Users of hospital emergency department who are discharged home

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Thesis for the degree of Philosophiae Doctor

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Ágrip

Aðalmarkmið rannsóknarinnar var að lýsa einkennum og afdrifum notenda bráðamóttöku, sem voru útskrifaðir heim. Önnur markmið voru að lýsa árlegum fjölda útskrifaðra heim af bráðamóttöku (BM); lýsa mynstri útskriftasjúkdómsgreininga; flokka notendur eftir aldri og kyni, kanna árlegan komufjölda þeirra og hvort hann hafi forspárgildi um dánartíðni; meta tengsl einkenna sjúkdómsgreininga við dánartíðni almennt og sérstaklega vegna dánarmeina af ytri orsökum, lyfjaeitrunum og sjálfsvígum; greina áhættuþætti sjálfsvíga og banvænna lyfjaeitrana; meta tengsl andláts innan átta daga eftir útskrift heim af BM við einkenna sjúkdómsgreiningar.

Aðferðir: Efniviður var rafrænar skrár sjúklinga 18 ára og eldri, sem komu á BM Landspítala á árunum 1995 til 2001. Aðalsjúkdómsgreiningar voru skráðar samkvæmt Alþjóðlegri tölfræðiflokkun sjúkdóma og skyldra heilbrigðisvandamála. Til að meta árlega aukningu í komum voru þær bornar saman við mannfjölda á Stór- Reykjavíkursvæðinu, gerð var Poisson aðhvarfsgreining og 95% öryggismörk (ÖM) reiknuð. Breytingar á sjúkdómsgreiningum var metin með kí- kvarðaprófi fyrir línulega leitni (Mantel extension). Afdrif sjúklinga voru fengin með samkeyrslu við skrár Hagstofu Íslands. Dánartíðni hópsins var borin saman við dánartíðni þjóðarinnar með hefðbundnum aðferðum við útreikning á stöðluðu dánarhlutfalli (SMR) og 95% ÖM.

Hættuhlutfall (HR) með 95% ÖM var reiknað fyrir öll dánarmein og valin dánarmein í tímaháðri margþátta aðhvarfsgreiningu að teknu tilliti til hversu oft sjúklingar komu á BM á almanaksári og þegar bornir voru saman hópar sjúklinga með mismunandi sjúkdómsgreiningar við útskrift.

Í tilfella- viðmiðarannsóknum voru sjálfsvíg og banvænar eitranir athugaðar m.t.t. fimm sjúkdómsgreininga, það er að segja geðraskana, áfengisnotkunar, lyfjaeitrana, einkenna sjúkdómsgreininga og þátta sem hafa áhrif á heilbrigðisástand. Reiknað var margþátta lógístik aðhvarfsgreining með líkindahlutfalli (OR) og 95% ÖM.

Dánartíðni innan átta daga meðal sjúklinga með einkenna sjúkdómsgreiningu var borin saman við dánartíðni annarra sem leituðu á BM. HR og 95% ÖM var reiknað fyrir öll dánarmein í tímaháðri greiningu.

Niðurstöður: Komur á BM sem leiddu til útskriftar voru 2.888 árið 1995 eða 54.5% af öllum komum á BM og árið 2001 var fjöldinn 5.604 eða 72.5% af öllum komum.

Komur sem leiddu til útskriftar voru 30.221 en fjöldi sjúklinga var 19.259 kynjaskipting var u.þ.b. jöfn. Hlutfall sjúklinga sem komu einu sinni á ári voru 84% en 1.5% sjúklinga komu fjórum sinnum eða oftar á ári. Árleg aukning var 7 – 14%, en hæst meðal eldri karla. Algengasta sjúkdómsgreiningin við útskrift eða 20% að meðaltali var einkenna sjúkdómsgreining (R00-R99) og hafði hún aukist yfir tímabilið.

SMR vegna allra dánarmeina var 1.81 (95% CI, 1.71 til 1.92) hjá körlum og 1.93 (95% CI, 1.81 til 2.05) hjá konum. SMR sjúklinga með einkenna sjúkdómsgreiningu var 1.57 (95% CI, 1.39 til 1.77) hjá körlum og 1.83 (95% CI, 1.61 til 2.08) hjá konum, enn fremur var SMR 3.72 (95% CI, 2.72 til 4.98) hjá körlum með geðraskanir en 2.45 (95% CI, 1.76 til 3.36) hjá konum.

Algengustu dánarmein voru illkynja æxli, blóðþurrðarhjartasjúkdómar, heilaæðasjúkdómar, langvinnir neðri öndunarfærasjúkdómar og að viðbættum flokknum ytri orsökum og töldust þau vera 73% þeirra 2.105 sem létust á fylgni tíma.

HR allra dánarmeina var 1.4 (95% CI, 1.2 til 1.5) hjá þeim sem komu tvisvar á almanaksári og 1.7 (95% CI, 1.4 til 2.0) hjá þeim sem komu þrisvar eða oftar á almanaksári.

Þeir sem fengu einkenna sjúkdómsgreiningu höfðu HR 0.84 (95% CI, 0.76 til 0.93) vegna allra dánarmeina samanborið við þá með líkamlegar sjúkdómsgreiningar. HR vegna ytri orsaka var 1.64 (95% CI, 1.07 til 2.52) og 2.08 (95% CI, 1.02 til 4.24), vegna sjálfsvíga að teknu tilliti til aldurs og kyns.

Vegna sjálfsvíga hjá þeim sem greindir voru með geðraskanir var OR 7.84 (95% CI, 1.66 til 37.06), 96.89 (95% CI, 11.14 til 843) með áfengisnotkun, 24.51 (95% CI, 6.11 til 98.25) með lyfjaeitranir og 2.69 (95% CI, 1.04 til 6.95) með einkenna sjúkdómsgreiningar.

Vegna banvænna eitrana var OR 12.26 (95% CI, 2.10 til 71.76) fyrir þá sem greindir voru með áfengisnotkun, 37.22 (95% CI, 3.57 til 388.29) með lyfjaeitranir, 5.76 (95% CI, 1.23 til 26.95), með sjúkdómsgreininguna þættir sem hafa áhrif á heilbrigðisástand.

Þeir sem voru með einkenna sjúkdómsgreiningu voru með HR 0.44 (95% CI, 0.20 til 0.96) vegna allra dánarmeina innan átta daga þegar þeir voru bornir saman við þá sem fengu aðrar sjúkdómsgreiningar að teknu tilliti til kyns og aldurs.

Ályktun: Aukning í heimsóknum var umfarm mannfjöldaaukningu á Stór- Reykjavíkursvæðinu, sem leiddi til aukins álags á BM.

Einkenna sjúkdómsgreining var algengasta útskriftargreiningin. Fjöldi heimsókna hafði forspárgildi fyrir hærri dánartíðni.

Algengustu dánarmein voru illkynja æxli, blóðþurrðarhjartasjúkdómar, heilaæðasjúkdómar, langvinnir neðri öndunarfærasjúkdómar og ytri orsakir.

Dánartíðin sjúklinga sem voru með einkenna sjúkdómsgreiningar var hærri en dánartíðni annarra sjúklinga vegna ytri orsaka, óhappaeitrana og sjálfsvíga.

Endurteknar komur á BM voru sterkir áhættuþættir sjálfsvíga og banvænna eitrana. Sjálfstæðir áhættuþættir sjálfsvíga voru geðraskanir, áfengisnotkun og lyfjaeitrun auk einkenna sjúkdómsgreiningar. Sjálfstæðir áhættuþættir fyrir banvænar eitranir voru áfengisnotkun, lyfjaeitranir og sjúkdómsgreiningin: þættir sem hafa áhrif á heilbrigðisástand. Starfsfólk BM ætti að vera vakandi fyrir sjúklingum sem koma oft á BM og eru útskrifaðir heim auk þeirra sem útskrifaðir eru með hina nýju áhættuþætti sjálfsvíga og banvænna eitrana.

Tengsl einkenna sjúkdómsgreiningar við andlát innan átta daga eftir útskrift er hægt að nota til að meta skilvirkni BM.

Lykilorð: Bráðamóttaka, sjúkdómsgreining, dánartíðni, sjálfsvíg, lýðgrunduð rannsókn

Abstract

The overall aim of the studies was to determine characteristics and prognosis of Emergency Department users, who were discharged home.

The specific aims were to record the annual number of discharged users of the ED according to age and gender, their annual number of visits and to assess whether a higher frequency of visits predicted higher mortality; to describe the pattern of discharged diagnoses; to evaluate the association of non-causative diagnoses with mortality in general, and in particular with external causes of death, drug intoxication and suicide; to evaluate risk factors for suicide and fatal drug poisoning; to evaluate the association between death within eight days after discharge home from the ED and non-causative discharge diagnoses.

Material and Methods: The data were records of patients, 18 years and older, who attended the Landspitali ED during the years 1995 to 2001. The main diagnoses were registered according to the International Classification of Diseases (ICD). Annual increase in visits was evaluated in relation to the annual population of Reykjavik capital area using the Poisson regression model and 95% Confidence Interval (CI). The pattern of each diagnosis category during the period was analyzed by calculating chi-squares for the linear trend (Mantel extension). Patients' vital status was obtained by record linking to Statistics Iceland. The mortality of ED users was compared with the mortality of the general population of Iceland using conventional methods of calculating the standard mortality ratio (SMR) and 95% CI.

The Hazard ratios (HR) and 95% CI were calculated for all causes and selected causes of death in a time-dependent analysis in which annual visits to the ED were taken into account. Furthermore, the same method was used when comparing groups with different diagnoses at discharge.

In the case control studies the discharged diagnoses of mental disorders, use of alcohol, drug intoxication, non-causative diagnoses and factors influencing health status were risk factors for suicide and fatal drug poisoning, and were calculated in a multivariate logistic regression analysis. The adjusted Odd ratio (OR) and exact computation of 95% CI were calculated.

Deaths within 8, 15 and 30 days among individuals with a non-causative diagnosis were compared with deaths among those with a causative diagnosis. HR and 95% CI were computed for all causes of death in a time-dependent analysis.

Results: Of all visits to the ED in the year 1995, 2,888 or 54.5% resulted in discharge and of all visits in the year 2001, 5,604 or 72.5% resulted in discharge. Discharged patients in total over the study period numbered 19,259 and they made 30,221 visits, with visits by women slightly more frequent than by men. About 84% of users made one visit in a calendar year and 1.5% of users made four or more visits per calendar year. The annual increase of visits to the ED was 7% to 14% depending on the age group, with the highest increase among older men. The most frequent diagnostic category was non-causative diagnoses (R00-R99), accounting for 20% average, and increasing over the period.

SMR for all causes of death was 1.81 (95% CI, 1.71 to 1.92) for men and 1.93 (95% CI, 1.81.to 2.05) for women. For patients with non-causative diagnoses, SMR for all causes of death was 1.57 (95% CI, 1.39 to 1.77) for men and 1.83 (95% CI, 1.61 to 2.08) for women; furthermore, for those diagnosed with mental disorders, SMR was 3.72 (95% CI, 2.72 to 4.98) for men and 2.45 (95% CI, 1.76 to 3.36) for women.

The most common causes of death were malignant neoplasm, ischemic heart diseases, cerebrovascular disease, and the category of chronic lower respiratory diseases; by adding the category of external causes, these accounted for over 73% of the overall deaths, a total of 2,105.

HR for all causes of death was 1.4 (95% CI, 1.2 to 1.5) among patients with two visits in a calendar year and 1.7 (95% CI, 1.4 to 2.0) among those with three or more visits in a calendar year. Comparing those with non-causative diagnoses to those having causative physical diagnoses, the HR for all causes of death was 0.84 (95% CI, 0.76 to 0.93). On the other hand, the HR for the category of external causes was 1.64 (95% CI, 1.07 to 2.52); HR for accidental poisoning was 1.51 (95% CI, 0.56 to 4.08); and the HR for suicide was 2.08 (95% CI, 1.02 to 4.24), all adjusted for age and gender.

The OR for suicide among cases and controls was 7.84 (95% CI, 1.66 to 37.06) for patients with mental disorders, 96.89 (95% CI, 11.14 to 843) for those with use of alcohol, 24.51 (95% CI, 6.11 to 98.25) for those with drug intoxications and 2.69 (95% CI, 1.04 to 6.95) for those with non-causative diagnoses.

The OR for fatal drug poisoning among cases and controls was 12.26 (95% CI, 2.10 to 71.76) for patients with use of alcohol, 37.22 (95% CI, 3.57 to 388.29) for those with drug intoxications, 5.76 (95% CI, 1.23 to 26.95), for those with factors influencing health status.

The HR for non-causative diagnoses was 0.44 (95% CI, 0.20 to 0.96) for death within eight days when compared to causative diagnoses, adjusted for gender and age.

