.0	1.90	1.12	0.26–4.77	0.87
Intoxication	614	38.5	52.4	32.4	1.0	1.51	1.88	0.56–6.28	0.31
Symptoms of asthma	680	62.0	56.9	10.6	5.0	1.39	0.43	0.06–3.15	0.40
Vertigo/dizziness	617	67.0	60.8	43.4	4.0	1.12	0.36	0.11–1.17	0.090
Hyperglycaemia	297	65.0	54.2	66.3	7.0	1.02	0.39	0.09–1.62	0.19
Syncope	327	67.0	51.1	50.2	3.0	0.61	0.21	0.03–1.52	0.12
Allergic reaction	424	36.5	62.0	4.7	1.0	0.00	–		
Palpitation (arrhythmia)	325	62.0	53.5	51.5	2.0	0.00	–		
Seizure	289	46.0	38.8	28.7	3.0	0.00	–		
All entries	12995	66.0	52.2	48.2	4.0	5.17			

LOS, length of stay in hospital.
[a]Calculated with the chest pain group as the reference. ($P < 0.0001$ for differences in hospital fatality between presenting complaints).

Table 4 Discharge diagnoses in patients with chest pain

Chest pain symptom			
Diagnostic group	No.	% of chest pain symptoms	Fatalities (%)
Myocardial infarction	325	17.5	8.3
Chest pain of unknown origin (discharge diagnosis)	304	16.4	0.0
Stable angina	304	16.4	0.0
Arrhythmias	198	10.7	0.5
Congestive heart failure	155	8.4	3.2
Unstable angina	59	3.2	1.7
Miscellaneous diagnosis	52	2.8	3.8
Respiratory tract infection	50	2.7	2.0
Miscellaneous symptom diagnoses not from respiratory tract or cardiovascular system	49	2.6	0.0
Pericarditis/endocarditis/ myocarditis etc.	36	1.9	0.0
Total	1532	82.7	2.4

The 10 diagnostic groups containing the highest number of in-hospital deaths are given. ($P<0.0001$ for differences in hospital fatality rates between groups).

Table 5 Discharge diagnoses in patients with dyspnoea

Dyspnoea symptom			
Diagnostic group	No.	% of dyspnoeic symptom	Fatalitiy (%)
Congestive heart failure	201	33.7	5.5
Respiratory tract infection	74	12.4	8.1
Miscellaneous diagnosis	33	5.5	6.1
Arrhythmias	28	4.7	3.6
Respiratory organ diagnoses other than infections	27	4.5	14.8
Myocardial infarction	24	4.0	20.8
Pulmonary emboli	20	3.4	10
Chest pain	17	2.9	0
Chronic obstructive pulmonary diseases	16	2.7	0
Infection other than respiratory tract infection or urinary tract infections	15	2.5	13.3
Total/mean	455	76.3	6.5

The 10 diagnostic groups containing the highest number of in-hospital deaths are given ($P=0.42$ for differences in hospital fatality rates between groups).

Table 6 Discharge diagnoses after admitted with stroke-like symptoms

Stroke-like symptoms			
Diagnostic group	No.	% of stroke-like symptom	Fatalities (%)
Stroke (discharge diagnosis)	348	59.3	8.9
Syncope	29	4.9	3.4
Miscellaneous diagnosis	25	4.3	4.0
Cancer	17	2.9	17.6
CNS-diseases other than dementia	16	2.7	0.0
Psychiatric diagnoses	16	2.7	0.0
Urinary tract infection	16	2.7	0.0
Seizures	14	2.4	0.0
Infection other than respiratory tract infection or urinary tract infections	13	2.2	0.0
Respiratory tract infection	12	2.0	25.0
Total/mean	506	86.2	7.3

CNS, central nervous system.
The 10 most frequent groups are given ($P=0.21$ for differences in hospital fatality rates between groups).

Table 7 Discharge diagnoses after admitted from the symptom of general disability

Diagnostic group	No.	% of general disability symptom	Fatalities (%)
Respiratory tract infection	58	10.6	12.1
Urinary tract Infection	51	9.3	0.0
Miscellaneous diagnosis	50	9.1	6.0
Diabetes/endocrinology diagnosis	38	6.9	5.3
Cancer	36	6.6	27.8
Congestive heart failure	32	5.8	15.6
Stroke	30	5.5	6.7
Fluid or electrolyte disturbance	25	4.6	0.0
Infection other than respiratory tract infection or urinary tract infections	24	4.4	4.2
Intestinal diseases	20	3.6	15.0
Total	364	66.3	7.3

The 10 diagnostic groups containing the highest number of in-hospital deaths are given ($P=0.0023$ for differences in hospital fatality rates between groups).

(arrhythmias) or allergic reactions. When combining data on presenting complaint with the discharge diagnosis, it was found that for certain discharge diagnoses the in-hospital fatality rate could vary considerably depending on the presenting complaint.

Study design

Previous studies on presenting complaints at the ED and risk of dying during hospital stay have been limited to specific complaints, such as chest pain or dyspnoea [14,15]. The prognostic value of a single complaint can, however, be more valuable when it is compared with other presenting complaints. We, therefore, studied the impact of the presenting complaint and in-hospital fatality in all nonsurgical patients admitted to our hospital during 1 year to obtain a cohort comprising a mixture of patients resembling what is seen in general.

Overall fatality risk

The exponential relationship between age and in-hospital fatality observed in this study agrees well with the finding about age and all-cause mortality in the general population described in 1825 by Gompertz [16], but the fatality rate among patients younger than 60 was higher than expected when calculated from the Gompertz equation. The equation is, however, not applicable when the group of patients is not representative of the general population of that age group. In particular, young and middle-aged patients attending the ED tend to have more life-threatening conditions than is usually encountered in these age groups in the general population.

Chest pain

Strategies to evaluate chest pain as a predictor for myocardial infarction have been studied and developed

by Karlson *et al.* [17]. Their study, however, included only patients who arrived at the ED with symptoms that raised suspicion of acute myocardial infarction. This may induce a selection bias as some patients who later developed myocardial infarctions in hospital might have presented other symptoms on arrival. We included all nonsurgical patients to minimize this risk of sample bias.

Most studies on chest pain have been conducted as retrospective chart reviews. In 2002, Gupta *et al.* [18] published a retrospective chart review of 721 cases of diagnosed myocardial infarctions in which 47% reported no chest pain. Canto *et al.* [19] show, from the National Registry of Myocardial Infarction 2 database, that 33% of the registered myocardial infarctions had not reported chest pain as a complaint at entry to the ED. Similarly, Dorsch *et al.* [20] found in their retrospective study that 20% of the patients with myocardial infarction presented themselves with nonchest-pain complaints. We found a slightly lower frequency (14%) of nonchest pain on arrival in patients eventually discharged with a diagnosis of acute myocardial infarction. Herlitz and colleagues [21] found only 7% of the 921 patients with myocardial infarction admitted to a single hospital not to have chest pain as the presenting complaint. These differences might be due to different study designs. We used a prospective approach, following the patient from symptom presentation to discharge diagnosis, whereas most other investigators used a retrospective design to investigate the presenting complaint from a sample with acute myocardial infarctions. The first approach is associated with less recall bias of the selecting symptom than the retrospective approach.

In accordance with previous investigators, we could demonstrate a more than two-fold increase in in-hospital fatality risk for those with myocardial infarction presenting without chest pain compared with the group presenting with chest pain. In the majority of the cases without chest pain, the presenting complaint was dyspnoea, which might represent heart failure as a consequence of the acute myocardial infarction. Less than 5% of all patients admitted with dyspnoea, however, received a diagnosis of acute myocardial infarction, and of all patients with dyspnoea less than 1% died because of acute myocardial infarction. This demonstrates the importance of using the whole population of ED patients and not just a single complaint or a single diagnosis to obtain the complete picture.

Stroke-like symptoms

Stroke-like symptoms were a common reason for ED admission in the nonsurgical group and counted for 7.3% of all visits. Although symptoms of stroke are easy to recognize, only 60% of all patients with stroke-like symptoms received a discharge diagnosis of stroke. The most common conditions mimicking stroke were infections and syncope. The knowledge of differential diagnoses of acute stroke is especially important nowadays, when thrombolysis can be administrated to patients with ischaemic stroke [22,23]. The difficulties of predicting the stroke diagnosis from the presenting complaints have previously been demonstrated by Libman *et al.* [24].

Dyspnoea

As with chest pain and stroke-like symptoms, dyspnoea can be due to many different causes. Although congestive heart failure (CHF) is a leading course for hospitalization in the industrialized world [25,26], and dyspnoea is one of the cardinal symptoms of that condition, no more than 34% in this group received a diagnosis of CHF. The dyspnoea group as a whole showed an in-hospital fatality of 6.5%. Patients receiving the diagnosis of CHF showed a fatality rate of 5.5%, which is higher than the rate found by Adams and co-workers in the Acute Decompensate Heart Failure National Registry (4%) [27], but similar to the findings of 5% from Baker and co-workers [28]. The difference in hospital fatality rates between our study and that of Adams and co-workers [29] might be explained by the increased usage of ACE-inhibitors, angiotensin receptor blockers and β-blockers between the two investigations.

General disability

Of all complaints defined in our study, general disability was the most heterogeneous. No single diagnosis contributed to more than 10% of the causes of general disability. Nevertheless, the patients in this group had the highest fatality risk. This symptom group has rarely been studied before, but is nowadays common at the ED (in our study 5.5%). It represents in many cases the terminal stage of an underlying disease. It should, however, be emphasized that the fatality rates in this group ranged from 0 to 27% depending on discharge diagnosis.

Registering the complaint

The importance of presenting complaint at the ED is rapidly being acknowledged as an important sorting tool. Currently the complaint classification at the ED is often performed by specially trained ('Triage') nurses [30]. This classification form was first developed in Ipswich, Australia in the 1970s [31] and is now mandatory in many countries. The system of sorting patients on the basis of need for medical treatment (TRIAGE) mostly uses the combination of the presenting complaint, as interpreted by a trained nurse, and vital signs to give each patient a certain ranking [32]. Although we have previously shown vital signs at the ED to be of great importance regarding in-hospital fatality risk [33], our aim in this study was to use the sole complaint reported by the patient with as little medical interpretation as possible.

Strengths and weaknesses

To avoid a large group of nonclassified symptoms jeopardizing the validity of the study, we defined as many as 33 complaint groups before the study. When reviewing the data, however, the 16 most frequently reported complaint groups contained almost 90% of all entries. The group of nonclassified complaints (miscellaneous symptom group) constituted less than 4% of all entries.

The major limitation with this study is that, although almost 13 000 patients were included, the number of in-hospital fatalities was too small to allow a detailed analysis of mortality risk in other than in the largest complaint groups. The major strength is the prospective design in an unselected nonsurgical ED population with very few missing data both of collection at admission and during the follow-up.

A limitation is that the present cohort was collected in the mid-1990s. We have, therefore, compared the present sample with a cohort collected in the beginning of this century and found the proportions of admission complaints to be essentially the same, and the in-hospital mortality to be very similar. Thus, although the present sample is 12 years old, it is likely to be representative of the nonsurgical patients admitted to the ED today.

Conclusion

In conclusion, the presenting complaint at the ED carries valuable information of the risk for in-hospital fatality in nonsurgical patients. This knowledge can be valuable in a prioritization between different patient groups in the process of initiating diagnostic and treatment procedures at the ED.

Acknowledgement

The outstanding work of the ED staff in registering all the 12 995 patients in the database making this study possible is highly acknowledged.