Conclusion: There was an increase in visits to the ED in relation to the population of the Reykjavik capital area and this increase contributed to an increased burden at the ED. The most frequent diagnoses were non-causative diagnoses. Number of visits predicted higher mortality. The most common causes of death were due to malignant neoplasm, ischemic heart diseases, cerebrovascular diseases, chronic lower respiratory diseases, and external causes. Mortality was higher among ED users than in the general population. Users with non-causative diagnoses had higher mortality due to external causes, accidental poisoning, and suicide.

Frequent visits to the ED were a strong risk factor for suicide and fatal drug poisoning . The discharged diagnoses of mental disorders, alcohol use, drug intoxication and non-causative diagnoses were independent risk factors for suicide. The discharge diagnoses of alcohol use, drug intoxication and factors influencing health status were independent risk factors for fatal drug poisoning. Health professionals at EDs should be careful when users have a number of discharged visits and they need to be aware that patients who have been discharged home present with new risk factors for suicide and fatal drug poisoning.

The association of non-causative diagnoses with death within eight days after discharge can be used to evaluate the performance of the ED.

Keywords: emergency department, diagnoses, mortality, suicide, population based study

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Contents

List of abbreviation

AMA = Against medical advise

CI = Confidence Interval

ED = Emergency department

F00-F99 = Mental and behavioural disorders

F10 = Mental and behavioural disorders due to use of alcohol

HR = Hazard ratio

ICD = International Classification of Diseases

LOS = Length of stay

LUH = Landspitali University Hospital

LWBS = Left without been seen

OR = Odd ratio

R00-R99 = Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified

SMR = Standardized mortality ratio

Z00-Z00 = Factors influencing health status and contact with the health services

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IV. Gunnarsdottir OS, Rafnsson V. Risk of suicide and fatal drug poisonings after discharge home from the emergency department: a nested case-control study. Emerg Med J. 2010;27:93-6.

V. Gunnarsdottir OS, Rafnsson V. Death within 8 days after discharge to home from the emergency department. Eur J Public Health 2008;18:522-6.

Declaration of contribution

Paper I

Oddny Sigurborg Gunnarsdottir (OSG) suggested the study and designed the study with Vilhjalmur Rafnsson (VR). Both authors were responsible for getting approvals for the study and OSG was responsible for collecting the data records. OSG and VR were responsible for analyzing the data with the assistance of Helgi Sigvaldason (HS). OSG wrote the first draft of the manuscript and VR carefully edited it. Both authors approved and worked on the final version.

Paper II

OSG and VR designed the study. Both authors were responsible for getting approvals for the study, but OSG was responsible for collecting the data records. OSG and VR were responsible for analyzing the data, OSG wrote the first draft of the manuscript and VR carefully edited it. Both authors worked on and approved the final version.

Paper III

OSG and VR designed the study. Both authors were responsible for getting approvals for the study and OSG was responsible for collecting the data records. OSG and VR were responsible for analyzing the data with the assistance of HS. OSG wrote the first draft of the manuscript and VR carefully edited it. Both authors worked on and approved the final version.

Paper IV

OSG and VR designed the studies. Both authors were responsible for getting approvals for the studies and OSG was responsible for collecting the data records. OSG and VR were responsible for analyzing the data with the assistance of HS. OSG and VR worked on the first draft of the manuscript and were responsible for editing the manuscript and approving its final version.

Paper V

OSG suggested the study and designed the study with supervision from VR. OSG was responsible for collecting the data records. OSG and VR were responsible for analyzing the data with the assistance of HS. Both authors were responsible for getting approvals for the study, writing the manuscript and approving its final version.

1 Introduction

A uniform definition of emergency departments (ED) is lacking today but ED activities have been defined both in a broad and a narrow scope. Hansagi and co-workers from Sweden used the following definition: “Emergency departments are designed to provide highly professional medical treatment to those who need urgent or emergency care” (Hansagi et al., 2001). However, Nawar and co-workers defined ED as follows: “Emergency departments provide unscheduled care for a wide variety of persons for reasons that range from life-threatening conditions to problems that could be treated in a primary care setting” (Nawar et al., 2007).

The number of individuals seeking emergency medical services, along with the total number of visits to hospital EDs, have increased in many developed countries during recent decades and have thus drawn attention in public health discussions (Capewell, 1996, Derlet & Richards, 2002b, Hansagi et al., 2001, Nawar et al., 2007).

Many individuals seek ED treatment as their first choice when feeling ill. ED’s are also an intake path for patients to be hospitalized and as such are one of the cornerstones of the public health care system. In the US, approximately 20% of the population made one or more visits to the ED over a 12-month period (Hunt et al., 2006), while subgroups such as infants and people aged 75 and older had higher rates of attendance (Burt et al., 2007, Nawar et al., 2007, Niska & Shimizu, 2011). Similar results were obtained in a cross-sectional study of EDs in Canada and the US (Li et al., 2007) and furthermore, a retrospective study from Hong Kong showed that increased age was related to increased ED visits (Yim et al., 2009).

The increasing age of a population leads to increased numbers of visits of elderly patients to the ED and to an increased burden on the EDs (Yim et al., 2009). One reason for this increase is that the elderly often have multiple and complex diseases (Aminzadeh & Dalziel, 2002, Yim et al., 2009) and often need more time and more diagnostic tests than other users (George et al., 2006, Yim et al., 2009).

According to a register-based study in a general hospital in South Midland UK, between the years 1990 and 2004, the increase in the total number of ED patients was 54%, and the increase in the number of patients aged 70 and older was 198% over the same period (George et al., 2006). However, the increase in a nation-wide survey on EDs in the US was 20% over the period 1995 to 2005 (Nawar et al., 2007) and the increase was similar over the period 1997 to 2007 (Niska et al., 2010).

Approximately 85% or more of ED users in the US were discharged home (Cook et al., 2004, Kefer et al., 1994, Nawar et al., 2007, Niska et al., 2010) and in Barcelona, around 80% were discharged home, according to Salazar and co-workers (Salazar et al., 2005). Patients aged 65 or older were more often admitted to the hospital wards than younger patients (Yim et al., 2009).These results are consistent with a study from South Midland where patients aged 70 and older were admitted to the hospital wards nearly five times more frequently (George et al., 2006).

Patients who arrive at EDs are categorized according to the level of emergency of treatment and on completion of the visit they are assigned a diagnosis, after a diagnostic work-up. Patients are then either discharged or admitted to one of the hospital wards.

1.1 Frequent users

Studies of ED services have focused on those who visit the ED frequently and they are often called frequent users, frequent flyers or hyper-users (Blank et al., 2005, Dale et al., 1995, Hansagi et al., 1985, Hansagi et al., 1990, Huang et al., 2008, Jelinek et al., 2008, Kne et al., 1998, Lucas & Sanford,

1998, Mandelberg et al., 2000, Milbrett & Halm, 2009, Moore et al., 2009, Olsson & Hansagi, 2001, Da Cruz et al., 2011).

The definition of a frequent user differs between studies (Jelinek et al., 2008, Milbrett & Halm, 2009, Moore et al., 2009). Most researchers used the definition for patients with four or more visits per 12-month period (Byrne et al., 2003, Hansagi et al., 1990, Hansagi et al., 2001, Huang et al., 2008, Lucas & Sanford, 1998, Milbrett & Halm, 2009, Murphy et al., 1999), whereas others use the term for patients with 10 or more visits in a 12-month period (Aminzadeh & Dalziel, 2002, Kennedy & Ardagh, 2004, Kne et al., 1998, Salazar et al., 2005). Some studies show that 3% to 8% of patients pay frequent visits to the ED but they account for 12% to 28% of the total visits (Blank et al., 2005, Hansagi et al., 2001, Huang et al., 2008, Hunt et al., 2006, Murphy et al., 1999). Some studies show a higher proportion of females than males amongst frequent users (Blank et al., 2005, Hunt et al., 2006, Li et al., 2007, Milbrett & Halm, 2009); however other studies show the opposite (Moore et al., 2009, Salazar et al., 2005). Still other studies show no gender differences among frequent users and other users (Shiber et al., 2009). A representative population-based survey from the US showed that frequent users were younger than other users (Hunt et al., 2006). Jelinek and co-workers found similar results in a register-based study in Perth (Jelinek et al., 2008). The number of visits increased as patient´s age increased (Hansagi et al., 2001, Moore et al., 2009, Murphy et al., 1999).

Results indicate that frequent users have poor physical (Hunt et al., 2006, Olsson & Hansagi, 2001) and mental health (Chan & Ovens, 2002, Hansagi et al., 1990, Hunt et al., 2006, Mandelberg et al., 2000, Salazar et al., 2005, Sun et al., 2003), and that they use other health care services frequently (Byrne et al., 2003, Chan & Ovens, 2002, Hansagi et al., 1985, Hansagi et al., 2001, Huang et al., 2008). Frequent users also lack social support or a network (Hansagi et al., 1990, Olsson & Hansagi, 2001); they tend to be in a low income bracket (Hansagi et al., 1990, Hunt et al., 2006) and some studies indicate that they are in socioeconomic distress (Andren & Rosenqvist, 1985, Chan & Ovens, 2002, Lucas & Sanford, 1998, Mandelberg et al., 2000, Milbrett & Halm, 2009, Murphy et al., 1999, Sun et al., 2003).

Frequent users were more often hospitalized than non-frequent users (Mandelberg et al., 2000) and they did not remain frequent users all the time (Kennedy & Ardagh, 2004, Kne et al., 1998). Furthermore the pattern of diagnoses changes with increasing frequency of the patient's visits to the ED (Jelinek et al., 2008).

Approximately 70% of the frequent users' visits were made during the day and evening shifts (Milbrett & Halm, 2009, Moore et al., 2009). Frequent users went to the ED because they believed they were in need of emergency care (Lucas & Sanford, 1998, Olsson & Hansagi, 2001). Frequent ED users had increased mortality compared with the general population (Andren & Rosenqvist, 1985, Hansagi et al., 1990).

1.2 Overcrowding

Overcrowding is a problem in EDs that has been studied extensively in recent years (Bernstein et al., 2009, Derlet, 2002, Derlet & Richards, 2002, Fatovich et al., 2005, McCarthy et al., 2009, Richardson, 2006, Rogers, 2009). Overcrowding has been defined in various ways, according to Hwang U and co-workers in their review (Hwang & Concato, 2004).

According to Trzeciak and co-workers, who reviewed published articles from 1990 to 2002, public health is threatened by overcrowding in EDs (Trzeciak & Rivers, 2003). Results from a retrospective stratified cohort analysis from Australia in the years 2002 to 2004 showed that there is an association between overcrowding in the ED in a tertiary hospital and increased risk in mortality within 10 days among hospitalized patients (Richardson, 2006). Sprivulis and co-workers came to a similar conclusion when they detected an association between mortality in hospitalized patients and

overcrowded hospitals and EDs in a retrospective analysis on three tertiary hospitals; the increase in mortality was on the second and the seventh day (Sprivulis et al., 2006).

According to the literature, the causes of overcrowding in the EDs are various. Asplin and co-workers categorize overcrowding in the ED according to three factors: input factors, through-out factors and output factors (Asplin et al., 2003). An increase in visits is one of the factors for overcrowding in the ED (Hoot & Aronsky, 2008, Derlet & Richards, 2002b). Higher age of the population also increases the number of visits to the EDs (Yim et al., 2009, Roberts et al., 2008). In the years 1993 to 2002, the increase in visits to the EDs was 34% per population in the age group 65 to 74 years (Roberts et al., 2008). More often, these patients had multiple and complex diseases (Aminzadeh & Dalziel, 2002, Yim et al., 2009), which can make it difficult and demanding to diagnose them (Salvi et al., 2007, George et al., 2006, Yim et al., 2009); as a result, they require more time of the hospital personnel than other patients do (Derlet & Richard, 2002b). Moreover, they are more frequently hospitalized (Roberts et al., 2008) and often have to wait in the ED because of insufficient availability of hospital inpatient beds (Derlet & Richard, 2002b).

Long waiting time in the ED can result in having the patient stay longer at the hospital (Richardson, 2002)

Influenza outbreaks cause an increase in visits to the ED, especially among elderly people (Schull & Vermeulen, 2005, Fatovich et al., 2005) and at the same time, these outbreaks lead to an increase in ambulance diversion (Fatovich et al., 2005). Other studies point out that the cause of overcrowding is a through-out factor that is a systemic problem, such as lack of personnel and a shortage of hospital beds (Derlet & Richard, 2002b)

Overcrowding in the EDs has also been associated with the number of non-urgent visits (Dale et al., 1995, Hoot & Aronsky, 2008, Lang et al., 1996) or frequent users (Hansagi et al., 2001), but the study by Hunt and co-workers did not support this view (Hunt et al., 2006).

1.3 Triage

The increase in attendance at EDs has led to the implementation of ED triage systems. Triage is considered the starting point of the ED service. The triage system categorizes patients according to the level of urgency (Fernandes et al., 2005, Travers et al., 2002), based on the patient's complaints, their general condition, a brief examination and physiological factors. Thus, triage systems are used to minimize the waiting time for treatment of the most urgent patients, while other patients not needing as urgent treatment are left to wait (Cooke & Jinks, 1999, Murray et al., 2004, ACEM, 2006, Fernandes et al., 2005**,** Parenti et al., 2010). Different triage systems are used in different countries; for example, the UK uses the Manchester triage system (MTS) (Cooke & Jinks, 1999), Canada uses the Canadian Triage and Acuity Scale (CTAS) (Murray et al., 2004), Australia uses the Australasian system (ATS) (ACEM, 2006), the US uses the Emergency Severity Index (ESI) (Fernandes et al., 2005) and France uses the FRENCH system (Taboulet et al., 2009). Triage systems categories patients from level one to three, to four or to fifth level (ACEM, 2006, Bullard et al., 2009, Cooke & Jinks, 1999, Fernandes et al., 2005, Gilligan et al., 2009, Taboulet et al., 2009, Parenti et al., 2010), with highly urgent patients placed in the first categories and those with lower urgency placed in the higher categories. There are different opinions on the triage systems and they have been studied (Tanabe et al., 2005, van der Wulp et al., 2008) and compared (Travers et al., 2002). The study of Gill and co-workers showed that there was discrepancy between patient triage among health care professionals (Gill et al., 1996). It is also noted that a serious illness can present itself in different ways that can lead to incorrect triage of the patients (Cooke & Jinks, 1999). Patient symptoms can worsen during the stay at the ED, which is why it is extremely important to monitor the patients´ condition, even when they have been triaged as less urgent (Cooke & Jinks, 1999).

1.4 Non-urgent users

Some studies state that certain patients can be served just as well by general practitioners or within primary health care centres as by the ED (Bianco et al., 2003, Dale et al., 1995, Hansagi et al., 1989, Hansagi et al., 1985, Lang et al., 1996, Lang et al., 1997, Nawar et al., 2007,Da Cruz et al., 2011) and that such patients account for between 19.6% and 41 % of the total ED attendance (Bianco et al., 2003, Dale et al., 1995). Patients who make non-urgent visits are often called non-urgent users (Redstone et al., 2008) or inappropriate users (Lang et al., 1997) and sometimes they are blamed for ED overcrowding (Harris et al., 2004, Li et al., 2007). A uniform definition is lacking for non-urgent visits (Lang et al., 1997, Murphy, 1998, Redstone et al., 2008, Trzeciak & Rivers, 2003). The study of Redstone and co-workers showed that 6% of non-urgent users were hospitalized compared to 40% of urgent ED users (Redstone et al., 2008). In a prospective study in an academic hospital in Canada, the results showed that the proportion of ED patients categorized as high acuity increased over a seven year study period (Bullard et al., 2009).

Non-urgent visits have an effect on the quality of the EDs (Ragin et al., 2005, Trzeciak & Rivers, 2003), but this is not in agreement with results from Schull and co-workers (Schull et al., 2007). Their retrospective study of 110 EDs in Ontario, Canada showed that non-urgent users have little impact on the length of stay for critically ill patients in the ED (Schull et al., 2007).

Studies also show that non-urgent users are typically young (Afilalo et al., 2004, Lang et al., 1996) unemployed (Lang et al., 1996), and more often females (Redstone et al., 2008), but other studies show few differences in gender proportions (Backman et al., 2008, Schull et al., 2007).

According to a qualitative study based on structured interviews among non-urgent ED users, they visited the ED because of its accessibility when they were unable to get an appointment with a physician or in primary care (Grumbach et al., 1993). In questionnaire studies on patients classified as less urgent or non-urgent, one from Halifax and the other one from Sheffield, patients claimed that they came to the ED because they were in need of emergency care, needed special services, or they were referred to the ED (Field & Lantz, 2006, Penson et al., 2011).

In a cross-sectional study by Redstone and co-workers, 24% of non-urgent patients thought that they should be hospitalized (Redstone et al., 2008).

Non-urgent users who visited the ED were more often hospitalized than non-urgent users who visited primary care facilities in Stockholm, according to Backman and co-workers (Backman et al., 2008).

1.5 Uncompleted visits

Uncompleted visits to the ED have been debated over recent years (Baker et al., 1991, Gratton, 1987, Henson & Vickery, 2005, Jerrard, 2009, Johnson et al., 2009, Kennedy et al., 2008, Lee et al., 2006, Mohsin et al., 2005, Weissberg et al., 1986). Uncompleted visits are divided into two groups of patients, i.e. those who leave without being seen (LWBS), which is more common, and those who leave against medical advice (AMA). The proportion of those groups out of the total visits to the ED varies between hospitals. It has been indicated that the proportion of patients who LWBS and patients who leave AMA can be a criterion for the quality and effectiveness of the healthcare service (Devkaran et al., 2009, Pennycook et al., 1992).

1.5.1 Leave without been seen (LWBS)

No overall definition exists for LWBS patients. The general definition is that the patient visits an ED but leaves before receiving medical service (Gilligan et al., 2009, Hobbs et al., 2000, Johnson et al., 2009, Mohsin et al., 2005, Guttmann et al., 2011). The rate of LWBS patients varies between countries from 0.36% in Hong Kong up to 15% in the US, according to results from Kennedy and co-

workers in their review of articles published between 1990 and 2006 (Kennedy et al., 2008). In a recent Irish study, the LWBS rate was 7.47% (Gilligan et al., 2009). Studies show that the LWBS rate is increasing (Bullard et al., 2009, Sun et al., 2007) and that LWBS patients are often triaged as non-urgent (Baker et al., 1991, Ding et al., 2006, Gilligan et al., 2009, Kennedy et al., 2008, Pham et al., 2009, Sun et al., 2007, Guttmann et al., 2011), and are younger (Ding et al., 2006, Gilligan et al., 2009, Johnson et al., 2009, Mohsin et al., 2007, Rowe et al., 2006, Guttmann et al., 2011), and they wait longer than those who received medical care (Kennedy et al., 2008, Monzon et al., 2005). The proportion between genders varies in different studies (Ding et al., 2006, Gilligan et al., 2009, Johnson et al., 2009, Mohsin et al., 2007, Rowe et al., 2006, Sun et al., 2007, Guttmann et al., 2011). LWBS patients often belong to minority groups (Pham et al., 2009, Sun et al., 2007), are not insured (Ding et al., 2006, Mohsin et al., 2007, Sun et al., 2007), and have relatively low socioeconomic status (Mohsin et al., 2005, Pham et al., 2009).

Some cases have been reported of patients who LWBS, who later needed emergency surgery (Baker et al., 1991, Rowe et al., 2006), but the occurrence of death amongst LWBS patients shortly after a visit to an ED is rare (Pennycook et al., 1992, Rowe et al., 2006, Guttmann et al., 2011).

1.5.2 Leave against medical advice (AMA)

The concept of AMA refers to patients who leave against medical advice. They refuse treatment or even refuse hospitalization (Ding et al., 2007, Henson & Vickery, 2005, Jerrard, 2009, Lee et al., 2006, Niska & Shimizu 2011). The rate of patients who leave AMA is between 0.5% and 2.7% of total visits to the EDs (Ding et al., 2007, Henson & Vickery, 2005, Nawar et al., 2007, Pennycook et al., 1992, Niska & Shimizu 2011).

Typically, patients who leave AMA are young (Ding et al., 2007, Henson & Vickery, 2005, Lee et al., 2006, Pennycook et al., 1992), men (Henson & Vickery, 2005, Lee et al., 2006, Pennycook et al., 1992), although there are exceptions (Ding et al., 2007). They often have a lower socioeconomic status (Ding et al., 2007), and are unemployed and unmarried (Ding et al., 2007). The majority of these patients have a history of substance abuse (Pennycook et al., 1992) and more than 50% were under influence of alcohol or drugs at the ED (Henson & Vickery, 2005, Pennycook et al., 1992). Thus, it is questionable whether patients who leave AMA are capable of understanding their condition. Diagnoses of patients who leave AMA differ (Ding et al., 2007, Jerrard, 2009), and are triaged in all categories (Ding et al., 2007, Henson & Vickery, 2005, Lee et al., 2006).

Patients who left AMA had higher acuity levels than LWBS patients (Ding et al., 2007). Furthermore, ED crowding does not have the same effect on the proportion of patients who leave AMA as on the proportion of patients who LWBS (Ding et al., 2007).

When a patient decides to leave AMA, the physician in the ED may be placed in a difficult situation. Physicians try to make patients realize the necessity of completing their visit to the ED. Patients who left AMA in the ED are urged to seek medical care within a short time, either in the ED or in another health care facility. A follow-up study from Maryland showed that 65% of patients who left the ED AMA did not seek any medical assessment within 72 hours, although they had been advised to do so (Jerrard, 2009) The majority of them were considered to have potential cardiovascular problems (Jerrard, 2009).

1.6 Length of stay (LOS)

Length of stay (LOS) generally refers to the interval between the time the patient is registered at the ED and the time the patient leaves the ED. This applies whether the patient is hospitalized, referred to another facility or discharged home (Gardner et al., 2007, Lucas et al., 2009, Schull et al., 2007).

Increased workload in the ED has had the consequence that patients have to wait longer to get medical service (Derlet & Richards, 2000). A retrospective analysis in the years 2001 to 2005 showed a 3.5% increase per year in median LOS and that the annual increase among critically ill patients was 7% (Herring et al., 2009).

Various factors influence the LOS in EDs. LOS depended on whether a patient was hospitalized or not (Gardner et al., 2007, Herring et al., 2009), and also on which ward the patients were admitted to (Gardner et al., 2007, Lucas et al., 2009).

A retrospective study from the US by Rathlev and co-workers showed an association between LOS and the number of admitted patients from the ED, as well as an association between hospital occupancy and LOS (Rathlev et al., 2007). However, in another study from the US carried out in five hospitals, the results revealed (Lucas et al., 2009) no association between LOS and hospital occupancy. According to Lambe and co-workers, the number of physicians and triage nurses was associated with LOS (Lambe et al., 2003). Other factors that influenced increased LOS were diagnostic testing, e.g. computerized tomography (CT), magnetic resonance imaging (MRI), ultrasound (US) (Gardner et al., 2007, Herring et al., 2009), especially among those who were discharged (Gardner et al., 2007). There was also an association between LOS and ethnicity (Gardner et al., 2007, Herring et al., 2009).

Patients aged 65 and older stayed longer in the ED, had more complex diseases and needed more diagnostic tests than other ED patients, according to results from three acute hospitals in Hong Kong (Yim et al., 2009). Solberg and co-workers concluded that LOS should be used to evaluate the efficiency of the ED (Solberg et al., 2003).

1.7 Mortality

In follow-up studies on ED users in Stockholm and Uppsala, Sweden, the users had increased mortality, compared with the local and the general population (Andren & Rosenqvist, 1985, Hansagi et al., 1990, Hansagi et al., 2001, Safwenberg et al., 2008).

According to Safwenberg and co-workers, discharged patients in Uppsala, revisiting the ED after two to three days had increased mortality and furthermore, mortality differed according to the presenting complaints of the patients in the ED (Safwenberg et al., 2010). Frequent users of EDs had a two-fold excess mortality (Hansagi et al., 1990), which is similar to the results of Safwenberg and co-workers, but they found that in cases of more than three visits in a year, the mortality decreased (Safwenberg et al., 2010). In a cohort study with a nine-year follow-up time (Hansagi et al., 1990), the three dominant causes of death were diseases of the circulatory system, tumours and violent events. A retrospective study on frequent users in Spain (Salazar et al., 2005) showed that medical problems were the cause of death in 81% of total deaths. The proportion of death among frequent users who had ten or more visits was 18.6%, and one-quarter of those patients died in the hospital (Salazar et al., 2005). Hansagi and co-workers did not study the mortality in relation to diagnoses (Hansagi et al., 1990), nor did they differentiate between whether the patients were discharged home or admitted to one of the hospital wards.

1.8 Suicide

Suicide is a global public health problem and it affects many people, including the families and friends of the people who take their own lives. According to the World Health Organization (WHO), the global suicide rate is 16/100,000 and is one of the three most common causes of death in the age group of 15 to 44 years in some countries (WHO, 2011b). An international study from 17 countries has showed that lifetime prevalence of suicidal ideation is around 9%, plans are around 3% and attempts are around 3% (Nock et al., 2008). The findings of an international study have assessed that the

prevalence of non-fatal suicidal behaviour is estimated about 3% to 5% of the population, based on the numbers of individuals who acknowledge having made a suicide attempt (Weissman et al., 1999).