References

1 Centre for Epidemiology, National Board of Health and Welfare. The Swedish Hospital Discharge Register 1987–1995. Stockholm, 1997.
2 Hasdai D, Behar S, Wallentin L, Danchin N, Gitt AK, Boersma E, *et al.* A prospective survey of the characteristics, treatments and outcomes of patients with acute coronary syndromes in Europe and the Mediterranean basin; the Euro Heart Survey of Acute Coronary Syndromes (Euro Heart Survey ACS). *Eur Heart J* 2002; **23**:1190–1201.
3 Niewada M, Skowronska M, Ryglewicz D, Kamiński B, Czlonkowska A, on behalf of the Polish National Stroke Prevention and Treatment Collaborative Group. Acute ischemic stroke care and outcome in centers participating in the Polish National Stroke Prevention and Treatment Registry. *Stroke* 2006; **37**:1837–4183.
4 Osler M, Sorensen TI, Sorensen S, Rostgaard K, Jensen G, Iversen L, *et al.* Trends in mortality, incidence and case fatality of ischaemic heart disease in Denmark, 1982–1992. *Int J Epidemiol* 1996; **25**:1154–1161.
5 Abildstrom SZ, Rasmussen S, Rosén M, Madsen M. Trends in incidence and case fatality rates of acute myocardial infarction in Denmark and Sweden. *Heart* 2003; **89**:507–511.
6 Galvao M, Kalman J, DeMarco T, Fonarow GC, Galvin C, Ghali JK, *et al.* Gender differences in in-hospital management and outcomes in patients with decompensated heart failure: analysis from the Acute Decompensated Heart Failure National Registry (ADHERE). *J Card Fail* 2006; **12**:100–107.
7 Goldberg RJ, Yarzebski J, Lessard D, Gore JM. A two-decades (1975 to 1995) long experience in the incidence, in-hospital and long-term case-fatality rates of acute myocardial infarction: a community-wide perspective. *J Am Coll Cardiol* 1999; **33**:1533–1539.
8 Greenland P, Reicher-Reiss H, Goldbourt U, Behar S. In-hospital and 1-year mortality in 1524 women after myocardial infarction. Comparison with 4315 men. *Circulation* 1991; **83**:484–491.
9 Bateman BT, Schumacher HC, Boden-Albala B, Berman MF, Mohr JP, Sacco RL, *et al.* Factors associated with in-hospital mortality after administration of thrombolysis in acute ischemic stroke patients: an analysis of the nationwide inpatient sample 1999 to 2002. *Stroke* 2006; **37**: 440–446.
10 Herlitz J, Karlson BW, Lindqvist J, Sjölin M. Predictors and mode of death over 5 years amongst patients admitted to the emergency department with acute chest pain or other symptoms raising suspicion of acute myocardial infarction. *J Intern Med* 1998; **243**:41–48.
11 Stern S, Behar S, Leor J, Harpaz D, Boyko V, Gottlieb S, Israeli Working Group on Intensive Cardiac Care, Israel Heart Society. Presenting symptoms, admission electrocardiogram, management, and prognosis in acute coronary syndromes: differences by age. *Am J Geriatr Cardiol* 2004; **13**:188–196.
12 Ray P, Birolleau S, Boddaert J. Acute respiratory failure in the elderly: etiology, emergency diagnosis and prognosis. *Crit Care* 2006; **10**:R82.
13 Goldstein LB, Simel DL. Is this patient having a stroke? *JAMA* 2005; **293**:2391–2402.
14 Karlson BW, Kalin B, Karlsson T, Svensson L, Zehlertz E, Herlitz J. Use of medical resources, complications and long-term outcome in patients hospitalised with acute chest pain. A comparison between a city university hospital and a county hospital. *Int J Card* 2002; **85**:229–238.
15 Ray P, Birolleau S, Boddaert J. Acute respiratory failure in the elderly: etiology, emergency diagnosis and prognosis. *Crit Care* 2006; **10**:R82.
16 Gompertz B. On the nature of the function expressive of law of human mortality. *Philos Trans Roy Soc Lond Biol* 1825; **155**:513–583.
17 Karlson BW, Herlitz J, Hallgren P, Liljeqvist JA, Oden A, Hjalmarson A. Emergency room prediction of mortality and severe complications in patients with suspected acute myocardial infarction. *Eur Heart J* 1994; **15**:1558–1565.
18 Gupta M, Tabas JA, Kohn MA. Presenting complaint among patients with myocardial infarction who present to an urban, public hospital emergency department. *Ann Emerg Med* 2002; **40**:180–186.
19 Canto JG, Shlipak MG, Rogers WJ, Malmgren JA, Fredrick PD, Lambrew CT, *et al.* Prevalence, clinical characteristics, and mortality among patients with myocardial infarction presenting without chest pain. *JAMA* 2000; **283**:3223–3229.
20 Dorsch MF, Lawrance RA, Sapsford RJ, Durham N, Oldham J, Greenwood DC, *et al.* Poor prognosis of patients presenting with symptomatic myocardial infarction but without chest pain. *Heart* 2001; **86**:494–498.
21 Herlitz J, Karlsson BW, Richter A, Strombom U, Hjalmarson A. Prognosis for patients with initially suspected acute myocardial infarction in relation to presence of chest pain. *Clin Cardiol* 1992; **15**:570–576.
22 Adams HP Jr, Adams RJ, Brott T, del Zoppo GJ, Furland A, Goldstein LB, *et al.* Guidelines for the early management of patients with ischemic stroke: a scientific statement from the Stroke Council of the American Stroke Association. *Stroke* 2003; **34**:1056–1083.
23 Kwiatkowski TG, Libman RB, Frankel M, Tilley BC, Morgenstern LB, Lu M, *et al.* Effects of tissue plasminogen activator for acute ischemic stroke at one year. National Institute of Neurological Disorders and Stroke Recombinant Tissue Plasminogen Activator Stroke Study Group. *N Engl J Med* 1999; **340**:1781–1787.
24 Libman RB, Wirkowski E, Alvir J, Rao TH. Conditions hat mimic stroke in the emergency department. Implications for acute stroke trials. *Arch Neurol* 1995; **52**:1119–1122.
25 Bonneux L, Barendregt JJ, Meeter K, Bonsel GJ, van der Maas PJ. Estimating clinical morbidity due to ischemic heart disease and congestive heart failure: the future rise of heart failure. *Am J Publ Health* 1994; **84**: 20–28.
26 Ghali JK, Cooper R, Ford E. Trends in hospitalization rates for heart failure in the United States, 1973–1986: evidence for increasing population prevalence. *Arch Intern Med* 1990; **150**:769–773.
27 Adams KF, Fonarow GC, Emerman CH, LeJemtel TH, Costanzo MR, Abraham WT, *et al.* Characteristics and outcomes of patients Hospitalised for heart failure in the United States: rationale, design, and preliminary observations

from the first 100 000 cases in the Acute Decompensated Heart Failure National Registry (ADHERE). *Am Heart J* 2005; **149**:209–216.
28 Baker DW, Einstadter D, Thomas C, Cebul RD. Mortality trends for 23 505 Medicare patients hospitalised with heart failure in Northeast Ohio, 1991 to 1997. *Am Heart J* 2003; **146**:258–264.
29 Moster A, Reitsma JB, Grobbee DE. Angiotensin converting enzyme inhibition and hospitalisation rates for heart failure in the Netherlands, 1980 to 1999: the end of an epidemic? *Heart* 2002; **87**:75–76.
30 Gerdtz MF, Bucknall T. Australian triage nurses' decision making and scope of practice. *Aus J Adv Nurs* 2000; **18**:24–33.
31 Fitzgerald G. The National Triage Scale. *Emerg Med* 1996; **8**:205–206.
32 Mallet J, Woolwich C. Triage in accident and emergency departments. *J Adv Nurs* 1990; **15**:1443–1451.
33 Ohlsson T, Terént A, Lind L. Rapid Emergency Medicine score: a new prognostic tool for in-hospital mortality in non-surgical emergency department patients. *J Intern Med* 2004; **255**:579–587.

Paper II

Differences in Long-term Mortality for Different Emergency Department Presenting Complaints

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Abstract

Objectives: To characterize long-term mortality based on previous emergency department (ED) presenting complaints.

Methods: The authors followed, for 10 years, all of the 12,667 nonsurgical patients visiting an ED during 1995/1996. Differences in standardized mortality ratio (SMR) depending on presenting complaints were then investigated.

Results: During follow-up, 5,324 deaths occurred (mortality rate 6.6 per 100 person-years at risk), giving a SMR of 1.33 (95% CI = 1.30 to 1.37, $p < 0.001$) when compared with the expected mortality in the catchment area. Different presenting complaints were associated with different long-term mortality rates, independent of age and gender ($p < 0.0001$). The subjects with seizures had the highest SMR (2.62, 95% CI = 2.13 to 3.22) followed by intoxications (2.51, 95% CI = 2.11 to 2.98), asthmalike symptoms (1.84, 95% CI = 1.65 to 2.06), and hyperglycemia (1.67, 95% CI = 1.42 to 1.95). The largest complaint group, chest pain, had a 20% higher mortality rate than the background population (95% CI = 1.13 to 1.26). Patients with a discharge diagnosis of myocardial infarction, but without chest pain as the presenting complaint, had an increased long-term mortality (hazard ratio [HR] 1.70, 95% CI = 1.15 to 2.42) compared to the group with chest pain. In contrast, stroke patients without strokelike symptoms had a reduced mortality (HR 0.74, 95% CI = 0.65 to 0.84) compared to patients with strokelike symptoms.

Conclusions: Long-term age- and gender-adjusted mortality is the highest with seizures out of 33 presenting complaints and differs markedly between different ED admission complaints. Furthermore, depending on the admission complaint, long-term mortality differs within the same discharge diagnosis. Hence, the presenting complaint adds unique information to the discharge diagnosis regarding long-term mortality in nonsurgical patients.

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Keywords: presenting complaint, emergency department, long-term mortality, risk prediction, standardized mortality ratio

The main task in the emergency department (ED) is to transform a reported complaint into a plausible diagnosis and simultaneously introduce proper treatment. Because the reason for attending an ED is not generally driven by diagnosis knowledge, but rather by the severity of a complaint, the presenting complaint, and the mortality risk might be of more interest than diagnosis for the emergency physician (EP). Long-term mortality is usually of interest for surgical, medical, or radiation oncologists, but might be of importance for the physicians or health planners in the emergency field.

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Several studies have investigated the impact of different discharge diagnoses (such as myocardial infarction, stroke, heart failure, epilepsy, etc.) on long-term mortality.[1–8] However, the knowledge of the admission complaint and the long-term mortality has not, to our knowledge, been investigated. Furthermore, it may well be that within a certain diagnosis group, the presenting complaint adds important risk-prediction information.

This study investigated the relationship between ED admission complaints and long-term mortality, with the primary hypothesis that differences in admission complaint at the ED affect long-term mortality risk over a period of 10 years. Because a certain diagnosis can present itself through different symptoms, a secondary aim of the study was to evaluate if the prognosis for a certain diagnosis is dependent on the presenting complaint.

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METHODS

Study Design

This was a prospective longitudinal population study seeking to characterize the effects of ED presenting complaint on long-term mortality. The study was approved by the local ethics Committee at Uppsala University.

Study Setting and Population

The study was conducted at the Uppsala University Hospital, Sweden. The University Hospital is the only emergency hospital in the catchment area and at the time of the study was serving a population of 186,834 adult inhabitants (51.5% female). Over a 12-month period (April 1, 1995, to March 31st 1996), 12,995 entries to the nonsurgical ED for adults (age 18 years and older) were registered in a database. Trained ED staff members sorted the patients to either the surgical and orthopedic or the nonsurgical area of the ED and registered the presenting complaint. Presenting complaints were defined as the patients' statements of their reasons for seeking care in the ED, as interpreted and recorded by the receiving nurse, before any major diagnostic procedures were performed. When applicable, the referring institution's complaints in the referral note were used. If the patients were brought in by emergency medical services (EMS), the complaint as interpreted by the EMS staff in the ambulance report was used as the presenting complaint. Only the main complaint was recorded if the patient presented with more than one complaint. The presenting complaint was registered before any other diagnostic proceedings were done at the ED.

After the study, the various recorded presenting complaints were sorted into predefined complaint groups by a physician (US) and revised by a senior physician (LL). Selection of the predefined complaint groups was done by investigating the previous year's records of unsorted presenting complaints and sorting these into easily separated complaint groups. A task group of four physicians extracted 33 definable complaint groups (Table 1).

Entries considered as non-symptom-derived (i.e., administrative or nonmedical reasons, for example renewal of a prescription, administration of an injection, etc.) were assigned to a separate group. Patients reporting symptoms not fitting into any of the symptom groups were allocated in a separate (miscellaneous) group. In-hospital patients were defined as those staying more than 24 hours in the hospital or dying within that time. Discharge diagnoses were available only for those treated as in-hospital patients admitted to a ward or who died in the hospital or ED.

Information on long-term mortality and cause of death to the censor date (September 15, 2005) was obtained from the Swedish national death registry for 12,890 of the 12,995 ED patients (99.2%).

For the reference population, the catchment area of Akademiska, University Hospital, was used (i.e., the county of Uppland). Information on age- and gender-adjusted mortality for the county of Uppland was obtained from Official Statistics of Sweden (SCB) for the period. Gender-specific mean values for mortality for each 5-year period and each age-group (5 years) were used when calculating the expected mortality and standardized mortality ratio (SMR).

Data Analysis

Relationships between categorical variables were evaluated by the chi-square test. For differences in continuous variables between groups, analysis of variance (ANOVA) or Kruskal–Wallis test was used. For differences in survival rate, the Cox proportional hazard was used as the regression model for calculating with covariates, together with Kaplan–Meier cumulative survival curves. StatView for Windows Version 5.0.1 (SAS Institute Inc., Cary, NC) was used for the calculations. The SMR was calculated from the observed death rate divided by the expected death rate adjusted for age group, calendar period, and gender. To minimize the risk for unadjusted cofactors, the population of the catchments area was used as the reference population.[9] During the studied years, the average number of inhabitants within the age span studied in the catchment area was 190,000. Each age group except the first (18–20 years) consisted of 5 years and every calendar period was 5 years (1995–2000 and 2000–2005), giving an average of more than 55,000 years at risk for each compared age group per calendar period for the reference population. When analyzing the relative likelihood of experiencing a particular event, the hazard ratio (HR) was used.[10] A p-value <0.05 was considered as significant.