The lifetime prevalence of suicide ideation in Western countries is estimated at around 8% to 13.5% (Bernal et al., 2007, Kessler et al., 1999). According to Nock and co-workers, the duration from ideation to plan and attempt was 12 months in 60% of the suicides (Nock et al., 2008). Those who take their own lives have had previous contact with health care services, either in the form of psychiatric services or primary health care during the year preceding death, according to a review of 24 studies (Pirkis & Burgess, 1998). A study of mental health patients in North West UK showed that patients with a history of clinical alcohol abuse were associated with death within one month after a visit to the ED (Da Cruz et al., 2011). This coincides with the results of reviews indicating that persons with various mental disorders and substance abuse have increased risk of suicide (Harris & Barraclough, 1997, Harris & Barraclough, 1998). Results from Canada and the US indicate that most suicide attempts are treated in EDs (Baraff et al., 2006, Owens et al., 2002), and in the US an increasing proportion of mental health care is provided by EDs (Owens et al., 2002). Patients' contact with health care services has been considered as an opportunity for preventive measures against suicide. Nevertheless, more than 75% of people who die of suicide did not have contact with mental health services in the year before their death, according to a nation-wide study in the UK (Appleby et al., 1999b).

Suicide victims frequently had contact with all kinds of physicians during the year preceding death, and these contacts had increased towards the end, more so among men than women (Deisenhammer et al., 2007). Kessler and co-workers showed in a population survey that 43% of those who made an attempt did so as a call for help (Kessler et al., 1999). Contact with health care professionals has therefore been considered an opportunity to prevent suicides. However, results from studies on users of EDs indicate that suicidal ideation and planning may not always be readily detected at the ED (Claassen & Larkin, 2005, Crandall et al., 2006, Gairin et al., 2003). Risk factors for suicide identified among the ED users who later die from suicide are alcohol and drug use, intoxication or overdose, mental disorders and physical injuries (Claassen & Larkin, 2005, Crandall et al., 2006, Da Cruz et al., 2011).

Individuals who injure themselves suffer from various psychosocial problems (Goldney, 2002); many will repeat this behaviour and some will eventually take their own lives (Owens et al., 2002). For that reason, this group gets special attention at the ED. Results from Leeds show that 60% of those who took their own lives had been to the ED, but for reasons other than self-harm (Gairin et al., 2003).

A follow-up study on all users of EDs has shown that frequent visits predicted higher mortality (Hansagi et al., 1990), the most important excess mortality being cases of violent death, comprising suicide, probable suicide and alcohol/drug abuse (Hansagi et al., 1990).

1.9 Death shortly after discharge

The most alarming outcome for a patient discharged home would be death within a short time after an ED visit, but few studies have focused on this subject. Results of a study from the UK show that death rates within 30 days after discharge home were 79 per 100,000 individuals (Baker & Clancy, 2006).

Four other retrospective studies have analyzed death within a short time and evaluated the ED records. Kefer and co-workers attempted to evaluate the relationship of the cause of death to the ED visits (Kefer et al., 1994). In this study, the death rate was 30 per 100,000 visits (Kefer et al., 1994). Sklar and co-workers reviewed whether the death was expected, and whether preventable medical errors were identified. In this study the death rate was 12.5 per 100,000 visits (Sklar et al., 2007). Hasting and co-workers studied death of discharged ED users aged 65 and older over a 57-month period (Hastings et al., 2009). The death rate was 972.4 per 100,000 individuals, which is considerably

higher than in the study by Baker and co-workers, but in their study, age was not taken into consideration (Baker & Clancy, 2006). A recent population-based cohort study from Canada showed that there is association between an extra hour of mean length of stay in the ED and death within seven days. All age groups were included in the study and the death rate was 75 per 100,000 patients (Guttmann et al., 2011).

According to ICD instructions to physicians, hospital records surely influence the recorded cause of death, as death certificates are to be attested according to recent medical evaluation and medical history in addition to the circumstances of death, autopsy results when an autopsy has been carried out, and sometimes the outcome of forensic investigations (WHO, 2004). Thus, the procedures in the above-mentioned studies may have induced a circular reasoning.

2 Aims

The overall aim of the studies was to determine characteristics and prognosis of Emergency Department users, who were discharged home. The specific aims were to record the annual number of discharged users of the ED according to age and gender and their annual number of visits, and to assess whether a higher frequency of visits predicted higher mortality (I); to describe the pattern of discharged diagnoses (II); to evaluate the association of non-causative diagnoses with mortality in general, and in particular with external causes of death, drug intoxication and suicide (III); to evaluate risk factors for suicide and fatal drug poisoning (IV); to evaluate the association between death within eight days after discharge home from the ED and non-causative discharge diagnoses (V).

3 Materials and methods

3.1 Landspitali University Hospital (LUH)

The objective of the laws regarding healthcare services in Iceland is that all citizens of Iceland shall have access to the optimum health services that can possibly be provided at any time (Lög um heilbrigðisþjónustu, 1990). Health care service in Iceland, including the ED service, is financed by government taxes and all residents are covered by a national health insurance system, which pays the bulk of the cost for the patient. The ED investigated in this study is at Landspitali University Hospital (LUH), Hringbraut, Reykjavik, Iceland. The hospital is owned and operated by the state of Iceland and administered by the Ministry of Health and Social Security (Lög um heilbrigðisþjónustu, 1990). LUH is at the forefront of specialized and hospital health care in Iceland and it is the central knowledge base for the nation´s health service and the education of health professionals. LUH offers tertiary level of care for the whole country. The Medical and the Nursing Faculties of the University of Iceland are closely connected with LUH (Bjornsson A, [s.a.]).

3.1.1 ED at Hringbraut LUH

The ED has been in operation since October 1987 and initially, it was only open on weekdays. Literature describing the operation of the ED is scarce. The hospital annual reports through the years 1993 to 1999 each include a short section on the ED (Ríkisspítalar, 1994, Ríkisspítalar, 1995, Ríkisspítalar, 1996, Ríkisspítalar, 1997, Ríkisspítalar, 1998, Ríkisspítalar, 1999, Ríkisspítalar, 2000). In general the activities described indicate that the patients who visit the department get medical examinations, initial laboratory tests are done, and treatment is started. Patients who attended the ED were discharged home after periods varying from several minutes up to 24 hours or they were admitted to one of the hospital wards (Ríkisspítalar, 1994, Ríkisspítalar, 1997). The ED served internal medicine patients and general surgery patients and was not intended to be a walk-in clinic or level one trauma centre. The department was operated by different specialties, most often, internal medicine, neurology, surgery, and orthopaedics, where the residents and internists attended to patients with the support and under the responsibility of the respective consultant on duty (Ríkisspítalar, 1996). In addition to the physicians, the ED was staffed by 24 registered nurses, four nursing aids, six secretaries and one assistant (Ríkisspítalar, 1996). Furthermore, the department was administered by a senior physician (cardiologist) in a half-time position. In the 1993 annual report, it is stated that: “The role of the hospital emergency department is to deal with all urgent cases that attended the hospital;” (Ríkisspítalar, 1994) and the personnel of the hospital should, in case of illness or injuries, be offered medical attention at the ED (Ríkisspítalar, 1995). In the 1994 annual report it is stated that: “The majority of the patients are referred by physicians, and many are seriously ill, and arrive by ambulance” (Ríkisspítalar, 1995). According to the 1995 annual report, the ED was opened 24 hours a day and it is stated that most patients were referred to it by physicians, and 35% to 40% of the patients were discharged home (Ríkisspítalar, 1996). The hospitals offered acute service alternating every other day.

During the study period, the general practitioners and the health authorities encouraged patients to consult their local health care centre as the first point of contact to the public health care sector, in cases of sickness and minor injuries. Patients were free to choose to visit out-of-hospital specialist practices or the various EDs at the hospitals, including the ED at LUH (Halldorsson M, 2003).

At this time, the Icelandic health care system operated no compulsory referral system for secondary or tertiary levels of care, although doctors could of course refer their patients to a higher level of care and were obligated to do so according to medical indications (Halldorsson M, 2003).

A contradiction can be found between the statement in the 1995 annual report saying that 35% to 40% of the patients who presented were discharged home (Ríkisspítalar, 1996), and the figures in the computer records received from the ED. According to the records, 55% of all patients who visited the ED were discharged home in 1995 and this proportion increased during the inclusion period up to 73% in 2001. There is also an inconsistency between the annual report (Ríkisspítalar, 1996) stating that the majority of the patients were referred by physicians to the ED and the description of the Icelandic health care system (Halldorsson M, 2003), maintaining that people had a free choice to attend any level of care. In spite of a request, no information was available from the computer records of the attendances at the hospital about whether the patients were referred to the ED.

3.1.2 Setting

The ED at LUH, was intended to serve internal medicine patients, including cardiology and oncology, and general surgery patients. Throughout the inclusion period, 1995 to 2001, another hospital, the Reykjavik Hospital, was operating in the capital within a 3 km distance from the ED at LUH. The hospitals offered acute service alternating every other day. A large accident and emergency department (A&ED) was operated at the Reykjavik Hospital during the inclusion period. The A&ED at Reykjavik Hospital was the level-one trauma centre for the neighbouring communities and tertiary trauma centre for the whole country. The population of the hospitals catchment area, the city of Reykjavik and nearby suburbs (Hafnarfjordur, Kopavogur, Seltjarnarnes, Gardabaer, Alftanes, and Mosfellsbaer) was around 178,000 in the year 2001 (Hagstofa Íslands [Statistics Iceland], [s.a.a]) and the total population of Iceland was approximately 280,000 (Hagstofa Íslands [Statistics Iceland], [s.a.a]). The catchment area for these two EDs was thus overlapping, however, without exact geographical or administrative boundaries. In addition having a different clientele and a different assignment, these two EDs also differed in size measured in terms of numbers of attending patients. The A&ED at the Reykjavik Hospital had about 49,000 visits in 2001 (Landspitali - háskólasjúkrahús, 2002) which means that the A&ED had around 300,000 visits during the inclusion period, while the ED at Landspitali University Hospital (LUH), Hringbraut, had about 45,000 visits during same time period (see below).

At the LUH and other nearby hospitals, there were EDs for psychiatry, paediatrics, gynaecology and obstetrics. In addition to these services, the primary health care system was accessible 24 hours a day, and specialists in out-of-hospital practices offered service during the daytime.

3.2 Source of data

Initially, it was intended to study the two EDs in Reykjavik, but unfortunately, registered data including diagnoses was only available from the ED at Hringbraut LUH. Thus the study was confirmed to that department.

These are register-based studies and the primary source of data was computer records of all new attendances for patients 18 years and older, discharged home from the ED over the period 1995 to 2001. This database includes information on gender, age, admission date and time, the main discharge diagnosis and personal identification number. All residents of Iceland are included in the National Registry under a unique personal identification number issued at birth or when a person gains Icelandic nationality (a ten-digit number which includes the day, month and year of birth). Each visit to the ED is filed under the patient's personal identification number, enabling automatic and accurate record linkages.

The main discharge diagnoses during the two first years of the study period (1995 and 1996) were classified according to the International Classification of Diseases, 9th revision (ICD 9) (WHO, 1977) and during the rest of the period according to the International Classification of Diseases, 10th

revisions (ICD 10) (WHO, 2011a). The diagnoses were all standardized to ICD 10, and according to the European shortlist (Hagstofa Íslands [Statistics Iceland], [s.a.b]).

All diagnoses used in these studies are main diagnoses registered according to ICD 10; however, patients could also have received other diagnoses at the ED that were not in the computer files (WHO, 2004). The registered main diagnosis at discharge is considered to reflect the medical conclusion relating to the patient's complaints on the occasion of the specific visit. The physician draws his conclusion on the grounds of patient symptoms, signs, diagnostic tests and investigation.

3.3 Record linkages

The first record linkage was based on personal identification numbers and permitted a count of the total number of discharged visits, number of visits per user and per calendar year during the seven-year inclusion period of 1995 to 2001 (I, II, III, IV, V). Subsequently, the users were categorised into groups, corresponding to the highest number of visits in any single calendar year (I, III).

The second record linkage was with the National Registry and was based on personal identification numbers. The purpose was to identify patients who had migrated from Iceland during the follow-up period, 1995 and through 2002, along with those who had no personal identification number or had dummy numbers (since they were not residents of Iceland). In total, there were 1,037 patients excluded from the follow-up, as it was not possible to ascertain their vital status on the basis of the National Registry. In this seven-year period, 19,259 individuals who had Icelandic personal identification numbers were discharged from the ED.

The third record linkage based on personal identification numbers was with the National Cause-of-Death Registry. Information obtained was on the day of death, cause of death and in which cases an autopsy had been performed. Both the National Registry and the National Cause-of-Death Registry were maintained at Statistics Iceland. The National Cause-of-Death Registry records the causes of death according to death certificates, according to ICD 9 and ICD 10, which were subsequently standardised to ICD 10 (WHO, 2011a).

All death certificates in Iceland are issued by a physician, and if the deceased person's physician refuses to sign the death certificate because he or she is unable to state the cause of death or due to the circumstances of the death (unexplained, unusual, suspicious, due to intoxication, or following an accident), the death is reported to the police and the medical examiner, who takes care of autopsy and forensic investigations, after which the death certificate is issued (Lög um dánarvottorð, 1998). No cremation or burial can take place unless the death certificate is in the hands of lawful authorities (Lög um dánarvottorð, 1998).