RESULTS

Of the 12,995 admissions to the nonsurgical ED, 12,455 (95.8%) were allocated to one of the defined complaint groups. Among the other 540 admissions, 69 (0.6% of total) were non-symptom-derived and 471 (3.6%) were classified as miscellaneous. Sixty-one (0.5%) of the entries lacked a record of the presenting complaint. Of the 33 defined complaint groups, 17 received more than 200 entries, which included 89.5% of all entries.

A total of 6,263 (48.2%) of the admissions were treated as in-hospital patients, with an in-hospital mortality rate of 5.2%. A total of 12,667 patients survived the hospital stay. Ten-year mortality data was obtained for 12,890 (99.2%) patients. In the group with missing mortality data ($n = 105$) gender, age, and admission symptoms did not differ compared to the group with available data. The median follow-up time was 9.6 years (range 0–10.6 years), during which 5,727 deaths occurred, resulting in a mortality rate of 6.6 per 100 person-years at risk (PYAR). In the region, age-, and gender-adjusted population would have given an expected mortality of 4.0 per 100 PYAR, giving 4,290 expected deaths. This gives a SMR of 1.33 (95% CI = 1.30 to 1.37, $p < 0.001$) for our ED sample.

Age was a powerful predictor of long-term mortality (HR 1.08, 95% CI = 1.077 to 1.082, $p < 0.0001$). The relationship between age and long-term mortality rate was slightly S-shaped, ranging from 3.72% in young subjects (20–39 years), 22.6% in middle-aged subjects

Table 1
Definition of the 33 Different Complaint Groups and Their Corresponding Classification in International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)

Presenting Complaint	Definition	Classification in ICD-10	No. of Patients
Chest pain	Pain or discomfort from thorax not only localized to spine.	R07	3,339
Dyspnea	The patient's own experience of lack of breath but no known history of asthma and no wheezing at expiration.	R06.0	1,057
Strokelike symptoms	Either history of transient loss of strength in face, arm, or leg or transient loss of speech, vision, or dysphasia. Facial paralysis, own experience of loss of sensation in a part of the body, or sudden loss of vision field or sight.	R20.0, R27.0, R29.8, R47, I69.3	946
One swollen leg	One or asymmetrical swelling of the legs with or without adjunct pain, discomfort, or rash.	R60.0, M79.6	797
General disability	A conscious patient's own (or referring institutions) experience of rapid decline of physical and/or mental condition but no signs or symptoms from a specific organ and no knowledge of ongoing fever.	R69, R41.0, R63.0, R63.4, R64, R69	719
Symptoms of asthma	The patient's own experience of lack of breath and having history of asthma and typical wheezing at expiration.	R06.2, J45, J46	680
Vertigo/dizziness	The patient's own experience of discomfort in form of a sense of spatial disorientation, motion of the environment, or light headedness.	R42	617
Intoxication	Suspicion of or report of deliberate or accidental intake, inhalation, overdose, or injection of medical drugs, illegal drugs, chemicals, fire smoke, or combustions with or without symptoms thereof or a person with alcohol abuse in such a state that he or she needed medical or technical assistance to secure vital functions.	T36-T65, X00-X09, X40-49	614
Headache	Pain or severe discomfort from head.	R51	483
Miscellaneous	Complaints not fitting into any other complaint group.		471
Allergic reaction	Onset of skin rashes, hives, or wheals such as contact dermatitis or eczema with or without symptoms from respiratory organs. Sudden onset of wheezing or other symptoms from respiratory organs after intake of drugs or food with or without symptoms on the skin. Circulatory shock after ingestion of known allergen.	R21, L53.9, T78.2, T78.0, T80.0, T88.6, 88.7	424
Syncope	Sudden and transient episode of unconsciousness but no convulsions.	R55	327
Palpitation (arrhythmia)	Sensation of an alteration in the rhythm of the heartbeat in time or force, of functional, or organic origin.	R00, I49.9	325
Hyperglycemia	Self-diagnosed or suspicion of hyperglycemia, hyperglycemia detected by the EMS personnel, or any referral stating hyperglycemia, disregarding actual blood glucose level later registered at the ED.	R73, R81	297
Seizure	Witnessed or self-reported signs of a convulsion with or without unconsciousness.	G40, G41, R56	289
Cough/pneumonia	Symptoms of or report of cough with or without fever and/or general decline of health.	R05, R09.3, J18.9	266
Unspecified ache	Self-reported experience of pain not from chest or head.	R52	240
Fever	An increase in the temperature of the body but no focal symptom suggesting its cause.	R50	169
Hypoglycemia	Self-diagnosed hypoglycemia, hypoglycemia detected by the EMS personnel, or any referral stating hypoglycemia, disregarding actual blood glucose level later registered at the ED.	E16.2	110
Edema	Symmetrical swelling of extremities, face, or trunk but no rash or exanthemas suggesting allergic reactions.	R60.9	107
Cardiac arrest	Unconscious patient with cessation of the action of the heart.	I46.9	98
Anemia	Self-diagnosed anemia or any referral stating anemia, disregarding actual hematocrit later registered at the ED.	D64,9	94
Hypertension	Self-diagnosed elevated blood pressure or a referral stating hypertension, disregarding actual blood pressure later registered at the ED.	R03.0	83
Not symptom-derived reason	Entries considered as non–symptom-derived (i.e., administrative or nonmedical reasons).	Z02	74
Psychiatric symptoms	Referred or self-reported with altered personality, aggressiveness, hearing voices, bizarre behavior, and no other physical symptoms or signs and no suspicion of drug or alcohol abuse.	F44.8, R44, 45.4, R45.8, R46.2, R46.8, F09	44
Coma	A state of deep and prolonged unconsciousness with no history of convulsions.	R40.2	43

Table 1
Continued

Presenting Complaint	Definition	Classification in ICD-10	No. of Patients
Diarrhea	Self-reported or referred with a history of passage of excessively liquid or excessively frequent stools.	K52.9, K59.1, A09, F45.3	33
Fatigue	Self-reported fatigue with no report of altered mental or physical decline.	R40.0, R53	32
Bite or sting from animals, insects, or snakes	Bite or stings or suspicion thereof from insects, snakes, or other animals.	X20-X29	31
Bleeding/hematuria/melena	Ongoing bleeding, melena, or hematuria of any kind and not considered surgical ED patient.	R31, R58, R04, K92.0, K92,1	28
Nausea	Self-reported unpleasant sensation in the stomach usually accompanied by the urge to vomit with or without vomiting.	R11	27
Electric shock	Passage of electric current through the body: domestic current, high-voltage current, or lightning	T75.4, T75.0, X33,	24
Alcohol abuse–related states	Drunkenness but no signs of intoxication as above or referred from an institution stating alcohol-related conditions with no signs of alarming intoxication	R78.0	18

(50–59 years), to 90.5% in those aged 80–89 years ($p < 0.0001$ for differences between age groups).

Gender was a significant predictor for long-term mortality even after adjustment for age, with an HR of 1.35 (95% CI = 1.28 to 1.42, $p < 0.0001$). Compared to the reference population, males had an SMR of 1.45 (95% CI = 1.40 to 1.51, $p < 0.001$) and females 1.24 (95% CI = 1.19 to 1.28, $p < 0.001$).

As shown in Figure 1, long-term mortality differed between different admission complaint groups in unadjusted analysis ($p < 0.0001$). The highest long-term mortality rates in crude analysis, among complaint groups with more than 200 entries, were seen in those with general disability (84.2%), strokelike symptoms (67.4%), and dyspnea (63.1%), while the mortality rate was lowest in those presenting with allergic reactions (6.7%), headache (15.2%), and intoxications (21.7%).

However, by adjusting for age and gender, another picture emerges. When analyzing SMR, the highest long-term mortality risks were seen in patients presenting with seizures (SMR 2.62), intoxications (SMR 2.51), and symptoms of asthma (SMR 1.84) (Table 2).

For patients presenting with chest pain, there was a difference in mortality between the different discharge diagnoses ($p < 0.001$). An increased mortality was seen in patients discharged with a diagnosis of myocardial infarction (SMR 1.18), but a more pronounced increased mortality was seen in patients discharged with the diagnosis of congestive heart failure (SMR 1.34) or a pulmonary disease (SMR 1.84) (Table 3).

Patients presenting with dyspnea who were admitted showed different mortality rates according to the different discharge diagnoses ($p < 0.0001$). Patients discharged with a diabetes, endocrine, or inflammatory-related diagnosis had an SMR of 2.29, while those with congestive heart failure diagnosis had an SMR of 1.31 (Table 4).

For patients admitted with general disability, the p-value was < 0.001 for differences between diagnoses. Those with a cancer diagnosis or gastrointestinal diagnosis had the highest SMR, whereas patients with a discharge diagnosis of intoxication, psychiatric diagnosis, infections, arrhythmias, and symptom diagnosis did not show significantly different mortality rates compared to the expected long-term mortality in the region (Table 5).

For the presenting complaint ''strokelike symptoms,'' there was an elevated SMR for those with cancer (SMR 2.30, 95% CI = 1.43 to 3.70, $p < 0.001$) and stroke (SMR 1.32, 95% CI = 1.17 to 1.49, $p < 0.001$) discharge diagnosis, but not for other patients with this complaint.

There was a higher mortality for patients discharged with the diagnosis of myocardial infarction and not presenting with chest pain (HR 1.70, 95% CI = 1.150 to 2.422, $p = 0.007$), compared to patients who presented with chest pain at the ED (Figure 2). On the contrary, patients receiving stroke as the discharge diagnosis had a higher mortality in the group with strokelike symptoms than in those without such a complaint (HR 0.76, 95% CI = 0.585 to 0.978, $p = 0.033$) (Figure 3).

DISCUSSION

This study showed that the presenting complaint at the ED visit affected the long-term mortality rate. Furthermore, the long-term mortality for certain presenting complaints differed depending on the discharge diagnosis, suggesting that both the presenting complaint and the discharge diagnosis are important for long-term mortality.

We had a hospital admittance of 48%, which is high compared with findings of 11% from Stussman in the National Hospital Ambulatory Medical Care Survey in the United States.[11] This is probably due to the different health care systems in these two countries, where a more unselected population visits the ED in the United States, whereas more patients with minor complaints or injuries are seen by the general practitioners in Sweden. Our findings are more in line with those reported

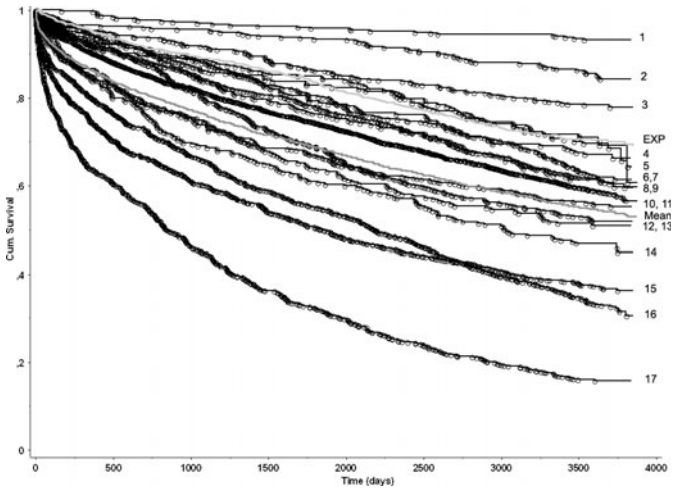

Figure 1. Cumulative survival for different complaint groups: allergic reaction (1), headache (2), intoxication (3), unspecified ache (4), seizure (5),vertigo/dizziness (6), symptoms of arrhythmia (7), syncope (8), one swollen leg (9), chest pain (10), miscellaneous (11), symptoms for asthma (12), cough/pneumonia (13), hyperglycemia (14), dyspnea (15), strokelike symptoms (16), and general disability (17). EXP is the expected survival for the region. Mean is the cumulative survival for the whole ED population. Follow-up time is 3,650 days (10 years).

Table 2
Standardized Mortality Ration (SMR) Over Ten Years for Different Admission Complaints Compared to the Age- and Gender-adjusted Reference Population

Admission Complaint*	Number of Entries	Age at ED Visit (yr), Median	% Female	Ten-Year Mortality (%)	SMR	95% CI	p-value
Allergic reaction	424	36.5	62.0	6.7	0.96	0.67, 1.38	ns
Vertigo/dizziness	617	67.0	60.8	38.2	1.11	0.98, 1.27	ns
Syncope	327	67.0	51.1	38.9	1.14	0.95, 1.36	ns
Palpitation (arrhythmia)	325	62.0	53.5	31.3	1.16	0.95, 1.41	ns
Unspecified ache	240	57.5	59.2	30.1	1.19	0.94, 1.51	ns
Chest pain	3,339	67.0	46.6	41.9	1.20	1.13, 1.26	<0.001
One swollen leg	797	67.0	60.0	39.3	1.22	1.09, 1.37	<0.001
Headache	483	42.0	62.7	15.1	1.24	0.99, 1.57	ns
General disability	719	82.0	55.6	84.2	1.25	1.15, 1.36	<0.001
Stroke-like symptoms	946	77.0	50.7	67.4	1.26	1.17, 1.37	<0.001
Cough/pneumonia	266	65.0	50.0	48.5	1.33	1.11, 1.58	<0.01
Dyspnea	1,056	75.0	50.0	63.1	1.37	1.27, 1.47	<0.001
Miscellaneous	471	53.0	50.1	44.4	1.62	1.44, 1.82	<0.001
Hyperglycemia	297	65.0	54.2	53.5	1.67	1.42, 1.95	<0.001
Symptoms of asthma	680	62.0	56.9	48.1	1.84	1.65, 2.06	<0.001
Intoxication	614	38.5	52.4	21.7	2.51	2.11, 2.98	<0.001
Seizure	289	46.0	38.8	33.7	2.62	2.13, 3.22	<0.001
All entries	12,885	61.6	52.2	44.4	1.33	1.30, 1.37	<0.001

*This list includes only the 17 complaints with at least 200 entries.

in a Dutch survey from 2001,[12] where referred patients had a hospital admittance of 41%. In our sample, we analyzed only patients with non-surgical complaints. This group is older and more likely to have comorbidities than patients with surgical complaints. A high hospitalization rate was therefore to be expected in the study sample.

We used the population of Uppland as a reference population instead of the total Swedish population for two reasons. Uppland has a somewhat lower mortality than most other areas in Sweden.[13–15] This is probably due to the lack of hazardous industries and many academic employees. Upland is also the catchment area for Uppsala University Hospital, giving the studied sample the same exposure for unadjusted risk factors.

Comparing long-term mortality between different presenting complaints in crude analysis and after adjustment for expected mortality yielded substantially different results. This was probably due to the uneven age and gender distributions in the different complaint groups.

Table 3
Standardized Mortality Ration (SMR) Over Ten Years for Different Discharge Diagnoses for Those Admitted after Presenting with Chest Pain at the ED

Discharge Diagnosis	*n*	10-Years Mortality (%)	SMR	95% CI	p-value
Arrhythmias	198	43.8	0.90	0.73, 1.11	ns
Angina pectoris	363	59.6	0.99	0.86, 1.13	ns
Symptom diagnosis*	382	29.9	1.14	0.95, 1.36	ns
Myocardial infarction	325	54.9	1.18	1.02, 1.36	<0.05
Infections	82	65.9	1.22	0.94, 1.59	ns
Venous thromboembolic diseases	20	70.0	1.28	0.76, 2.17	ns
Gastrointestinal diagnoses (including liver and kidney diseases)	38	39.0	1.28	0.83, 1.99	ns
Congestive heart failure	155	94.1	1.34	1.14, 1.58	<0.001
Diabetes/endocrine/inflammatory diagnosis	42	48.9	1.37	0.91, 2.06	ns
Miscellaneous diagnosis	163	60.2	1.40	1.15, 1.70	<0.001
Cancer	17	88.2	1.45	0.87, 2.40	ns
Pulmonary diseases	39	50.0	1.84	1.19, 2.86	<0.01
All patients admitted with chest pain	1,928	54.7	1.28	1.20, 1.36	<0.001

ns = not significant.
*Classification codes that refer to a symptom instead of an actual disease or injury.

Table 4
Standardized Mortality Ration (SMR) over Ten Years for Different Discharge Diagnoses for Those Admitted after Presenting with Dyspnea at the ED

Discharge Diagnosis	*n*	10-Years Mortality (%)	SMR	95% CI	p-value
Angina pectoris	16	17.4	0.64	0.24, 1.70	ns
Symptom diagnosis*	28	26.7	0.98	0.49, 1.97	ns
Arrhythmias	29	69	1.24	0.80, 1.92	ns
Congestive heart failure	203	95	1.31	1.14, 1.51	<0.001
Infections	99	83	1.38	1.12, 1.71	<0.01
Myocardial infarction	24	95.7	1.39	0.91, 2.11	ns
Pulmonary diseases	53	77.6	1.42	1.06, 1.90	<0.05
Venous thromboembolic diseases	31	64.5	1.42	0.91, 2.19	ns
Miscellaneous diagnosis	68	76.1	1.52	1.17, 1.99	<0.01
Gastrointestinal diagnoses (including liver and kidney diseases)	15	86.7	1.87	1.08, 3.21	<0.05
Cancer	15	100	2.22	1.34, 3.69	<0.01
Diabetes/endocrine/inflammatory diagnosis	19	72.7	2.29	1.14, 4.57	<0.05
All patients admitted with dyspnea	627	76.3	1.21	1.11, 1.32	<0.001

*Classification codes that refer to a symptom instead of an actual disease or injury.

Table 5
Standardized Mortality Ration (SMR) Over 10 Years for Different Discharge Diagnoses for Those Admitted after Presenting with General Disability at the ED

Discharge diagnosis	*n*	10-Years Mortality (%)	SMR	95% CI	p-value
Intoxication, alcohol abuse etc.	11	18.2	0.81	0.20, 3.23	ns
Psychiatric diagnosis	17	70.6	1.05	0.61, 1.81	ns
Infections	133	91	1.18	0.99, 1.41	ns
Arrhythmias	12	91.7	1.18	0.66, 2.14	ns
Symptom diagnosis*	18	77.8	1.22	0.75, 2.00	ns
Miscellaneous diagnosis	148	90.5	1.25	1.05, 1.48	<0.01
Stroke	30	86.7	1.26	0.85, 1.84	ns
Congestive heart failure	32	100	1.29	0.91, 1.82	ns
Diabetes/endocrine/inflammatory diagnosis	54	88.9	1.36	1.03, 1.79	<0.05
Gastrointestinal diagnoses (including liver and kidney diseases)	32	87.5	1.46	1.01, 2.12	<0.05
Cancer	36	100	1.73	1.25, 2.40	*<0.001*
All patients admitted with general disability	549	88.9	1.25	1.15, 1.36	<0.001

*Classification codes that refer to a symptom instead of an actual disease or injury.

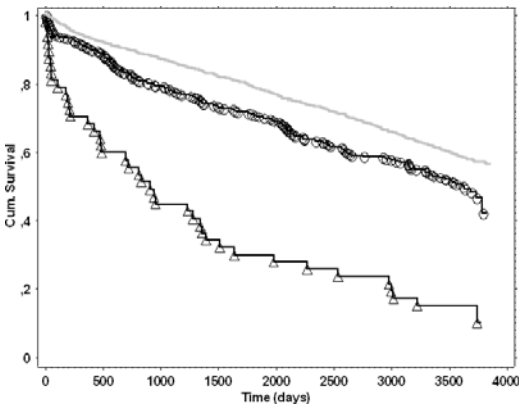

Figure 2. Survival of patients discharged with myocardial infarction in patients presenting with (○) or without (△) chest pain at the ED. Kaplan–Meier curve for cumulative survival for 10 years (age and gender adjusted OR 1.7, 95% CI = 1.150 to 2.422, p = 0.007, *n* = 415). The gray line is the expected survival in the reference population.

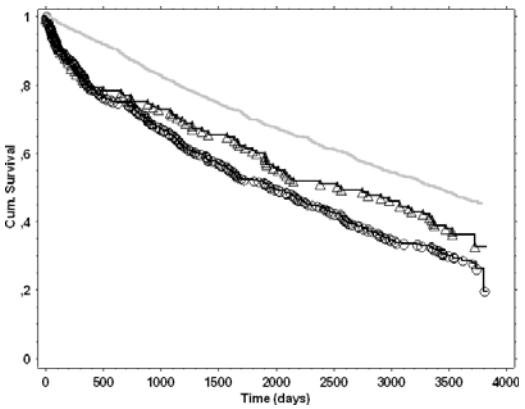

Figure 3. Survival of patients discharged with stroke diagnosis in patients presenting with (○) or without (△) strokelike symptoms at the ED. Kaplan–Meier curve for cumulative survival for 10 years (age and gender adjusted OR 0.76, 95% CI = 0.585 to 0.978, p = 0.033, *n* = 443). The gray line is the expected survival in the reference population.

Seizures had the highest long-term SMR among the presenting complaints. The main discharge diagnosis for patients admitted with seizure was epilepsy (66%). As Lhatoo and coworkers[16] have shown, epilepsy has an increased long-term mortality of two to five times the expected rate, which is in line with our findings and strengthens the accuracy of our findings of high SMR for seizure.

Intoxications as the presenting complaint ranked as the second highest SMR. The main reason for long-term mortality in patients with intoxications was suicide. Data from other studies confirm the elevated long-term mortality in this group.[17,18]

The presenting complaint of symptoms of asthma showed an SMR of 1.84 times the expected rate. This presenting complaint had a higher long-term mortality than the other respiratory complaints of dyspnea and cough/pneumonia. The diagnosis of chronic obstructive pulmonary disease (COPD) and asthma bronchiale are probably the underlying causes of the complaints, and both diagnoses have high 10-year mortality.[19]

Herlitz and coworkers[20] reported in their study from Gothenburg, Sweden, a 10-year mortality of 41.2% in patients visiting the ED with chest pain, a figure comparable to our 46.6%. The gender and age distributions in their patients were similar to ours, indicating that our results might be applicable even outside the region of Uppland. However, among the patients discharged with the diagnosis of myocardial infarction, the long-term mortality was 66.5% in Gothenburg, compared to 54.6% in our sample. This difference is probably a result of improved treatment over time between the two studies (1986 and 1995, respectively).

When analyzing patients with the discharge diagnosis of myocardial infarction, there was higher mortality in the group not presenting with chest pain compared to those with chest pain. While patients with chest pain and myocardial infarction seem to have the same mortality risk after 2 years as the reference population, the mortality risk for the non–chest pain group seemed to increase during the entire 10-year period.

The classification of acute myocardial infarction into ST-Elevated myocardial infarction (STEMI) and non-STEMI is considered to be of prognostic importance.[21] A prefix of chest pain or nonchest pain added to STEMI or non-STEMI might give an even higher accuracy in mortality prediction. In contradiction to patients with myocardial infarction, where the presenting complaints affected long-term mortality, there seemed to be no difference in long-term mortality for patients discharged with the diagnosis of congestive heart failure if they presented with dyspnea or chest pain at arrival.

Unlike complaints of chest pain and myocardial infarction, patients presenting with strokelike symptoms had a worse prognosis compared to patients not presenting with this complaint and later receiving the diagnosis of stroke. The group of patients discharged with stroke had a 10-year mortality of 74.1%, which is almost the same as that found by Terént[22] in Söderhamn, Sweden. However, the SMR was lower in our study, possibly indicating an improvement in stroke care. The majority of deaths due to stroke were seen the first 2 years, and thereafter the mortality was the same as for the reference population. As others also have reported,[23] the increased mortality risk for only the first 2 years of our study suggests that stroke care has improved over time.

CONCLUSIONS

The complaint of ''seizures'' had the highest long-term age and gender adjusted mortality out of 33 presenting complaints. Long-term mortality differs markedly between different ED admission complaints. Furthermore, depending on the admission complaint, long-term mortality differs within the same discharge diagnosis.

Hence, the presenting complaint adds unique information to the discharge diagnosis regarding long-term mortality in nonsurgical ED patients.