3.4 Descriptive parts of the studies (I, II)

The annual number of visits to the ED in the inclusion period 1995 to 2001 was divided into those admitted to the hospital ward and those discharged home (II) and according to gender (I). The main discharge diagnoses were standardized to ICD 10 (WHO, 2011a) and according to the European shortlist (Hagstofa Íslands [Statistics Iceland], [s.a.b]). The diagnoses were divided according to year and gender (II). The patients visiting the ED were categorized according to number of visits per calendar year (I).

The annual increase in ED visits of discharged users in the inclusion period was analyzed in relation to the population of the Reykjavik capital area, in three age groups (I).

3.5 Follow-up studies (I, III, V)

The mortality of ED users was compared with the mortality of Iceland's general population (I). The mortality of individuals with discharge diagnoses in the categories symptoms, signs, abnormal clinical and laboratory findings, not elsewhere classified (R00-R99), mental and behavioural disorders (F00-F99), and those in the categories of causative physical discharge diagnoses were also compared with the mortality of the Icelandic general population (III).

The follow-up on mortality started on the date of each patient's discharge home after their first visit to the ED and ended on the date of death or on December the 31, 2002, whichever occurred first (I, III).

In the first follow-up study, internal comparison on mortality according to numbers of visits to the ED during a calendar year was performed for all causes of death and for selected causes of death (I). Users were categorized into groups according to numbers of visits. Users switched to a higher category group by visiting two, three or more times during a calendar year. Risk time was computed in more than one category (I).

In the second follow-up study on mortality, patients were classified in three groups according to their diagnoses at discharge, and how often they visited the ED during a calendar year (III). In the first group were individuals that at any given time received diagnoses in the category symptoms, signs, abnormal clinical and laboratory findings, not elsewhere classified (R00-R99) according to ICD 10. In these studies, this is referred to as non-causative diagnoses (III). Non-causative diagnoses means that the responsible physician was not conclusive on the condition of the ED user. Mental illnesses are known to be related to poor prognosis. The individuals with discharge diagnoses in the category of mental and behavioural disorders (F00-F99) were treated separately in a second group. This group includes patients with the diagnosis of mental and behavioural disorders due to use of alcohol (F10). They were treated as an additional separate subcategory in this study, referred to as alcohol abuse (III). Finally, the third group consisted of the remaining diagnoses (causative physical diagnoses), which served as a comparison group (A00-E99, G00-Q99, S00-Z99) (III).

The third follow-up study concerned death within a short time and the follow-up started on the date of each patient's discharge home after their visits to the ED, and ended on the date of death or on the 30^{th} day after discharge, whichever occurred first. Individuals who made multiple visits to the ED were followed up after each visit. The risk period was computed several times for some users. The follow-up period was divided into 8, 15 and 30 days after discharge home from the ED (V).

3.6 Case control studies (IV)

Case control studies nested in the cohort were carried out among those discharged home from the ED. The risk of suicide and the risk of fatal drug poisoning were explored. The cases were identified from the National Causes-of-Death Registry. In the first case control study, the risk of suicide was studied. The cases consisted of 41 patients and their causes of death pertained to two ICD categories, the category suicide (X60 to X84), 29 deaths, and the category injury undermined how inflicted (Y10 to Y34), 12 deaths, herein referred to as suicide.

In the latter case control study, the risk of fatal drug poisoning was studied. The cases consisted of persons with causes of death due to accidental intoxication by drugs (X40 to X45), a total of 21 deaths, herein referred to as fatal drug poisoning. This procedure ensures that all people who died from suicide and fatal drug poisoning in the cohort are included as cases in the studies (IV).

Five times as many controls as cases were selected at random from the cohort. The unique risk set was defined for every single case. The controls had to have a visit to the ED before the case´s date of death and had to be alive when the case died. The control selection was done according to description by Rothman (Rothman, 2008) (IV).

Exposure in the case control studies was defined as the diagnoses at discharge and five groups were selected a priori:

1) Mental disorders, (F00 to F99, except F10 to F19)

2) Use of alcohol, contained the categories:

Mental and behavioural disorders due to use of alcohol F10 and toxic effect of alcohol T51

3) Drug intoxication, contained the categories:

Mental and behavioural disorders due to psychoactive substance use (F11 to F19)

Poisoning by drug, medicaments and biological substances (T36 to T50)

Accidental poisoning by and exposure to drugs (X40 to X44)

Intentional self-poisoning by and exposure to drugs (X61 to X63)

4) Non-causative diagnoses, (R00 to R99)

5) Factors influencing health status, (Z00 to Z99) (IV)

According to ICD-10, the category factors influencing health status and contact with health services (Z00-Z99), herein called factors influencing health status, is "provided for occasions when circumstances other than disease, injury or external cause classifiable to categories A00 – Y89 are recorded as 'diagnoses' or 'problems'" (WHO, 2011a). Initially, an analysis was performed to evaluate the number of visits to the ED adjusted for age and gender. In different separate analyses, the other exposure categories were each treated as dichotomous variables and the number of visits to the ED omitted, as the exposure categories are partly overlapping the number of visits (IV).

3.7 Statistical methods

The annual number of ED visits was divided both by gender and three age groupings: 18 to 49, 50 to 69 and 70 and older. To evaluate the increase in visits throughout the period of 1995 to 2001, visits per year were related to the annual population of the Reykjavik capital area (Hagstofa Íslands [Statistics Iceland], [s.a.a]). Poisson regression model was used and 95% confidence interval (CI) (Dixon, 1990) was computed (I).

The percentages in each diagnostic category per year were calculated and the changes during the inclusion period analyzed by calculating the chi-square for linear trend (Mantel extension) using Epi-Info statistical software (Centers for Disease Control and Prevention, 2011). All P-values were two-tailed and considered statistically significant at P-value less than 0.05 (II).

The comparison of the ED users' mortality with the general population of Iceland was based on the five-year age- and gender-specific death rates of the population for 1996 to 2000, using conventional methods of calculating standardized mortality ratio (SMR), (observed variables were divided by expected variables) and 95% CI (Breslow & Day, 1987) (I, III).

After categorizing users according to number of visits per calendar year, the hazard ratio (HR) and 95% CI were computed by Cox modelling, for all causes of death and for selected causes of death in a time-dependent analysis using multivariate regression and BMDP software (Dixon, 1990), whereby gender was introduced as a dichotomous variable, age as a continuous variable in years, and the highest number of visits within a calendar year as an ordinal variable (I).

The HR and 95% CI were computed for all causes of death and for selected causes of death according to discharged diagnoses groups, in a time-dependent analysis using multivariate regression and BMDP software (Dixon, 1990), whereby gender was introduced as a dichotomous variable and age as a continuous variable in years. The three diagnostic groups, non-causative diagnoses, mental and behavioural disorders, and alcohol abuse, were compared in separate analyses with the comparison group (the categories of causative physical diagnoses), and in a still separate analysis,

adjustment was made for the highest number of visits within a calendar year, treated as an ordinal variable (III).

Deaths within a short time among individuals with a non-causative diagnosis were compared with deaths among those with all other diagnoses. HR and 95% CI were computed for all causes of death in a time-dependent analysis using BMDP software (Dixon, 1990).

Gender was introduced as a dichotomous variable and age as a continuous variable in years (V).

The multivariate case control analysis was performed using a logistic regression analysis (Breslow & Day, 1980). The adjusted odds ratio (OR) and exact computation of 95% CI were calculated using the SPIDA software package (Gebski et al., 1992).

In both case control studies, the case control status was the dependent variable. Age was treated as a continuous variable expressed in years, and gender as a dichotomous variable. The number of visits to the ED was treated as a continuous variable. Initially an analysis was performed to evaluate the number of visits to the ED adjusted for age and gender. Whether or not an individual ever had the particular exposure diagnosis was treated as a dichotomous variable in separate analyses. (IV).

4 Results

4.1 The annual number of discharged users and pattern of diagnoses (I, II)

In the period 1995 to 2001, the total number of visits to the ED was 45,242. Of those, 15,021 visits concluded in hospitalization and 30,221 visits resulted in discharge home from the ED (II). The number of individuals discharged home was 19,259, of which 10,232 were women and 9,027 were men (I).

Total visits increased during the period from 5,302 visits in the year 1995 to 7,725 in the year 2001.

The proportion of visits that ended in discharge in a calendar year showed an increase throughout the inclusion period. In 1995, the proportion was 54.5% but in 2001, the proportion was 72.5% (Table 1) (II).

Table 1 Total number of visits to the ED, number of hospital admission and number of discharged home during the period 1995 to 2001 (II), from the ED at LUH, Reykjavik

Year	Total number of visits N	Admitted N (%)	Discharged N (%)
1995	5302	2414 (45.5)	2888 (54.5)
1996	6067	2294 (37.9)	3773 (62.2)
1997	6003	2318 (38.6)	3685 (61.4)
1998	6315	2194 (34.7)	4121 (65.3)
1999	6753	1915 (28.4)	4838 (71.6)
2000	7077	1765 (24.9)	5312 (75.1)
2001	7725	2121 (27.5)	5604 (72.5)
Total	45242	15021	30221

The proportion of men and women was similar throughout the period 1995 to 2001, women making more visits than men (Table 2).

Table 2 Total number of discharged visits per year, according to gender during the period 1995 to 2001, from the ED at LUH, Reykjavik

Year	Total number of visits N	Men (%)	Women (%)
1995	2888	1365 (47.3)	1523 (52.7)
1996	3773	1747 (46.3)	2026 (53.7)
1997	3685	1710 (46.4)	1975 (53.6)
1998	4121	1997 (48.5)	2124 (51.5)
1999	4838	2297 (47.5)	2541 (52.5)
2000	5312	2552 (48.0)	2760 (52.0)
2001	5604	2752 (49.1)	2852 (50.9)
Total	30221	14,420 (47.7)	15801 (52.3)

The proportion of gender according to age groups is shown in Table 3.

Table 3 Total number of discharged visits, according to age and gender during the period 1995 to 2001, from the ED at LUH, Reykjavik

Age	Total number of visits N	Men (%)	Women (%)
18 - 24	3686	1552 (42.1)	2134 (57.9)
25 – 34	4301	2057 (47.8)	2244 (52.2)
35 - 44	4585	2139 (46.7)	2446 (53.3)
45 - 54	4318	2228 (51.6)	2090 (48.8)
55 - 64	3940	1937 (49.2)	2003 (50.8)
65 - 74	4542	2371 (52.2)	2171 (47.8)
75 - 84	3561	1618 (45.4)	1943 (54.6)
85^{+}	1288	518 (40.2)	770 (59.8)
Total	30221	14420 (47.7)	15801 (52.3)

Of the total number of discharged users of the ED, 84% made one visit in a calendar year, 11.5% made two visits per calendar year, 2.7% made three visits per calendar year and 1.5% made four or more visits per calendar year (I).

Table 4. shows the annual increase in ED visits of patients discharged home from the ED during the inclusion period, in relation to the annual population of the Reykjavik capital area, in three age groups. The annual increase was 7.6% among the youngest women and 8.5% among women aged 70 and older. The increase was 6.7% among the youngest men and 14.1% among men aged 70 and older (I).

Table 4 Proportional increase per year in ED visits of patients discharged home during the inclusion period of 1995 to 2001, in relation to the population of the Reykjavik capital area, in three age groups (I), from the ED at LUH, Reykjavik

	Men		Women	
Age (years)	Increase (%)	95% CI	Increase (%)	95% CI
18 to 49	6.7	5.4 to 8.0	7.6	7.3 to 7.9
50 to 69	9.3	7.5 to 10.9	7.2	5.5 to 8.9
70 and older	14.1	12.0 to 16.0	8.5	6.7 to 10.3

4.2 The most frequent discharged diagnoses (II)

The most frequent discharged diagnoses were in the category non-causative diagnoses (R00-R99). This category accounts for 20.5% on average of all visits for both genders during the inclusion period. In 1995, the proportion of non-causative diagnoses was 17.2% for men and 18.6% for women, but in 2001, the proportion was 23.9 for both genders (Tables 5 and 6) (II).

Table 5 Number of men and percentages in each diagnosis category discharged from the ED by calendar year, classified according to the main categories on the European shortlist, showing changing trends during the study period 1995 to 2001 and P-values (II), from the ED at LUH, Reykjavik

Categories of the European shortlist (No)	Years															
	1995	%	1996	%	1997	%	1998	%	1999	%	2000	%	2001	%	Trend[b]	P-value[c]
Infectious and parasitic diseases (1)	74	5.4	95	5.4	68	4.0	86	4.3	103	4.5	97	3.8	65	2.4	D	<0.0001
Neoplasms (6)	17	1.3	22	1.3	16	0.9	26	1.3	34	1.5	40	1.6	53	1.9	I	0.001
Diseases of the blood and blood-forming organs, immunological disorders (25)	19	1.4	23	1.3	23	1.4	28	1.4	18	0.8	15	0.6	20	0.7	D	0.0005
Endocrine, nutritional and metabolic diseases (26)	25	1.8	33	1.9	24	1.4	31	1.6	20	0.9	22	0.9	33	1.2	D	0.001
Mental and behavioural disorders (28)	75	5.5	90	5.2	73	4.3	91	4.6	105	4.6	110	4.3	123	4.5	N	0.1
Diseases of the nervous system and sense organs (31)	76	5.6	79	4.5	94	5.5	103	5.2	125	5.4	127	5.0	136	4.9	N	0.7
Diseases of the circulatory system (33)	234	17.1	286	16.4	273	16.0	331	16.6	337	14.7	440	17.2	454	16.5	N	0.9
Diseases of the respiratory diseases (37)	84	6.5	108	6.8	89	5.2	135	6.8	138	6.0	125	4.9	114	4.1	D	0.001
Diseases of the digestive system (42)	106	14.5	117	6.7	155	9.1	159	8.0	170	7.4	178	7.0	174	6.3	D	0.04
Diseases of the skin and subcutaneous tissues (45)	50	3.7	78	4.5	60	3.5	80	4.0	77	3.4	75	2.9	87	3.2	D	0.02
Diseases of the musculoskeletal system/ connective tissue (46)	115	8.4	149	8.5	169	9.9	190	9.5	246	10.7	216	8.5	213	7.7	N	0.3
Diseases of the genitourinary system (48)	93	6.8	135	7.7	132	7.7	139	7.0	205	8.9	235	9.2	298	10.8	I	<0.0001
Complication of pregnancy, childbirth and puerperium (50)	1	0.1	0	0	0	0	0	0	1	0.0	0	0	0	0	N	NA
Certain conditions originating in the perinatal period (51)	0	0	0	0	0	0	0	0	0	0	2	0.1	0	0	N	NA
Congenital malformation and chromosomal abnormalities (52)	2	0.2	2	0.1	1	0.1	4	0.2	4	0.2	2	0.1	2	0.1	N	NA
Symptoms, signs, abnormal findings, and ill-defined causes (55)	235	17.2	310	17.7	340	19.9	363	18.2	447	19.5	536	21.0	658	23.9	I	<0.0001
External causes of injury and poisoning (58)	104	7.6	125	7.2	138	8.1	173	8.7	194	8.5	227	8.9	170	6.2	N	0.5
Factors influencing health status and contact with the health services[a]	55	4.0	95	5.4	55	3.2	58	2.9	73	3.2	105	4.1	152	5.5	N	0.1
All causes	1365	100	1747	100	1710	100	1997	100	2297	100	2552	100	2752	100		

a Chapter XXI in ICD-10, not a separate category on the European shortlist

b Change through the study period, I = increased, D = decreased, N = non significant change

c P-value for linear trend, NA = not applicable

Table 6 Number of women and percentages in each diagnosis category discharged from the ED by calendar year, classified according to the main categories on the European shortlist, showing changing trends during the study period 1995 to 2001 and P-values (II), from the ED at LUH, Reykjavik

Main categories of the European shortlist (No)	Years															
	1995	%	1996	%	1997	%	1998	%	1999	%	2000	%	2001	%	Trend[b]	P-value[c]
Infectious and parasitic diseases (1)	80	5.3	118	5.8	72	3.7	85	4.0	105	4.1	110	4.0	108	3.8	D	<0.0001
Neoplasms (6)	12	0.8	26	1.3	10	0.5	24	1.1	32	1.3	34	1.2	42	1.5	I	0.001
Diseases of the blood and blood-forming organs, immunological disorders (25)	8	0.5	21	1.0	13	0.7	18	0.9	20	0.8	14	0.5	13	0.5	D	0.0005
Endocrine, nutritional and metabolic diseases (26)	28	1.8	22	1.1	37	1.9	23	1.1	37	1.5	35	1.3	47	1.7	D	0.001
Mental and behavioural disorders (28)	76	5.0	79	3.9	98	5.0	77	3.6	97	3.8	121	4.4	109	3.8	N	0.1
Diseases of the nervous system and sense organs (31)	88	5.8	109	5.4	137	6.9	122	5.7	166	6.5	174	6.3	158	5.5	N	0.7
Diseases of the circulatory system (33)	224	14.7	246	12.1	273	13.8	266	12.5	274	10.8	313	11.3	364	12.8	N	0.9
Diseases of the respiratory diseases (37)	103	6.8	172	8.5	110	5.6	158	7.4	212	8.3	158	5.7	164	5.8	D	0.001
Diseases of the digestive system (42)	106	7.0	139	6.9	151	7.7	194	9.1	212	8.3	229	8.3	201	7.1	D	0.04
Diseases of the skin and subcutaneous tissues (45)	55	3.6	66	3.3	59	3.0	75	3.5	82	3.2	86	3.1	88	3.1	D	0.02
Diseases of the musculoskeletal system/ connective tissue (46)	164	10.8	245	12.1	229	11.6	234	11.0	300	11.8	297	10.8	230	8.1	N	0.3
Diseases of the genitourinary system (48)	84	5.5	151	7.5	132	6.7	169	8.0	184	7.2	162	5.9	239	8.4	I	<0.0001
Complication of pregnancy, childbirth and puerperium (50)	1	0.1	5	0.3	3	0.2	2	0.1	2	0.1	1	0.0	0	0	N	NA
Certain conditions originating in the perinatal period (51)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	NA
Congenital malformation and chromosomal abnormalities (52)	4	0.3	5	0.3	2	0.1	3	0.1	1	0.0	0	0	6	0.2	N	NA
Symptoms, signs, abnormal findings, and ill-defined causes (55)	284	18.6	406	20.0	391	19.8	391	18.4	508	20.0	635	23.0	682	23.9	I	<0.0001
External causes of injury and poisoning (58)	126	8.3	129	6.4	175	8.9	209	9.8	233	9.2	273	9.9	241	8.5	N	0.5
Factors influencing health status and contact with the health services[a]	80	5.3	87	4.3	83	4.2	74	3.5	76	3.0	118	4.3	160	5.6	N	0.1
All causes	1523	100	2026	100	1975	100	2124	100	2541	100	2760	100	2852	100		

a Chapter XXI in ICD-10, not a separate category on the European shortlist

b Change through the study period, I = increased, D = decreased, N = non significant change

c P-value for linear trend, NA = not applicable

Non-causative diagnoses increased through the inclusion period. Other categories that increased were neoplasms (C00-C97) and diseases of the genitourinary system (N00-N99) for both men and women.

The second most frequent diagnosis category at discharge was diseases of the circulatory system (I00-I99), which accounted for 16.3% on average for men and 12.4% for women. The third most frequent diagnosis category was diseases of the musculoskeletal system and connective tissue (M00-M99), 9.0% on average for men and 10.8% for women (Tables 5 and 6) (II).

The average proportion of the diagnoses mental and behavioural disorders (F00-F99) was 4.6% among men and 4.1% among women. The average proportion of the diagnosis external causes (V01-Y98) was 7.8% among men and 8.7% among women respectively.

The diagnosis factors influencing health status (Z00-Z99), accounted for 4.2% of diagnoses over the period for both genders (II).

4.3 Mortality compared to the general population (I, III)

Altogether 2,105 individuals died in the follow-up period 1995 to 2002. The most common causes of death among ED discharged users were in the following categories: 1) malignant neoplasm with 32.2%, 2) ischemic heart disease with 21.2%, 3) cerebrovascular disease with 9.9%, 4) chronic lower respiratory disease with 4.9%. These categories accounted for nearly 70% of all causes of death. By adding the external causes (V01-Y98), altogether 5.2%, these categories accounted for over 73% of the total number of deaths (I).

Information on causes of death according to death certificates was obtained for everyone. The SMR and 95% CI for men were 1.81 (1.71 to 1.92) and 1.93 (1.81 to 2.05) for women, or nearly twice as high as for the general population. The SMR was highest for the middle-aged (30 to 64 years) and decreased towards the highest ages (I).

The SMR and 95% CI were calculated according to discharge diagnoses of ED users. Among those with non-causative diagnoses (R00-R99), the SMR was 1.57 (95% CI, 1.39 to 1.77) in men and 1.83 (95% CI, 1.61 to 2.08) in women. Among those with diagnoses under mental and behavioural disorders (F00-F99), the SMR was 3.72 (95% CI, 2.72 to 4.98) for men and 2.45 (95% CI, 1.76 to 3.36) for women. The SMR for those with the remaining discharge diagnoses was higher than for the general population, or 1.97 (95% CI, 1.83 to 2.11) for men and 2.04 (95% CI, 1.90 to 2.19) for women (III).

4.4 Mortality and increased numbers of discharged visits (I)

The adjusted HR and 95% CI were determined for all causes of death and selected causes of death and the patient´s number of visits to the ED in any single calendar year, adjusted for age and gender. The results show that HR was higher for men than for women in the categories of all causes of death, malignant neoplasm (C00-C97), ischemic heart diseases (I20-I25), external causes (V01-Y98) and suicide (X60-X84, Y10-Y34) (Table 7) (I).

Furthermore, the HR increased along with increasing numbers of visits for the categories of all causes of death. The HR for all causes of death was 1.4 for 2 visits and 1.7 for 3 or more visits. Moreover, the same trend emerged for the categories malignant neoplasm, ischemic heart diseases, external causes, including the subgroups, accidental intoxication and suicide and chronic lower respiratory diseases, but the results were non-significant for chronic lower respiratory diseases. The HR for cerebrovascular diseases decreased with increasing numbers of visits to the ED, albeit non-significantly (Table 7) (I).

Table 7 Adjusted HR from multivariate regression and 95% CI for all causes of death and selected categories of death (ICD-10 in parentheses), according to gender, age (in years), and the patient's highest number of visits in any single calendar year (I), from the ED at LUH, Reykjavik

	All causes of death (A00-Y89)			Malignant neoplasms (C00-C97)			Ischemic heart diseases (I20-I25)			Cerebrovascular diseases (I60-I69)		
	n	HR	95% CI	n	HR	95% CI	n	HR	95% CI	n	HR	95% CI
Men	1088	1.0	Reference	366	1.0	Reference	265	1.0	Reference	82	1.0	Reference
Women	1017	0.7	0.6 to 0.8	312	0.7	0.6 to 0.8	181	0.5	0.4 to 0.6	126	1.0	0.8 to 1.3
Age (years)		1.1	1.1 to 1.1		1.1	1.1 to 1.1		1.1	1.1 to 1.1		1.1	1.1 to 1.1
1 visit	1672	1.0	Reference	541	1.0	Reference	350	1.0	Reference	181	1.0	Reference
2 visits	320	1.4	1.2 to 1.5	101	1.4	1.1 to 1.7	74	1.4	1.1 to 1.9	24	0.9	0.6 to 1.4
3 or more visits	113	1.7	1.4 to 2.0	36	1.8	1.3 to 2.5	22	1.5	1.0 to 2.3	3	0.4	0.1 to 1.3

Continue

	Chronic lower respiratory diseases (J40-J47)			External causes of injury and poisoning (V01-Y89)			Accidental intoxication by drugs and chemicals. (X40-X49)			Suicide and injury undetermined how inflicted. (X60-X84, Y10-Y34)		
	n	HR	95% CI	n	HR	95% CI	n	HR	95% CI	n	HR	95% CI
Men	44	1.0	Reference	70	1.0	Reference	11	1.0	Reference	25	1.0	Reference
Women	60	1.0	0.7 to 1.4	39	0.5	0.4 to 0.7	10	0.8	0.3 to 1.9	16	0.6	0.3 to 1.0
Age (years)		1.1	1.1 to 1.1		1.0	1.0 to 1.0		1.0	1.0 to 1.0		1.0	1.0 to 1.0
1 visit	80	1.0	Reference	77	1.0	Reference	9	1.0	Reference	26	1.0	Reference
2 visits	18	1.5	0.9 to 2.6	19	2.0	1.2 to 3.3	7	6.4	2.4 to 17.2	8	2.6	1.2 to 5.7
3 or more visits	6	1.7	0.7 to 4.0	13	3.9	2.1 to 7.0	5	12.8	4.3 to 38.6	7	6.3	2.7 to 14.6

The category external causes of injury and poisoning (V01-Y98) is a heterogeneous one that includes traffic and falling accidents, any type of poisoning, and suicides and homicides. The HR for this category was 2.0 for 2 visits and 3.9 for 3 or more visits.

In the subcategory of accidental poisoning (X40 to X49), 21 deaths were registered and drugs were involved in all except two of these deaths. There were two alcohol intoxications in the category but no industrial intoxication. The HR in this category increased from 6.4 for 2 visits to 12.8 for 3 or more visits in a calendar year. The category of suicides comprised 29 cases of suicide and 12 cases in which it remained undetermined whether injury was accidental or purposely inflicted. This category had the HR of 2.6 for 2 visits and 6.3 for 3 or more visits (I).