References

1. Herlitz J, Karlson BW, Hjalmarson A. Ten-year mortality rate after development of acute myocardial infarction in relation to clinical history and observations during hospital stay: experience from the Göteborg metoprolol trial. Coron Artery Dis 1993; 4(12):1077–83.
2. Herlitz J, Karlson BW, Hjalmarson A. Ten-year mortality among patients with suspected acute myocardial infarction in relation to early diagnosis. Cardiology. 1994; 84(2):114–20.
3. Launbjerg J, Fruergaard P, Madsen JK, Mortensen LS, Hansen JF. Ten-year mortality of patients admitted to coronary care units with and without myocardial infarction. Risk factors from medical history and diagnosis at discharge. DAVIT-Study Group. Danish Verapamil Infarction Trial. Cardiology. 1994; 4:259–66.
4. Szklo M, Goldberg R, Kennedy HL, Tonascia JA. Survival of patients with nontransmural myocardial infarction: a population-based study. Am J Cardiol. 1978; 42(4):648–52.
5. Prencipe M, Culasso F, Rasura M, et al. Long-term prognosis after a minor stroke: 10-year mortality and major stroke recurrence rates in a hospital-based cohort. Stroke. 1998; 29(1):126–32.
6. Goldberg RJ, Ciampa J, Lessard D, Meyer TE, Spencer FA. Long-term survival after heart failure: a contemporary population-based perspective. Arch Intern Med. 2007; 167(5):490–6.
7. Huynh BC, Rovner A, Rich MW. Long-term survival in elderly patients hospitalized for heart failure: 14-year follow-up from a prospective randomized trial. Arch Intern Med. 2006; 166(17):1892–8.
8. Jallon P. Mortality in patients with epilepsy. Curr Opin Neurol. 2004; 17(2):141–6.
9. Tsai SP, Wen CP. A review of methodological issues of the standardized mortality ratio (SMR) in occupational cohort studies. Int J Epidemiol. 1986; 15:8–21.
10. Cox DR, Oaks D. Analysis of Survival Data. London: Chapman and Hall, 1984.
11. Stussman BJ. National Hospital Ambulatory Medical Care Survey: 1995 Emergency Department Summary. Adv Data. 1997; 1(285):1–19.
12. Elshove-Bolk J, Mencl F, van Rijswijck BT, Weiss IM, Simons MP, van Vugt AB. Emergency department patient characteristics: potential impact on emergency medicine residency programs in the Netherlands. Eur J Emerg Med. 2006; 13(6):325–9.
13. Vågerö D, Norell SE. Mortality and social class in Sweden–exploring a new epidemiological tool. Scand J Soc Med. 1989; 17(1):49–58.
14. Hammar N, Ahlbom A, Theorell T. Geographical differences in myocardial infarction incidence in eight Swedish counties, 1976-1981. Epidemiology. 1992; 3(4):348–55.
15. Hammar N, Andersson T, Reuterwall C, et al. Geographical differences in the incidence of acute myocardial infarction in Sweden. Analyses of possible causes using two parallel case-control studies. J Intern Med. 2001; 249(2):137–44.
16. Lhatoo SD, Johnson AL, Goodridge DM, MacDonald BK, Sander JW, Shorvon SD. Mortality in epilepsy in the first 11 to 14 years after diagnosis: multivariate analysis of a long-term, prospective, population-based cohort. Ann Neurol. 2001; 49(3):336–44.
17. Nordentoft M, Breum L, Munck LK, Nordestgaard AG, Hunding A, Laursen Bjaeldager PA. High mortality by natural and unnatural causes: a 10 year follow up study of patients admitted to a poisoning treatment centre after suicide attempts. BMJ. 1993; 306(6893):1637–41.
18. Rygnestad T. Mortality after deliberate self-poisoning. A prospective follow-up study of 587 persons observed for 5279 person years: risk factors and causes of death. Soc Psychiatry Psychiatr Epidemiol. 1997; 32(8):443–50.
19. Ringbaek T, Seersholm N, Viskum K. Standardised mortality rates in females and males with COPD and asthma. Eur Respir J. 2005; 25(5):891–5.
20. Herlitz J, Karlson BW, Lindqvist J, Sjölin M. Important factors for the 10-year mortality rate in patients with acute chest pain or other symptoms consistent with acute myocardial infarction with particular emphasis on the influence of age. Am Heart J. 2001; 142(4):624–32.
21. Montalescot G, Dallongeville J, Van Belle E, et al. STEMI and NSTEMI: are they so different? 1 year outcomes in acute myocardial infarction as defined by the ESC/ACC definition (the OPERA registry). Eur Heart J. 2007; 28(12):1409–17.
22. Terént A. Cerebrovascular mortality 10 years after stroke: a population-based study. Stroke. 2004; 35(7):e343–5.
23. Kiyohara Y, Kubo M, Kato I, et al. Ten-year prognosis of stroke and risk factors for death in a Japanese community: the Hisayama study. Stroke. 2003; 34(10):2343–7.

Paper III

A lower threshold for seeking emergent care -the reason for increasing ED utilization.

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Abstract

Background;

During the last decade, emergency departments (ED's) have faced a rapid increase in the number of visits. However, it is not known if this increase is due to a change in visiting patterns, an increase of the severity of disease or demographic changes.

Objectives;

To investigate the reason for the increased utilization of the ED.

Methods:

All non-surgical ED visits during1995 and 2000 in the county of Uppland were registered. Thirty-day and 5-year mortality rates were investigated in relation to the visiting year, presenting complaint and change in demographics.

Results:

Between 1995 and 2000 the number of non-surgical ED visitors increased from 12, 995 to 16, 891 (+ 30.0 %). Demographic changes between these studied years could, however, only account for 45.0% of this increase. There was an increase in such as unspecified ache (41.8%) and vertigo/dizziness (17.6%), while complaints associated with severe chronic diseases, dyspnoea (-26.0%), chest pain (-15.1%), general disability (-15.0%) and stroke-like symptoms (-5.8%) decreased.

Both, age- and gender-adjusted, 30-day and 5-year mortality decreased from 4.4 to 3.3% ($p<0.007$) and from 31.1 to 29.2% ($p= 0.008$), respectively. However, for patients admitted to a ward there was no difference in the 30 day mortality.

Conclusions:

The major part of the increased ED utilization seen between 1995 and 2000 is not due to an increase in the severity of diseases among ED visitors or demographic changes but rather to a change in the visiting pattern among the inhabitants.

Introduction:

The ED's, as we see them today, were developed in the post war era at the end of the1940´s. (ref 1). The ED's became more specialized by time and the first specific training for emergency physicians was started 1967 in the UK (ref 2) and soon recognized as its own speciality in the UK and the US. Today more than 40 countries around the world have the speciality. During the same period the primary health care systems and General Practitioners were also developed. Nowadays, in most countries, general practitioners have the responsibility as first responders to conditions not needing the special resources only available at hospital ED's

Despite this development there has been, in the last decades, an increased utilization of the ED in most western countries (ref 3-6). There are several plausible reasons for this increase but little research has been performed in this field.

The treatment of many chronic diseases has markedly improved, leading to an increased prevalence of inhabitants living with severe chronic diseases which might lead to an increased need of ED visits. Moreover, the population as a whole is getting older which might result in an increased use of the ED. Furthermore an urge of instant medical service, can increase the utilization of acute medical care.

To be able to address this increment in ED utilization it is important to know the underlying reasons. We aimed to investigate if this increase is due to an increase in the severity of illnesses, a change in demographics or a change in the visiting pattern.

The hypothesis tested was that the increased number of visitors to our ED could not be explained by changed demographics or an increase in the severity of illnesses in the population, but rather by a change in the visiting pattern towards less severe conditions.

In this study the differences in the visiting pattern between two periods, 5 years apart, in a county in Sweden (the county of Uppsala) has been investigated regarding presenting complaints and mortality adjusted for changes in demographics.

Material & Methods

Patient population and data collection

The study was conducted at the Uppsala University Hospital, Sweden. This is the only emergency hospital in the catchment area serving a population of approximately 200, 000 inhabitants at the time of this study. Over two twelve month periods five years apart (April 1, 1995 to March 31, 1996 and January 1, to December 31, 2000) trained ED-staff members sorted the patients to either the surgical/ orthopaedic ("accident ED") or the non-surgical part of the ED and registered the presenting complaint. For the surgical/ orthopaedic ("accident") ED there was a total increase of 187 visits (23, 173 to 23, 360) between the two periods. As there was no substantial change in the visiting numbers to the surgical/orthopaedic ED (0.8%), no further exploration of this group was done. For the non-surgical ED the 12, 995 and 16, 891 adult (18 years and older) entries for each year, respectively, were registered and recorded in a presenting complaint database. The presenting complaint for the non-surgical patients was sorted into 33 different symptom groups described earlier (ref 7): (table 1).

Table 1. *Definition of the 32 different complaint groups and their corresponding classification in International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)*

Presenting complaint	Definition	Classification in ICD 10
Chest pain	Pain or discomfort from thorax not only localized to spine	R07
Dyspnoea	The patient's own experience of lack of breath.	R06.0
Stroke-like symptoms	Either history of transient loss of strength in face, arm or leg. Or transient loss of speech, vision or dysphasia or presenting ED with loss of strength in one or more extremities, facial paralysis, loss of speech, own experience of loss of sensibility in a part of the body or sudden loss of vision field or sight.	R20.0, R27.0, R29.8, R47, I69.3
One swollen leg	One or asymmetrically swelling of the legs with or without adjunct pain, discomfort or rush	R60.0, M79.6
General disability	A conscious patient's own (or referring institutions) experience of rapid decline of physical and/or mental condition but no signs or symptoms from a specific organ and no knowledge of ongoing fever.	R69, R41.0, R63.0, R63.4, R64, R69
Vertigo/ dizziness	The patients own experience of discomfort in form of a sense of spatial disorientation, motion of the environment or light headedness.	R42
Intoxication	Suspicion of or report of deliberate or accidental intake, inhalation, overdose or injection of medical drugs, illegal drugs, chemicals, fire smoke or combustions with or without symptoms thereof or a person with alcohol abuse in such a state that he/she needed medical or technical assistance to secure vital functions.	T36-T65, X00-X09, X40-49
Headache	Pain or severe discomfort from head	R51
Miscellaneous	complaints not fitting into any other complaint group	
Allergic reaction	Onset of skin rashes, hives or weal's such as contact dermatitis or eczema with or without symptoms from respiratory organs. Or sudden onset of wheezing or other symptoms from respiratory organs after intake of drugs or food with or without symptoms on the skin. Circulatory chock after ingestion of known allergen.	R21, L53.9,, T78.2, T78.0,T80.0, T88.6, 88.7
Syncope	Sudden and transient episode of unconsciousness but no convulsions.	R55
Palpitation (arrhythmia)	Sensation of an alteration in the rhythm of the heartbeat either in time or force of functional or organic origin	R00, I49.9
Hyperglycaemia	Self diagnosed or suspicion of hyperglycaemia, hyperglycaemia detected by the EMS personnel or any referral stating hyperglycaemia unregarding actual blood glucose level later registered at the ED	R73, R81
Seizure	Witnessed or self reported signs of a convulsion with or without following unconsciousness	G40, G41, R56
Cough/ pneumonia	Symptoms of or reporting cough with or without fever and/ or general decline of health	R05, R09.3 J18.9
Unspecified ache	Self reported experience of pain not from chest or head	R52
Fever	A rise in the temperature of the body but no focal symptom suggesting its cause	R50
Hypoglycaemia	Self diagnosed hypoglycaemia, hypoglycaemia detected by the EMS personnel or any referral stating hypoglycaemia unregarding actual blood glucose level later registered at the ED	E16.2
Oedema	symmetrical swelling of extremities, face or trunk but no rush or exanthemas suggesting allergic reactions	R60.9
Cardiac arrest	Unconscious patient with cessation of the action of the heart	I46.9
Anaemia	Self diagnosed anaemia or any referral stating anaemia unregarding actual hamatocrite later registered at the ED	D64,9
Hypertension	Self diagnosed elevated blood pressure or a referral stating hypertension unregarding actual blood pressure later registered at the ED	R03.0
Not symptom derived reason	Entries considered as non-symptom derived (i.e. administrative or non-medical reasons)	Z02
Psychiatric symptoms	Referred or self reported with altered personality, aggressively, hearing voices, bizarre behavior and no other physical symptoms or signs and no suspicion of drug or alcohol abuse.	F44.8, R44, 45.4, R45.8, R46.2, R46.8, F09
Coma	A state of deep and prolonged unconsciousness with no history of convulsions	R40.2
Diarrhoea	Self reported or referred with a history of passage of excessively liquid or excessively frequent stools.	K52.9, K59.1, A09, F45.3
Fatigue	self reported fatigue with no report of altered mental or physical decline	R40.0, R53
Bite or sting from animals, insects or snakes	Bite or stings or suspicion thereof from insects, snakes or other animals	X20-X29
Bleeding/ hematuria/ melena	Ongoing bleeding, melena or hematuria of any kind and not considered surgical ED patient	R31, R58, R04, K92.0, K92,1
Nausea	Self reported unpleasant sensation in the stomach usually accompanied by the urge to vomit with or without vomiting.	R11
Electric chock	Passage of electric current through the body either domestic current, high voltage current or lightning	T75.4, T75.0, X33,
Alcohol abuse related states	Drunkenness but no signs of intoxication as above or referred from an institution stating alcohol related conditions with no signs of alarming intoxication.	R78.0

In-hospital patients were defined as those staying more than 24 hours in the hospital or dying within that time frame. Information of 30-day and-5 year mortality for each period was obtained from the Swedish national death registry.

Information of demographics for the catchment area of the hospital, for the two studied periods, was obtained from Official Statistics of Sweden (SCB). The expected increment in visits due to demographic changes caused by different age and different populations for the periods was calculated by applying the visiting ratio for each age group from the population in the first period on the population in the second period.

The study was approved by the Local Ethics Committee of Uppsala University.

Statistical methods

Relationships between categorical variables were evaluated by the chi-square test. For differences in continuous variables between groups, ANOVA or Kruskal-Walli's test were used. For differences in survival, Cox Proportional Hazard or Kaplan-Meier cumulative survival curves were used. StatView® for Windows version 5.0.1 (SAS institute Inc.) program was used for the calculations.

Results

Of the 12, 995 admissions to the non-surgical ED in 1995, 12, 485 (95.8%) were allocated to one of the defined complaint groups. Among the other 510 admissions, 74 (0.6% of total) were non-symptom derived and 436 (3.4%) of the entries lacked a record of the presenting complaint. Thirty-day and 5-year mortality data were obtained for 12, 890 patients (99.2%). 9, 903 unique individuals produced the 12, 995 visits in 1995, thus. 19.3 % of al visits were done by a re-visitors.

For the 16, 891 admissions to the non-surgical ED in 2000, 16, 294 (96.5%) were allocated to one of the defined complaint groups. Among the other 597 admissions, 84 (0.5% of total) were non-symptom derived and 513 (3.5%) of the entries lacked a record of the presenting complaint.