4.5 Mortality and selected discharge diagnoses (III)

The HR and 95% CI for all causes of death and selected causes of death among those discharged with non-causative diagnoses are shown in Table 8.

Table 8 Number of deaths, HR, and 95% CI for all causes of death and for selected causes of death of patients discharged with non-causative diagnoses (R00-R99) (n=5.032), in the year relative to those with causative physical diagnoses, adjusted for age and gender (III), from the ED at LUH, Reykjavik

Causes of death (ICD10)	No of deaths	Hazard ratio	95% CI
All causes	517	0.84	0.76 to 0.93
Malignant neoplasms (C00-C99)	159	0.77	0.64 to 0.92
Disease of the circulatory system (I00-I99)	209	0.84	0.72 to 0.98
Mental and behavioral disorders (F00-F99)	24	1.80	1.06 to 3.05
Injury, poisoning and external causes (V01-Y89)	34	1.64	1.07 to 2.52
Accidental poisoning (X40-X49)	6	1.51	0.56 to 4.08
Suicide and injury undetermined how inflicted (X60-X84, Y10-Y34)	13	2.08	1.02 to 4.24

ICD10 = International Classification of Diseases, 10th Revision

Compared to patients with a causative physical diagnosis, those with non-causative diagnoses had lower mortality due to: all causes of death, malignant neoplasms, and disease of the circulatory system. On the other hand, mortality due to mental and behavioural disorders, external causes and its subgroups was higher. The HR was 1.51 (95% CI, 0.56 – 4.08) for accidental poisoning and 2.08 (95% CI, 1.02 – 4.24) for suicide. When adjusted for the numbers of visits per calendar year, the HR were similar (III).

The HR and 95% CI were computed for all causes of death and selected causes of death among those discharged with the diagnoses mental and behavioural disorders. Compared to those with a causative physical diagnosis, this group had lower mortality due to malignant neoplasms, but higher mortality due to all causes, mental and behavioural disorders, external causes and its subgroups. When adjusted for the number of visits per calendar year, the HRs were similar (III).

The HR and 95% CI for all causes of death and selected causes among those discharged with alcohol diagnoses (F10) were computed. Compared to those with a causative physical diagnosis, this group had higher mortality due to all causes of death, mental and behavioural disorders, external causes and its subgroups. There were no deaths due to malignant neoplasm in this group. The HR for external causes and its subgroups were especially high and did not change substantially when adjustment was made for the number of visits per calendar year (III).

4.6 Risk factors of suicide and fatal drug poisonings (IV)

Altogether, there were 41 suicide cases (25 men) over the study period 1995 to 2002. The most common diagnoses were exposure to drugs (n = 15, 36.6%), followed by hanging, strangulation and suffocation (n = 9, 22.0%), intoxication due to other gases and vapours (n = 6, 14.6%), injury from firearms (n = 3, 7.3%), unspecified event (n = 3, 7.3%), drowning (n = 2, 4.9%), one case of intoxication by unspecified chemical, and one each of jumping from high place and injury by sharp object.

Cases of fatal drug poisonings were 21 (11 men), of which two were due to alcohol, but all others due to drugs. It was not possible to differentiate between prescription medications and illegal drug use. There were no cases of industrial intoxication in this cohort (IV).

Table 9. shows the adjusted OR and 95% CI for suicide according to age, gender, mental disorders, use of alcohol, drug intoxication, non-causative diagnoses and factors influencing health status. The ORs were high for all the diagnoses and significant for mental disorders, use of alcohol, drug intoxication, and non-causative diagnoses (Table 9).

Table 9 Adjusted OR and 95% CI from logistic regression among cases of suicides and controls according to age, gender, main discharge diagnosis attributable to mental disorders, use of alcohol, drug intoxications, non-causative diagnoses, and factors influencing health status and contact with health services (IV), from the ED at LUH, Reykjavik

	Cases n = 41	Controls n = 205	Odds ratio[a]	95% CI
Age (years)			0.98	0.96 to 1.01
Male	25	101	0.35	0.14 to 0.90
Female	16	104	1	Reference
Mental disorders[b]	5	6	7.84	1.66 to 37.06
Never Mental disorders	36	199	1	Reference
Use of alcohol[c]	10	1	96.89	11.14 to 843
Never Use of alcohol	31	204	1	Reference
Drug intoxications[d]	10	5	24.51	6.11 to 98.25
Never Drug intoxications	31	200	1	Reference
Non-causative diagnosis	13	45	2.69	1.04 to 6.95
Never Non-causative diagnosis	28	160	1	Reference
Factors influencing health status	5	16	2.63	0.61 to 11.46
Never Factors influencing health status	36	189	1	Reference

[a] Data have been calculated in unique multivariate analysis, taking into account simultaneously all the variables
[b] Excludes Use of alcohol and Drug intoxication
[c] The subcategories F10 and T51
[d] The subcategories F11 to F19, T36 to T50, X40 to X44, X61 to X63

Table 10. shows adjusted OR for fatal drug poisonings according to age, gender, mental disorders, use of alcohol, drug intoxication, non-causative diagnoses and factors influencing health status. The ORs were high and significant for use of alcohol, drug intoxication, and factors influencing health status (IV).

Further analysis showed that the number of visits to the ED was associated with suicide and fatal drug poisonings in a statistically significant way (IV).

Table 10 Adjusted OR and 95% CI from logistic regression among cases of fatal drug intoxications and controls according to age, gender, main discharge diagnosis attributable to mental disorders, use of alcohol, drug intoxications, non-causative diagnoses, and factors influencing health status and contact with health services (IV), from the ED at LUH, Reykjavik

	Cases n = 21	Controls n = 105	Odds ratio[a]	95% CI
Age (years)			1.00	0.97 to 1.03
Male	11	59	1.17	0.37 to 3.73
Female	10	46	1	Reference
Mental disorders[b]	1	5	2.21	0.22 to 21.81
Never Mental disorders	20	100	1	Reference
Use of alcohol[c]	5	3	12.26	2.10 to 71.76
Never Use of alcohol	16	102	1	Reference
Drug intoxicationsd[d]	6	1	37.22	3.57 to 388.29
Never Drug intoxications	15	104	1	Reference
Non-causative diagnosis	6	30	1.00	0.29 to 3.47
Never Non-causative diagnosis	15	75	1	Reference
Factors influencing health status	4	6	5.76	1.23 to 26.95
Never Factors influencing health status	17	99	1	Reference

[a] Data have been calculated in unique multivariate analysis, taking into account simultaneously all the variables
[b] Excludes Use of alcohol and Drug intoxication
[c] The subcategories F10 and T51
[d] The subcategories F11 to F19, T36 to T50, X40 to X44, X61 to X63

4.7 The association of non-causative discharge diagnoses and death within eight days (V)

The results from the multivariate analysis show that increase in age was significantly associated with death in all three time intervals (Table 11) (V).

In all time intervals, the HR was lower for women compared with men, or approximately 0.7, however only significantly lower than unity in the analysis of death within 30 days. The HR was lower for patients with a non-causative diagnosis at discharge compared to those with other diagnoses in all three time intervals and the 95% CI did not include unity.

Table 11 Number of deaths, HR, and 95% CI for all causes of death within 8 days, 15 days, and 30 days after discharge from the ED, according to non-causative discharge diagnoses, adjustments made in a multivariate analysis for gender and age (V), from the ED at LUH, Reykjavik

	Number of deaths	Hazard ratio[a]	95% CI
Death within 8 days	63		
Age (years)		1.06	1.05 to 1.08
Men	34	1	Reference
Women	29	0.73	0.45 to 1.20
Causative diagnosis	56	1	Reference
Non-causative diagnosis	7	0.44	0.20 to 0.96
Death within 15 days	104		
Age (years)		1.07	1.06 to 1.09
Men	57	1	Reference
Women	47	0.69	0.47 to 1.02
Causative diagnosis	90	1	Reference
Non-causative diagnosis	14	0.54	0.31 to 0.95
Death within 30 days	196		
Age (years)		1.07	1.06 to 1.08
Men	105	1	Reference
Women	91	0.73	0.55 to 0.97
Causative diagnosis	166	1	Reference
Non-causative diagnosis	30	0.60	0.41 to 0.89

[a] Data have been calculated in unique multivariate analysis, taking into account simultaneously all the variables in each time interval

5 Discussion

5.1 The annual number of discharged users (I, II)

The ED in the present studies (I, II, III, IV, V) is at Landspitali University Hospital, which offers tertiary level of care for the whole country and was intended to serve internal medicine patients and general surgery patients, with other patient categories being directed to other EDs.

Visits to the ED by users 18 years and older increased in the inclusion period, from 5,302 visits in 1995 to 7,725 visits in 2001 (I, II). An increase in the number visits to other EDs was also found in other studies (George et al., 2006, Nawar et al., 2007).

Gender proportion was similar among the users of the ED in the present study (I) and similar results were found in studies from Spain, the US and Canada (Li et al., 2007, Salazar et al., 2005, Nawar et al., 2007, Niska et al., 2010).

During the inclusion period, the annual increase of visits to the ED, in relation to the population of the Reykjavík capital area (I), was 7% or higher in every age group, 14% for men 70 years and older, and 9% for women in the same age group. These results are coherent with other studies, where increased age of the individuals was associated with an increase in the number of ED visits (Burt et al., 2007, Li et al., 2007, Nawar et al., 2007, Yim et al., 2009). The overall annual increase in visits to the ED (I) bears witness to the increased workload at the ED.

The proportion of users discharged home increased during the inclusion period, and was higher than 70% in 2001 (I, II), which was lower than in studies from the US and Barcelona, Spain (Cook et al., 2004, Kefer et al., 1994, McCaig & Burt, 2001, Nawar et al., 2007, Salazar et al., 2005). It is necessary to interpret these comparisons with caution, due to differences in the EDs, their users, the social structure of the communities, and financing of the health care systems. The high proportion of those discharged home could be an indication of the proportion of users who attended the ED (I, II) without a physician's referral, but no computerized records were available to indicate whether patients were referred to the ED (I).

5.2 Most frequent discharge diagnoses

The category non-causative diagnoses, (ICD 10, R00-R99) was the most frequent category, representing 20% of diagnoses, and it increased throughout the inclusion period, among men and women. A non-causative diagnosis may indicate that the responsible physician was not conclusive on the condition of the ED user and one may assume that these users were not suffering from acute diseases.

Mandelberg and co-workers determined diagnoses of patients discharged home from the ED in San Francisco General Hospital (SFGH) (Mandelberg et al., 2000). They applied a clustering system to group diagnoses into categories based on ICD 9. For the different clusters, the frequencies of all discharge diagnoses were shown in appendix, rather than the exact number in the different diagnostic categories. However, if diagnoses that would have fallen under the non-causative diagnoses are combined, the frequency of the discharge diagnoses is similar to the findings in the present study (II). However, the results of Mandelberg and co-workers are not directly comparable with the present results for several reasons (Mandelberg et al., 2000)(II): First, they used cluster diagnoses according to ICD 9. Secondly, the ED of SFGH served children and was the only level I trauma centre for the catchment area, whereas the ED in the present study (II) was not intended to treat injuries and poisonings and did not serve children. Thirdly, 12% of the patients attending the ED of SFGH were homeless; 33% were white and the rest were of different ethnic origins. In the present study,

practically no persons were homeless and all were white (Alþingi, 2004, NOMESCO, 2005). The proportion of non-causative diagnoses was similar in the report by Nawar and co-workers on visits to hospital EDs in the US (Nawar et al., 2007) and in a recent report, 18% of older patients discharged home from the ED had a non-causative diagnosis (Hastings et al., 2009).

In a research letter, Wogan has pointed out that 23% of patients admitted to a hospital ward from the ED had a non-causative diagnosis, but were admitted for further evaluation of symptoms and undefined causes (Wogan, 2001). He also emphasized that his survey only included hospitalized patients whose post-ED status was easily followed up, but that it did not cover those sent home after their ED attendance, indicating that some of these had no causative diagnoses, but that following up on them could benefit the patients and educate the physicians working at the ED (Wogan, 2001).

In the present study, the pattern of diagnoses other than non-causative diagnoses (II) was similar to the pattern in the study by Mandelberg and co-workers (Mandelberg et al., 2000), but different from the pattern found in a large survey of EDs in the US (Nawar et al., 2007), possibly because the latter included level-1 trauma centres in their survey.

5.3 Mortality compared to the general population (I, III)

The SMR was nearly twice as high among the ED users (I) and it increased for those with non-causative diagnoses (III). However, SMR was even higher for those with the diagnoses of mental and behavioural disorders (III) and it is well known that cohorts with various mental disorders have an increased risk of premature death (Harris & Barraclough, 1998), also found among individuals with schizophrenia in an Icelandic cohort (Helgason, 1990). According to studies from Sweden (Hansagi et al., 1990, Hansagi et al., 1985, Safwenberg et al., 2008), individuals attending EDs have increased SMR.