Thirty-day and-5 year mortality data were obtained for 16, 126 patients (99.0%). 12,709 unique individuals produced the 16,891 visits and 22.1% of the visits were done by re-visitors.

Changes in presenting complaint, proportion admitted to a ward, age and length of stay between the two years can be seen in table 2.

Table 2. *Description of non-surgical ED- visitors at Uppsala University hospital in 1995 and 2000. Only the 17complaint groups with more than 200 entries are listed. * Differences between the total is expressed as the total increase in % between the years*

Presenting complaint	Year	No visitors	mean age	% female	% of al visitors	Proportional differences for each presenting complaint between 1995 and 2000 (%) *	Admitted to ward (No)	Admitted to ward (%)	% differences from 1995	mean age of patients admitted to ward admitted	Mean length of stay for patients admitted to ward (Days)	Differences in length of hospital stay (days)
Allergic reaction	1995	404	40.0	62.0	3.24		20	5.0		49.5	5.6	
	2000	501	41.3	62.3	3.07	-5.0	10	2.0	-59.7	63.4	5.1	-0.5
Chest pain	1995	3310	63.5	46.6	26.51		1927	58.2		69.6	4.4	
	2000	3668	62.5	46.1	22.51	-15.1	1282	35.0	-40.0	71.1	4.7	**0.3**
Cough/ pneumonia	1995	264	60.5	50.0	2.11		130	49.2		72.7	6.6	
	2000	192	60.2	49.5	1.18	-44.3	62	32.3	-34.4	76.2	9.6	**3.0**
Dyspnoea	1995	1781	63.9	53.2	14.27		698	39.2		76.3	6.5	
	2000	1711	66.5	50.7	10.50	-26.4	755	44.1	12.6	76.5	7.1	**0.6**
General disability	1995	713	78.5	55.6	5.71		563	79.0		80.8	9.1	
	2000	791	75.4	54.9	4.85	-15.0	447	56.5	-28.4	79.7	10.4	**1.3**
Head ache	1995	479	45.2	62.7	3.84		105	21.9		55.6	8.0	
	2000	601	45.9	58.6	3.69	-3.9	53	8.8	-59.8	62.5	9.9	**1.9**
Hyperglycaemia	1995	292	61.1	54.2	2.34		197	67.5		63.0	7.8	
	2000	308	61.1	47.9	1.89	-19.2	159	51.6	-23.5	65.9	9.0	**1.2**
Intoxication	1995	611	40.1	52.4	4.89		199	32.6		45.0	3.9	
	2000	743	39.6	54.6	4.56	-6.8	47	6.3	-80.6	55.5	8.1	**4.2**
Miscellaneous	1995	469	55.5	50.3	3.76		197	42.0		62.4	7.4	
	2000	973	60.7	49.5	5.97	**59.0**	306	31.4	-25.1	68.8	9.4	**2.0**
One swollen leg	1995	789	63.4	60.1	6.32		218	27.6		69.9	6.5	
	2000	895	63.4	59.0	5.49	-13.1	88	9.8	-64.4	74.4	7.5	**1.0**
Seizure	1995	285	47.1	38.8	2.28		82	28.8		55.8	5.1	
	2000	364	48.1	41.2	2.23	-2.1	77	21.2	-26.5	59.4	5.5	**0.4**
Stroke like symptoms	1995	939	73.1	50.7	7.52		700	74.5		76.0	7.6	
	2000	1155	72.1	49.4	7.09	-5.8	646	55.9	-25.0	77.3	9.1	**1.5**
Symptoms of arrhythmia	1995	324	59.0	53.5	2.60		168	51.9		67.8	3.6	
	2000	867	61.2	49.1	5.32	**105.0**	225	26.0	-50.0	69.7	4.4	**0.8**
Syncope	1995	326	59.6	51.1	2.61		164	50.3		69.1	4.7	
	2000	434	55.8	57.7	2.66	**2.0**	117	27.0	-46.4	68.9	6.1	**1.4**
Unspecified ache	1995	235	57.2	59.2	1.88		58	24.7		68.2	8.6	
	2000	435	55.2	57.2	2.67	**41.8**	54	12.4	-49.7	68.4	8.5	-0.1
Vertigo/ dizziness	1995	613	62.4	60.8	4.91		268	43.7		72.1	5.2	
	2000	941	62.4	59.7	5.78	**17.6**	225	23.9	-45.3	73.5	6.2	**1**
Total	**1995**	**12485**	**61.3**	**52.4**	**100.00**		**6262**	**50.2**		**70.4**	**6.0**	
	2000	**16294**	**60.9**	**51.6**	**100.00**	**+30.5**	**5114**	**31.4**	**-37.4**	**72.8**	**7.1**	**+1.1**

The mean age for the non-surgical visitors decreased from 61.3 to 60. 9 years ($p < 0.005$), while the age of those admitted to a ward increased from 70.4 to 72.8 years ($p < 0.005$). The proportion of patients admitted to a ward decreased both in relative (- 37.4%) and in absolute (-1148) numbers, but mean length of hospital stay (LOS) increased with 1.1 day ($p < 0.005$). A decrease of ward admittance was seen in all complaint groups except for the dyspnoea complaint.

Among the complaint groups with more than 200 entries, the largest increases were seen in those with symptoms of arrhythmia (105.0%), miscellaneous complaints (59.0%), unspecified ache (41.8%) and vertigo/dizziness (17.6%). The largest decreases were seen in those with cough/pneumonia (-44.3%), dyspnoea (-26.4), hyperglycaemia (-19.2%), chest pain (-15.1%) and general disability (-15%).

Thirty-day and 5-year mortality for the different complaint groups and for the patients admitted to a ward can be seen in table 3.

Table 3. *30-day and 5-year mortality for non-surgical ED-visitors according to presenting complaint*

Presenting complaint	Year	No visitors	30 day mortality (no)	30 day mortality (%)	Age and gender adjusted p-value for differences in 30 d mortality	30 day mortality of patients admitted to a ward (no)	30 day mortality of patients admitted to a ward (%)	Age and gender adjusted p-value for differences in 30 d mortality	5 year mortality (no)	5 year mortality (%)	Age and gender adjusted p-value for differences in 5-year mortality
Allergic reaction	1995	404	0	0.0		0	0.0		19	4.7	
	2000	501	1	0.2	-	1	10.0	ns.	20	4.0	0.40
Chest pain	1995	3310	94	3.0		88	4.6		866	26.2	
	2000	3668	81	2.2	0.16	58	4.5	ns.	881	24.0	0.10
Cough/pneumonia	1995	264	14	5.3		11	8.5		95	36.0	
	2000	192	11	5.7	0.79	7	11.3	ns.	70	36.5	0.95
Dyspnoea	1995	1781	100	5.6		75	10.7		764	42.9	
	2000	1711	121	7.1	0.45	95	12.6	ns.	821	48.0	0.21
General disability	1995	713	80	11.2		71	12.6		484	67.9	
	2000	791	76	9.6	0.66	56	12.5	ns.	496	62.7	0.61
Head ache	1995	479	5	1.0		5	4.8		32	6.7	
	2000	601	3	0.5	0.23	2	3.8	ns.	47	7.8	0.62
Hyperglycaemia	1995	292	4	1.4		4	2.0		113	38.7	
	2000	308	9	2.9	0.20	5	3.1	ns.	111	36.0	0.12
Intoxication	1995	611	5	0.8		5	2.5		84	13.7	
	2000	743	6	0.8	0.86	3	6.4	ns.	76	10.2	0.20
Miscellaneous	1995	469	19	4.1		15	7.6		158	33.7	
	2000	973	38	3.9	0.33	15	4.9	ns.	355	36.5	0.37
One swollen leg	1995	789	12	1.5		8	3.7		178	22.6	
	2000	895	1	0.1	0.01	0	0.0	ns.	214	23.9	0.25
Seizure	1995	285	2	0.7		1	1.2		58	20.4	
	2000	364	2	0.5	0.27	0	0.0	ns.	89	24.5	0.06
Stroke like symptoms	1995	939	69	7.3		60	8.6		427	45.5	
	2000	1155	73	6.3	0.55	63	9.8	ns.	494	42.8	0.63
Symptoms of arrhythmia	1995	324	3	0.9		2	1.2		51	15.7	
	2000	867	8	0.9	0.94	4	1.8	ns.	122	14.1	0.25
Syncope	1995	326	5	1.5		4	2.4		76	23.3	
	2000	434	5	1.2	0.96	4	3.4	ns.	86	19.8	0.97
Unspecified ache	1995	235	2	0.9		2	3.4		40	17.0	
	2000	435	3	0.7	0.84	1	1.9	ns.	81	18.6	0.30
Vertigo/dizziness	1995	613	5	0.8		4	1.5		127	20.7	
	2000	941	8	0.9	0.95	7	3.1	ns.	182	19.3	0.37
Total	1995	12485	545	4.4		473	7.6		4015	31.1	
	2000	16294	576	3.5	0.007	433	8.5	0.310	4713	29.2	0.008

30-day mortality for all non-surgical visitors at the ED decreased between the studied periods from 4.4% to 3.5% (p=0.007). However, for the patients that were admitted to ward there was no difference in the 30-day mortality (p=0.31). Five-year mortality decreased from 31.1% to 29.2% (p= 0.008) in the total sample. The lowest 5-year mortality was seen in those with allergic reaction (4.0%), head ache (7.8%), intoxication (10.2) and symptoms of arrhythmia (14.1%), while the highest 5-year mortality was found in patients presenting with general disability (62.7%), dyspnoea (48.0%), stroke-like symptoms (42.8%) and cough/ pneumonia (36.5%). After adjustment for age and gender there were no differences in the 5-year mortality, between the two periods, for a given complaint.

The proportion, in 5-year age strata, of ED visits of the population in the catchment area was separately calculated for the two periods. The differences in visiting proportions between the studied periods can be seen in figure 1.

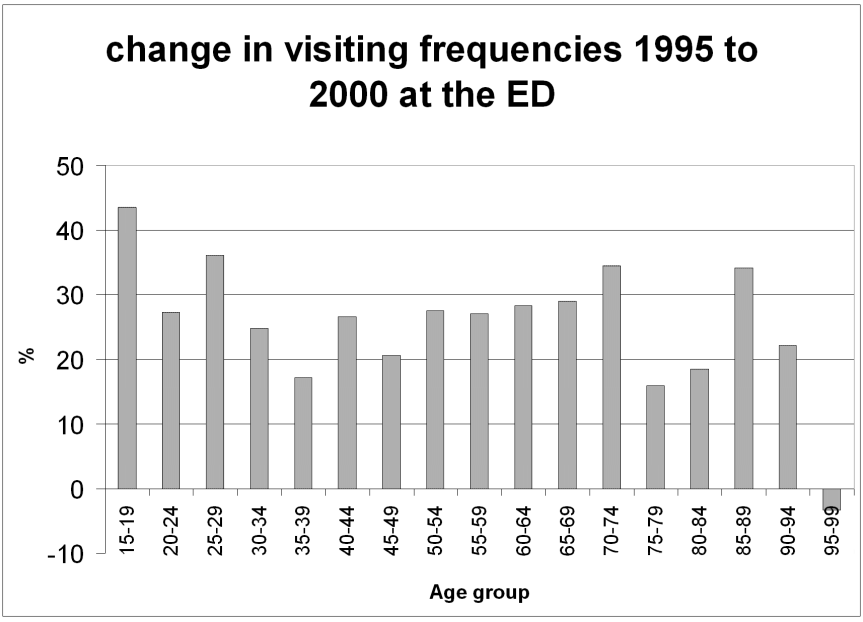

Figure 1. Change in proportion of visits to the non-surgical ED in the catchment area expressed as change in % from 1995 to 2000 in different age strata.

An increase of ED utilization could be seen in all age strata except in the very old (90-95 years).When calculating the expected increment in visits due to demographic changes there was a calculated expected increase in the amount of visits by 1767 (+13.6 %). The actual increase was 3896 (+30.0 %.).

Discussion

An increase in the number of visitors to an emergency department has been reported from many parts of the world. As in Burt and McCaig report we also found that visits due to accidents and wounds hardly changed between the years(ref 8), but the non-surgical admissions increased considerably. In an aging population it is plausible that the age increase results in a higher utilization of ED resources (ref 9), but changes in demographics could account for only 45% of the increment that was found. Similar findings have been reported from Australia (ref 10). We found a relative increase in all age groups, except in the very old, while the highest relative increase was seen in the youngest age group. These

findings do not support the idea that an aging population is the sole reason for the increment in ED utilization.

We found that presenting complaints associated with severe chronic diseases (i.e. conditions having high 5-year mortality) such as general disability, dyspnoea, stroke-like symptoms and cough/pneumonia, had decreased in relative numbers between the periods while symptoms with a low 5-year mortality had increased. This finding does not support the hypothesis that a higher prevalence of patients with severe chronic diseases in an aging population is the major reason for the increase, but rather evidence of a change in the visiting pattern of the population.

Although the number of visits at the ED increased by 30 % there was a decrease of ward admittance both in relative and absolute numbers. As has earlier been reported from the UK (ref 11) we also found the length of stay to have increased for the admitted patients. It is therefore tempting to assume that the few patients actually admitted to a ward were more severely ill. Nevertheless, the 30-day mortality rate for those admitted to a ward was the same and the overall 30-day mortality decreased suggesting that the ED visiting cohort of 2000 was less severely ill than the 1995 cohort.

When comparing the number of visits made by re-visiting patients there was an increase of 47.4% (1909 vs. 2815) between the studied years while the rise of visits made by single-visiting patients was a mere 23.8% (7994 vs. 9895).This could be explained by a lower threshold for the population (re-) visiting the ED. As the 30-day and 5-year mortality decreased during the same period it is unlikely that an increased prevalence of severe illness in the population to be the reason.

Although our findings to some extent are dependent on local, regional and national circumstances, we believe them to be of interest for decision makers in many countries facing a rapid increase in ED visits. As the actions needed to be taken depend on the underlying reasons, it is important for the health planner to address the correct issue.

In summary, the major part of increased ED utilization seen between 1995 and 2000 is not due to an increased severity of diseases among ED visitors or demographic changes but rather due to a change in the visiting patterns among the inhabitants.

References

1. Committee on the Future of Emergency Care in the United States Health System. Hospital-Based Emergency Care: At the Breaking Point. Appendix f. p 353. National Academy of Sciences. ISBN: 978-0-309-10173-8 (2007)

2. McHugh DF, Driscoll PA. Accident and emergency medicine in the United Kingdom. Ann Emerg Med 1999; 33:702–9.

3. Santos-Eggimann B. Increasing use of the emergency department in a Swiss hospital: observational study based on measures of the severity of cases. BMJ 2002; 324; 1186-1187

4. Kendrick S. The pattern of increase in emergency hospital admissions in Scotland. Health Bulletin 1996; 54:101-9.

5. Derlet RW. Overcrowding in emergency departments: increased demand and decreased capacity. Ann Emerg Med. April 2002; 39:430-432.

6. Gunnarsdottir O S, Rafnsson V. Mortality of the users of a hospital emergency department. Emerg Med J 2006; 23:269–273.

7. Safwenberg U, Terént A, Lind L. The Emergency Department presenting complaint as predictor of in-hospital fatality. Eur J Emerg Med. 2007 Dec; 14(6):324-31.

8. Burt C W, McCaig L F.Trends in hospital emergency department utilization: United States, 1992-99. DHHS publication; no. (PHS) 2001-1721) Vital and health statistics. Series 13, Data from the National Health Care Survey; no. 150.

9. Reeder T, Locassio E, Tucker J, Czaplijski T, Benson N,Megs W. ED Utilization: The Effect of Changing Demographics From 1992 to 2000. Am J Emerg Med 2002; 20: 583-587.

10. Gray C L, Yeo A M and Duckett J S. Trends in the use of hospital beds by older people in Australia: 1993–2002. Med J Aust. 2004 Nov 1; 181(9):478-81.

11. Black D, Pearson M. Average length of stay, delayed discharge, and hospital congestion. BMJ. 2002 September 21; 325(7365): 610–611.

Paper IV

Increased long-term mortality in patients with repeated visits to the ED

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Abstract

Background;

Revisits are common at the ED. If the number of, time between or the reasons for the revisits are indicative for increased mortality is however not clear.

Methods:

In 15,607 non-surgical patients, the number of visits, reason for the visit and time between visits were recorded during one year and related to one- and 5-year mortality.

Results

Five year mortality was dependent on the number of revisits in an inverse U-shaped fashion. Compared to single-visitors, patients with 3 visits showed an increased 5-year mortality (HR 1.85, 95% CI 1.58 – 2.16, p <0.0001), while in patients with 4 or 5 visits mortality decreased. Patients with 6 or more visits had 5-year mortality not different from single-visitors. However, the impact of the number of visits were dependant on the presenting complaint (p<0.0001)

Also the time between two adjacent visits influenced long-term mortality in an inverse U-shaped fashion. In patients not admitted to ward, a revisit

after 2-3 days was associated with an increased mortality (HR 1.89, 95% CI 1.06 – 3.35, p= 0.03).

In patients revisiting the ED with the same adjacent presenting complaint, mortality differed depending on the complaint ($p<0.0001$).

Conclusions

In non-surgical patients revisiting the ED long-term mortality was dependent on both the number of revisits, as well as the time between two visits, in an inverse U-shaped fashion. This indicates a possibility to detect the transition level between appropriate medical utilization and inappropriate frequent ED use.

Key words:

Revisit; Long-term mortality; Emergency Department; ED utilization; frequent ED users; frequent attenders.

Introduction

A revisit to the Emergency Department (ED) is most often due to a relapse in the condition treated at the first visit, or development of a new medical condition in need of emergent medical attention. However, some of the revisits are performed by so called frequent attenders. For frequent attenders the reasons for revisits are not only due to the medical reasons mentioned above, but usually multi-factorial due to reasons such as socioeconomic, substance abuse, or health-care system related reasons (ref 1-7). These frequent attenders are usually quite few in numbers, but are consuming a considerable amount of medical resources (ref 8). This group is recognized all over the world. However, when the number of ED visits for a patient is appropriate from a medical point of view, or when the number is inappropriate is not clear. This issue has, to our knowledge, not previously been addressed in detail.

Our hypothesis was that if a revisit was due to medical reasons (i.e. a relapse in an earlier treated condition or a new emergency condition) mortality would be higher than for revisitors to the ED due to other reasons. As the natural cause of some diseases consists of acute exacerbations, but not necessarily a high mortality risk, the reason for the ED visit must also be taken to account.

Thus, the primary aim of the study was to investigate if the number of visits to the ED during one year affected long-term mortality. A secondary aim was to investigate if the impact of the number of revisits on mortality was dependant on the presenting complaints. Furthermore, we investigated if the time between two adjacent visits affected the risk for future death.

Material & Methods

Patient population and data collection

The study was conducted at the Uppsala University Hospital, Sweden. This is the only emergency hospital in the catchment area serving a population of approximately 200, 000 inhabitants at the time of this study. From January 1, to December 31, 2000, trained ED-staff members sorted the patients to either the surgical/ orthopedic ("accident ED") or the non-surgical part of the ED and registered the presenting complaint. For the non-surgical ED the 15,607 adult (18 years and older) entries were registered and recorded in a present-

ing complaint database. The presenting complaint for the non-surgical patients was sorted into 32 different symptom groups described earlier (ref 9): (table 1). First time visitors dying during their first admission (n=268), and first time visitors on the last day of the studied period (n =24) were excluded from further analysis, as they were disqualified for later admissions during the study period.

In-hospital patients were defined as those staying more than 24 hours in the hospital or dying within that time frame. Revisits were defined as two visits recorded in the hospitals ED discharge records with more than 12 hours between the recordings. Information of one year and 5-year mortality was obtained from the Swedish national death registry.

The study was approved by the Local Ethics Committee of Uppsala University.

Statistical methods

Relationships between categorical variables were evaluated by the chi-square test. For differences in continuous variables between groups, ANOVA or Kruskal-Walli's test were used. For differences in survival, Cox Proportional Hazard and Kaplan-Meier cumulative survival curves were used. StatView® for Windows version 5.0.1 (SAS institute Inc.) program was used for the calculations.

Results

For the 15, 607 admissions to the non-surgical ED, 15,246 (97.7%) were allocated to one of the defined complaint groups. Among the other 362 admissions, 48 (0.3% of total) were non-symptom derived and 314 (2.0%) of the entries lacked a record of the presenting complaint.

One year and five year mortality data were obtained for 15,588 patients (99.7%). The 15,607 ED admissions were done by 11,522 different individuals, of whom 2318 individuals (20.1%) had two or more visits. Admissions performed by single- visitors accounted for 59.0 % of all visits, while revisitors were responsible for 6403 (41.0 %) of all visits. Approximately 80% of all visits were made by visitors performing one (59.0%) or two visits (20.2%). The remaining 20.8% of all visits were due to the 6.4% patients performing 3 or more visits. The 53 patients with more than 6 visits to the non-surgical ED constituted 0.5% of the visitors and were responsible for 5.1% of all visits. They had an average of 15 visits each. The proportions of

visitors and proportions of total visits depending on the number of revisits are shown in table 1.

Table 1. ***Proportion of visitors and admissions depending on visiting times***

Number of ED visits for the individual	Individuals (n)	Proportion of all patients (%)	Proportion of all visits (%)	number of visits
One visit	9204	79.9	59.0	9204
Two visits	1573	13.7	20.2	3146
Three visits	419	3.6	8.1	1257
Four visits	184	1.6	4.7	736
Five visits	60	0.5	1.9	300
Six visits	29	0.3	1.1	174
> Six visits	53	0.5	5.1	790
Total	11522	100.00	100.00	15607

The age- and gender-adjusted long- term mortality was dependent on the number of re-visits in an inverse U-shaped fashion. Compared to single-visitors, patients with 3 visits had an increased age-and gender-adjusted 5-year mortality (HR 1.85, 95% CI 1.58 – 2.16, <0.0001). For patients with 4 or 5 visits, the five year mortality decreased (HR 1.80, 95% CI 1.47 – 2.19, p < 0.0001) and patients with 6 and more visits per year had a long-term mortality not significantly different from age-and gender-adjusted single visitors (HR 1.29 , 95% CI 0.87 – 1.91 , p=0.21). (Figure 1)

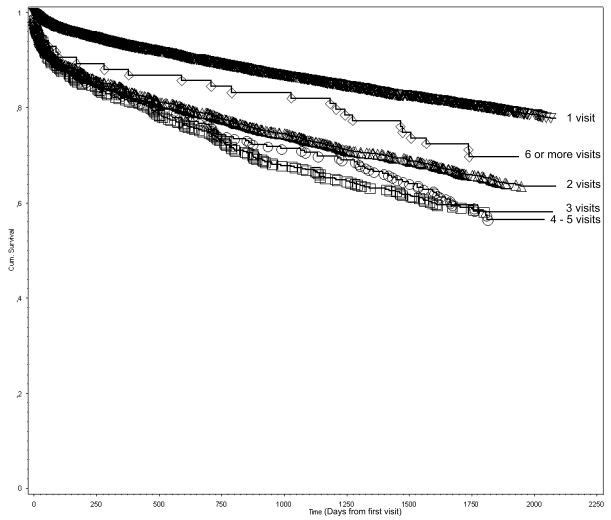

Figure 1. Differences in cumulative survival (Kaplan –Meier curve) depending on number of visits at the non-surgical ED during the year 2000.Five years follow up time.

Also the time between two adjacent visits influenced the long-term mortality in an inverse U-shaped fashion. One year mortality increased with time between the visits up to 7 days, and declined thereafter for patients admitted to ward at the first visit. A revisit on the seventh day from last visit had an increased one-year mortality more than 6 times (HR 6.34, 95% CI 3.27 – 12.29, p< 0.0001) compared to age-and gender-adjusted in-hospitalised patients with only one visit. If the time between the revisits increased to more than 14 days, the hazard ratio decreased (HR 2.10, 95% CI 1.75 – 2.52, p< 0.0001).

For patients not admitted to ward at the first ED- visit, there was a different pattern of long-term mortality compared to matched non-admitted single visitors (p<0.0001). Patients with a revisit on the 2nd or 3rd day from first visit had an increased mortality (HR 1.89, 95% CI 1.06 – 3.35, p= 0.03) as had patient re-visiting later than 2 weeks or later (HR 1.42, 5% CI 1.15 – 1.75, p=0.0009). (Fig 2)

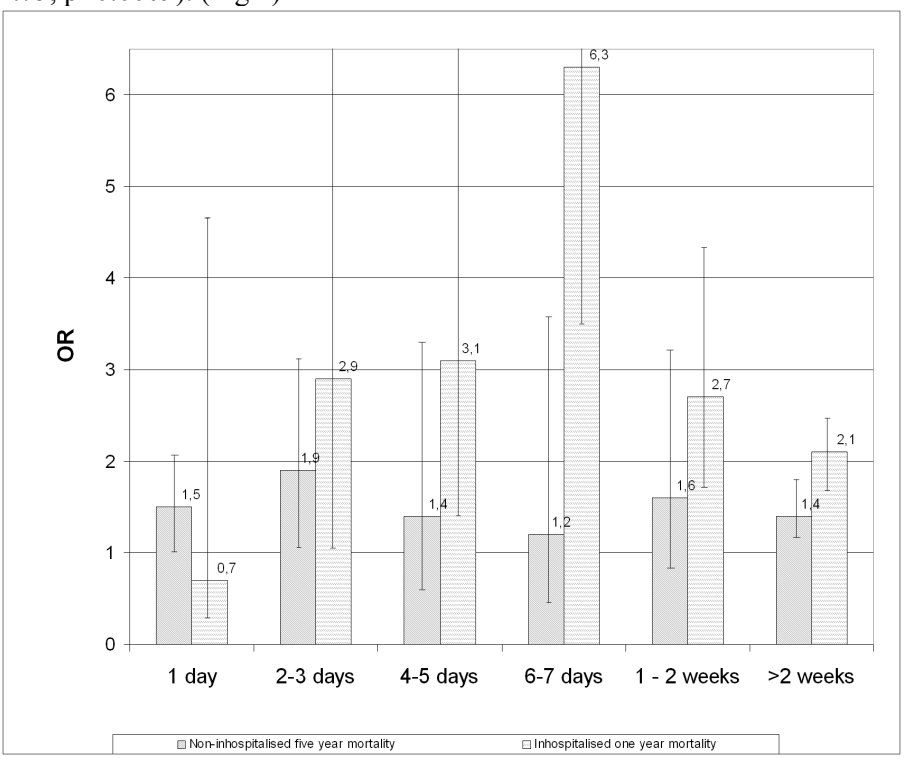

Figure 2. Long term mortality for non-in-hospitalized (five year) and in-hospitalized (one year) depending on time between two adjacent visits compared to single visitor non in-hospitalized or in-hospitalized. OR = Odds Ratio

One-thousand and forty-six of the 6403 (16.4%) revisits had an adjacent visit with the same presenting complaint. This sub sample was used for calculating the impact of revisits for long-term mortality for specific presenting complaints. Chest pain was the largest presenting complaint group (2771 visits) and had most revisitors (315 patients), while arrhythmia was the complaint with the largest proportion of revisitors (19.8%) followed by seizure (16.1%).

Arrhythmia (3.1%), intoxication (2.6%) and seizure (1.8%) had the largest proportion patients with 6 or more visits at the ED. Presenting complaints having more than 20 individuals with one or more adjacent ED revisit with the same presenting complaint are listed in table 2.

*Table 2. Characteristics of re-visiting patients depending on presenting complaint. * > one visit unregarding if visiting complaint is the same as adjacent visit*

Presenting complaint	Number of patients with the complaint	Visitors with > 1 adjacent visit with the same complaint	mean age (years)	% female	Proportion with one visit for the complaint	Proportion with 2 visits for the complaint	Proportion with 3 visits for the complaint	Proportion with 4 or 5 visits for the complaint	Proportion with 6 or more visits for the complaint
Chest pain	2416	315	60	45.8	86.9	7.2	2.9	2.1	0.9
Dyspnoe	931	115	63	50.1	87.6	6.8	2.8	2.3	0.5
Arrhythmia	514	102	59	49.6	80.2	7.6	4.1	5.1	3.1
Intoxication	504	61	37	54.5	87.9	5.4	2.0	2.2	2.6
Stroke-like symptoms	774	48	71	49.2	93.8	4.3	1.3	0.5	0.1
General disability	417	42	75	54.1	89.9	6.0	2.6	1.4	0.0
Seizure	217	35	46	41.6	83.9	8.8	2.3	3.2	1.8
Vertigo/ Diziness	651	35	61	60.0	94.6	3.8	0.9	0.5	0.2
Allergic reaction	374	34	40	62.4	90.9	5.9	1.9	1.1	0.3
Head ace	476	31	45	58.3	93.5	5.2	0.8	0.0	0.4
Miscellaneous	563	21	57	51.1	96.3	2.3	0.9	0.2	0.4
S:a	7837	839	59	51.6	89.3	5.9	2.2	1.7	0.8
total ED database	11522	2318*	60	51.7	79.9				

For patients revisiting the ED with the same adjacent presenting complaint, both one-and five-year mortality differed depending on presenting complaint ($p<0.0001$). The 35 patient visiting the ED with seizure more than once had an one year mortality more than 3 times (HR 3.1, 95% CI 1.00- 9.73, $p=0.049$) and a five year mortality almost 4 times (HR 3.9, 95% CI 2.03 – 7.54, $p< 0.0001$) higher compared to age-and gender-adjusted single visitors. On the contrary, the 102 revisitors because of arrhythmia had an reduced 5-year mortality (HR 0.38, 95% CI 0.19 – 0.76, $p=0.006$) compared to the age and gender-adjusted single-visitors (table 3)

Table 3. One and five year mortality for revisitor depending on presenting complaint at readmission. Compared to single-visitors. Adjusted for age and gender. Number of single-visitor n=8960

Presenting complaint at the readmission	Number of re-visiting patients with the complaint	Odds Ratio one year mortality compared to single-visitor	p value	95% CI	Odds Ratio five year mortality compared to single-visitor	p value	95% CI
Seizure	35	3.1	0.049	1.00 - 9.73	3.9	<0.0001	2.03 - 7.54
Dyspnoé	115	3.9	<0.0001	2.83 - 5.34	2.9	<0.0001	2.32 - 3.67
General disabil-ity	42	3.9	<0.0001	2.42 - 6.36	2.7	<0.0001	1.86 - 3.88
Miscellaneous	21	4.9	0.0004	2.03 - 11.79	2.6	0.006	1.32 - 5.30
Stroke-like symptoms	48	2.6	0.001	1.48 - 4.64	2.1	0.0002	1.43 - 3.15
Chest pain	315	1.0	ns.		1.0	ns.	
Intoxication	61	2.0	ns.		1.1	ns.	
Vertigo/ Dizzi-ness	35	0.71	ns.		0.62	ns.	
Head ace	31	0.93	ns.		0.54	ns.	
arrhythmia	102	0.24	ns.		0.38	0.006	0.19 - 0.76
Allergic reaction	34	1.1	ns.		0.34	ns.	

Different presenting complaints showed different long term-mortality depending on the amount of revisits for the patient ($p<0.0001$). For patients with revisits because of dyspnoea there was a marked increase in five-year mortality for patient visiting 4 times (HR 2.79, 95% CI 18 – 4.4, $p< 0.0001$), but thereafter the risk of dying decreased substantially. On the contrary, in patients with revisits because of chest pain the highest long- term mortality was seen in the patients with the most visits (HR 2.62, 95% CI 1.43 – 4.65, $p= 0.001$) (Fig 3)

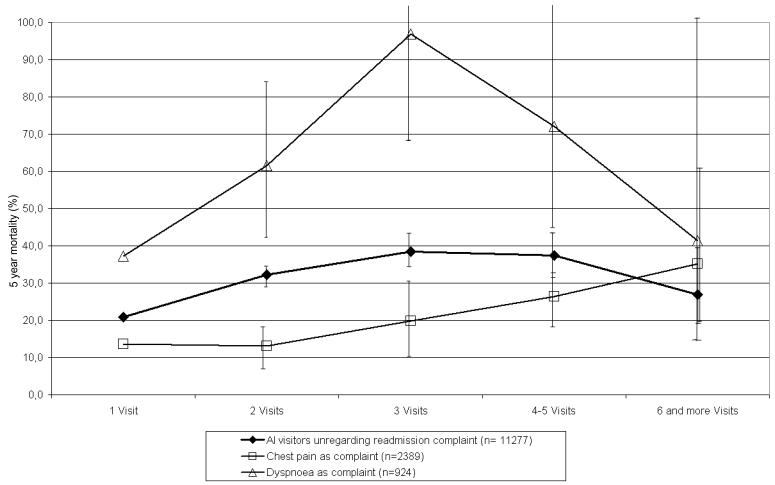

Figure 3. Differences in five year mortality depending on number of visits to the ED for all visitor un-regarding visiting complaints (♦), for chest pain as presenting complaint (□) and for patients presenting with dyspnoea as chief complaint (Δ).

Discussion

We found an increasing risk of one-year, as well as 5-year, mortality with increasing number of ED visits up to three visits. A patient visiting the non-surgical ED three times during the studied year showed an almost two-fold risk of dying within the coming five years. However, from the fourth visit the risk declined. In contrast to findings by Salazar et al from Spain (ref 10), patients conducting 7 or more visits had no significant risk elevation compared to matched single-visitors in the present study. This was true for most, but not all presenting complaints. Chest pain seems to be an exception, since the risk of further mortality did increase with the number of visits even after 3 visits.

Definitions of frequent use in the literature range from as few as 3 visits annually to 12 or more visits, often without a clear rationale for the choice

(ref 10-14). Hunt et al, using the US nation wide Community Tracking Study Household Survey (ref 15) as a source for studying frequent ED attenders, could not find a natural transition level for when a patient became a frequent visitor. No any other investigators have defined such a cut-off limit. By using age- and gender-adjusted long-term mortality and relate this to the number of ED visits and presenting complaint, we could demonstrate such cut-off limit for non-surgical patients. Our findings support the use of 4 or more visits to define the group of frequent attenders, as mortality declines in patients with more than three visits. Four was also the number of visits Hunt et al chose as cut-off limit from statistical, but not medical, reasons in their study, as the group of visitors making four or more visits was large enough (28%) to be of importance for intervention. Our data gives a medical support for this classification.

Also the number of days between two visits influenced long-term mortality. Returning to the ED within 24 hour did not increase mortality risk regardless if the patient was in-hospitalized or not at the previous visit. However, in patients with a readmission after one week, the risk increased more than 6-fold in those submitted to a ward during their first visit. Thus, readmission within one week implies that the primary condition was not properly handled during the in-hospital stay, or that the underlying condition had progressed rapidly. Nevertheless, patients previously in-hospitalized returning to the ED within a week should be handled with great care, since they represent a high risk group.

For revisitors, not admitted to ward at the previous visit, a two-fold increased risk of dying was seen for revisits within 3 days, and thereafter declining. For revisits after one week there were no differences in mortality risk compared to matched single visitors. This implicates that also a revisit within 3 days in patients not previously in-hospitalized should bee handled with great care, since they also represent a high risk group.

Limitations

We did only investigate the group of patients admitted to the non-surgical part of the ED, which might give a low number of readmissions, as many frequent attenders also visits the surgical part of the ED. Patients visiting the surgical part of the ED might have a different long-term mortality pattern in relation to the number of visits. We studied revisits during a period of one year at the ED and not following each visiting patient for one year, patients visited the ED at the end of the studied period had a lover revisiting probability as they was not followed for a whole year. However, despite these limitations a clear increase in mortality risk was seen in revisitors. This kind of investigations is also very much depending of other health resources available for the patient outside the ED.

Conclusions

In non-surgical patients revisiting the ED long-term mortality was dependent on both the number of revisits, as well as the time between two visits, in an inverse U-shaped fashion. This indicates a possibility to detect the transition level between appropriate medical utilization and inappropriate frequent ED use.

References

1. Helliwell PE, Hider PN, Ardagh MW. Frequent attenders at Christchurch Hospital's emergency department. N Z Med J. 2001 Apr 13;114(1129):160-1
2. Hansagi H, Allebeck P, Edhag O. Frequency of emergency department attendances as a predictor of mortality: nine year follow-up of a population – based cohort. J Publ Health Med 1990; 12:39-44
3. Hansagi H, Norell SE, Magnusson G. Hospital care utilization in a 17,000 population sample: 5-year follow-up. Soc Sci Med. 1985; 20(5):487-92.
4. Mandelberg JH, Kuhn RE, Kohn MA. Epidemiologic analysis of an urban, public emergency department's frequent users. Acad Emerg Med. 2000 Jun; 7(6):637-46.
5. Byrne M, Murphy AW, Plunkett PK, McGee HM, Murray A, Bury G. Frequent attenders to an emergency department: a study of primary health care use, medical profile, and psychosocial characteristics. Ann Emerg Med. 2003 Mar; 41(3):309-18.
6. Hansagi H, Olsson M, Sjoberg S, Tomson Y, Goransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. Ann Emerg Med. June 2001; 37:561-567.
7. Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. Ann Emerg Med. 1998 Nov; 32(5):563-8.
8. Fuda KK, Immekus R. Frequent users of Massachusetts emergency departments: a statewide analysis. Ann Emerg Med. 2006 Jul; 48(1):9-16.
9. Safwenberg U, Terént A, Lind L. The Emergency Department presenting complaint as predictor of in-hospital fatality. Eur J Emerg Med. 2007 Dec;14(6):324-31.
10. Salazar A, Bardés I, Juan A, Olona N, Sabido M, Corbella X. High mortality rates from medical problems of frequent emergency department users at a university hospital tertiary care centre. Eur J Emerg Med. 2005 Feb; 12(1):2-5.
11. Zuckerman S, Shen YC. Characteristics of occasional and frequent emergency department users: do insurance coverage and access to care matter? Med Care. 2004 Feb; 42(2):176-82.
12. Ruger JP, Richter CJ, Spitznagel EL, Lewis LM. Analysis of costs, length of stay, and utilization of emergency department services by frequent users: implications for health policy. Acad Emerg Med. 2004 Dec; 11(12):1311-7.
13. Blank FS, Li H, Henneman PL, Smithline HA, Santoro JS, Provost D, Maynard AM. A descriptive study of heavy emergency department users at an academic emergency department reveals heavy ED users have better access to care than average users. J Emerg Nurs. 2005 Apr; 31(2):139-44.
14. Chan BTB, Ovens HJ. Frequent users of emergency departments: do they also use family physicians' services? Can Fam Phys. 2002; 48:1654-1660.
15. Hunt KA, Weber EJ, Showstack JA, Colby DC, Callaham ML. Characteristics of frequent users of emergency departments. Ann Emerg Med. 2006 Jul; 48(1):1-8.