Causes of death due to malignant neoplasms, ischemic heart diseases, cerebrovascular disease, chronic lower respiratory diseases, external causes of injury and poisoning and including the three subgroups; accidental intoxication by drugs and chemicals, suicide and injury undetermined how inflicted accounted for 70% of the deaths in the studies (I).

5.4 Mortality and increased numbers of discharged visits (I)

The proportion of users with four or more annual visits to the ED (I) was lower in the present study than among users of EDs in London (Moore et al., 2009) and Stockholm (Hansagi et al., 2001), but neither of those studies made the distinction between patients who were hospitalized and those who were discharged.

Increasing numbers of visits to the ED predicted higher mortality and showed a common pattern for all causes of death and selected causes of death, except for causes of death due to cerebrovascular disease. (I). Frequent visits to an ED might actually reflect a serious underlying disease such as malignant neoplasm or atherosclerotic disorders (Hansagi et al., 1990). These arguments are sensible when mortality from chronic prevalent diseases is considered (I). Nonetheless, increased mortality due to external causes among those frequently attending the ED came as an unexpected result (I). Results from the present study (I) were coherent with a study from Sweden (Hansagi et al., 1990). The study by Hansagi and co-workers was based on a nine-year follow-up (Hansagi et al., 1990), which paralleled the present study (I) by finding a similar mortality pattern. The association between mortality due to injury and poisoning (Hansagi et al., 1990) and frequent visits to the ED underlines patient vulnerability (Hansagi et al., 1990), but the ED users in the present study (I) differ from the ED users in the Swedish study, as no distinctions were made between patients who were discharged home and those who were admitted to the hospital (Hansagi et al., 1990). In a later study on frequent ED users, Hansagi and co-workers found that these patients were also frequent users of other health care services (Hansagi et al., 2001).

5.5 Selected discharge diagnoses and internal comparison of mortality (III)

As non-causative diagnoses were the most frequent diagnoses in the ED (I), it was interesting to make internal comparisons between mortality of those with a non-causative diagnosis and those with a causative physical diagnosis (III). It is known from the literature that patients with mental illnesses and alcohol abuse have higher mortality than the general population (Harris & Barraclough, 1998, Helgason, 1990, Thorarinsson, 1979, Wilcox et al., 2004) and therefore they were excluded when evaluating the mortality among those with a non-causative diagnosis (III).

The study (III) showed decreased mortality due to all causes of death, malignant neoplasm, diseases of the circulatory system among those with a non-causative diagnosis compared to others. However, it revealed increased mortality due to mental and behavioural disorders, external causes and the subgroup suicide. The relationship between non-causative diagnoses and mortality from mental and behavioural disorders was not the hypothesis being tested; however this unexpected finding may indicate the vulnerability of those patients. Non-causative diagnoses at discharge home from the ED indicated a new risk factor for suicide (III) and the results might indicate that a physical manifestation and somatisation are often associated with depression and mental illness. Users with non-causative diagnoses might benefit from suicide prevention strategies. As expected, the separate analysis of patients with mental and behavioural disorders and alcohol abuse at discharge (III) showed increased mortality, mainly due to external causes and the subgroup suicide (III).

Health professionals at EDs should be careful when users have been discharged home from the ED more than once in a calendar year, especially those with diagnoses of mental and behavioural disorders, alcohol abuse or non-causative diagnoses (III).

5.6 Risk factors of suicide and fatal drug poisonings (IV)

In total, there were 41 suicide cases in the study (IV). One of them died within 8 days but altogether 6 died within 30 days (V). When studying the risk factors for suicide in the case control study (IV), the calculations showed a significant association of suicide with numbers of visits to the ED, the diagnoses of mental disorders, use of alcohol, drug intoxication, and non-causative diagnoses, adjusted for age and gender (IV).

There was a significant association between the 21 fatal drug poisonings and the number of visits to the ED, use of alcohol, drug intoxication and the category factors influencing health status, adjusted for age and gender (IV).

Studies on individuals attending EDs who later died of suicide showed that they have frequently been recorded with diagnoses of self-harm (Crandall et al., 2006, Gairin et al., 2003, Hickey et al., 2001) and potential suicidal risk (Crandall et al., 2006). Previous studies also indicated that some patients who took their own lives had also received an alcohol and drug use diagnosis (Crandall et al., 2006, Gairin et al., 2003); however the majority did not have the above-mentioned diagnoses in their records (Crandall et al., 2006, Gairin et al., 2003). Suicide rates among patients discharged from the ED who had attended the ED for suicide-related complaints were higher than for comparison groups in a prospective study from New Mexico (Crandall et al., 2006). However, the usefulness of these clinical characteristics for preventive purposes was considered limited, as the majority of ED users who later died of suicide had not been identified or were not on record as being at potential suicidal risk (Crandall et al., 2006). Results from a 16-year prospective cohort study from Nottingham on patients who attended the ED with non-fatal self-poisoning showed that this patient group had increased SMR for all causes of death and severely increased SMR for probable suicide (Karasouli et al., 2011).

About 40% of those who died by suicide had contacted the mental health service and the accident and emergency department (A&ED) within a year preceding their death and about 40% of them had attended because of self-harm (Da Cruz et al., 2011, Gairin et al., 2003). A few of these self-harm

patients appear to have been discharged home without being assessed by a psychiatrist (Gairin et al., 2003) and alcohol or other intoxicating drugs were mentioned as important factors. In a study of deliberate self-harm patients attending the A&ED of the general hospital in Oxford, UK, the results indicate that patients who did not receive a psychiatric assessment were at higher risk of further self-harm and of completed suicide than those who were assessed (Hickey et al., 2001). Studies on self-harming and self-poisoning patients in the UK show (Bennewith et al., 2005, Hawton et al., 2007, Kapur et al., 1998) that those who were not admitted to hospital wards were unlikely to receive psychosocial assessment. Results from a retrospective study on those who took their own lives indicated that reduced care of people with mental illness is associated with suicide (Appleby et al., 1999a). Gairin and co-workers concluded that suicide prevention may be enhanced if A&ED and mental health services were to intensify their collaboration (Gairin et al., 2003). In another retrospective study from Dallas, Texas (Claassen & Larkin, 2005), using a mental health screening panel on a sample of patients in an ED waiting room, the prevalence of suicidal ideation was 11.6% and 2% planned to take their own lives (Claassen & Larkin, 2005). A medical record review revealed that 25 of the 31 patients planning suicide were not detected during their actual visit and four of them attempted suicide within 45 days of the visit (Claassen & Larkin, 2005).

5.7 The association of non-causative discharge diagnoses and death within eight days (V)

When evaluating death within a short time after discharge (V), the calculations showed a significant association of non-causative diagnoses with decreased mortality in comparison to those with causative diagnoses, adjusted for gender and age. The hazard ratio was low and the 95% CI did not include unity in the analysis of death within 8 days, 15 days, and 30 days after discharge home from the ED (V).

There are few other studies dealing with death within a short time after discharge home from the ED (Baker & Clancy, 2006, Kefer et al., 1994, Sklar et al., 2007), and none of them focus on death of those discharged home with non-causative diagnoses. It is not known what death rate is expected within a short time for patients discharged home from the ED with a non-causative diagnosis.

The proportion of deaths of patients discharged from the ED in the present study (V) with a non-causative diagnosis increased with an increasing length of follow-up after discharge, from 11% to 15% for death within 8 and 30 days respectively. Death from ruptured aorta aneurism was found among those with unexpected death in the study by Kefer and co-workers (Kefer et al., 1994). This cause of death was also found in the study by Sklar and co-workers (Sklar et al., 2007), and likewise, it was the cause of death among four of those who died within 30 days after discharge from the ED in the present study (V).

The proportion of autopsy examination was low, only 18 and 19% among those who died within 8 and 30 days respectively, while autopsies were performed in 50 to 52% of patients in the studies from the US (Kefer et al., 1994, Sklar et al., 2007) and in 20% of the patients in Southampton UK (Baker & Clancy, 2006).

The autopsy rate in the present study (V) is similar to the officially reported autopsy rate by Statistics Iceland (Hagstofa Íslands [Statistics Iceland], [s.a.c]).

The low autopsy rate when death occurs shortly after visits to the ED might be because the cause of death was considered fully understood as a result of these visits. Another possibility is that the US studies (Kefer et al., 1994, Sklar et al., 2007) were based on information from the medical examiners, but they may handle the most complicated cases and thus more often request autopsy.

5.8 The limitations

Patients who attended the ED were registered in a computer system at the time of discharge and although the quality of such registrations has not been evaluated, no one was discharged without a main diagnosis. One of the limitations of these studies (I, II, III, IV, V) was the sole use of the main diagnosis at discharge home from the ED; many of these users of the department surely also had other diagnoses. Non- causative diagnoses (R00-R99), at discharge could mean that the physician was not conclusive on the condition of the ED user. On the other hand, main diagnosis in the R00-R99 category does not exclude other serious diagnoses or disease. However, the registered main diagnosis at discharge is considered to reflect the conclusion of the physician concerning the patients' complaints and problems on the occasion of each specific visit (I, II, III, IV, V). The diagnosis pattern reflects how the complicated ICD system was used routinely at the ED.

The quality of death certificates in Iceland has not yet been studied; however a study on the National Cause-of-Death Registry categorized Iceland as having high quality data overall, along with 23 other countries, including the UK and US (Mathers et al., 2005). The number of patients who LWBS or those who left AMA was not recorded in the database and the hospital was not able to provide this information in an electronic file; thus we were not able to study this phenomenon in this data.

Landspitali is an urban, university medical centre and its ED was intended mainly to serve internal medicine patients and general surgery patients. Therefore, it may not be appropriate to generalize the findings to other EDs, e.g. in rural locations, in other countries, and in a different healthcare insurance setting. The inclusion period was seven years (1995 to 2001) and an extended period would have made it possible to show further development in discharge diagnoses. Since 2001, attendances may have increased and other patterns of discharge diagnoses may have emerged.

The period of follow-up on mortality varies between individuals. Those who were discharged in 1995 were followed up for seven calendar years but those who visited in the last year of the study were only followed up for one calendar year, or to the end of 2002. Had the follow-up period been longer, changes in the pattern of causes of death might have been detected (I, III, IV).

No information was available as to whether the users of the ED had consulted other doctors or visited the primary health care centre or other institutions before their attendance at the department and thus, these studies do not address this subject. Further, it was not known what kind of treatment or care the users received during the follow-up period. From the study by Hansagi and co-workers, it is known that frequent users of the ED also use other types of health care services frequently (Hansagi et al., 2001).

A limitation is that there was no information on whether the patients were referred or how users were triaged. Therefore, we were not able to assess the seriousness of their condition when they arrived at the ED. As well, there was no information on users' LOS, which is considered an indicator of the workload at the department.

Individuals who had attended the ED but who were not residents of Iceland and those who had migrated from Iceland in the follow-up period were excluded from the studies because their vital status could not be ascertained in the National Registry and neither could they be identified in the National Cause-of-Death Registry. The consequence was a diminished study group and wider CI for the different ratios calculated (I, III, IV, V).

5.9 The strengths

The use of personal identification numbers in the record linkages was considered to have strengthened the studies. They provided the possibility of ascertaining vital status, the causes of death, and the emigration status for every patient and enabled an accurate examination of how often the patients had visited the ED during the inclusion period (I, II, III, IV, V).

Another strength of the studies was that all users received at least one main diagnosis (coded according to the ICD) (I, II, III, IV, V).

Using the comprehensive population registries in Iceland, particularly the National Registry, also strengthened the studies (I, II, III, IV, V). The universal use of personal identification numbers has made record linkage possible, and together with the registered time and hour of visits to the ED, enabled us to count every attendance for each person (I, II, III, IV, V). The record linkage with the National Registry enabled us to ascertain whether individuals were residents of Iceland and to access vital and emigration status for all patients. Those attending the ED who were not residents of Iceland have generally not benefited fully or in the long run from the comprehensive national health care system or health insurance coverage (I, II, III, IV, V). Moreover, follow-up of their vital status is unreliable. The National Registry and National Cause-of-Death Registry are nation-wide registries and through the latter, it was possible to identify the causes of death according to the death certificates (I, III, IV, V). All death certificates in Iceland are issued by a physician, and if the deceased person's physician refuses to sign the death certificate because he or she is unable to state the cause of death or due to the circumstances of the death (unexplained, unusual, suspicious, due to intoxication, or following an accident), it is reported to the police and a medical examiner, who takes care of autopsy and forensic investigations, after which the death certificate is issued (Lög um dánarvottorð, 1998). No cremation or burial can take place unless the death certificate is in the hands of lawful authorities (Lög um dánarvottorð, 1998).

When evaluating death registration at a global level, the registration data from Iceland was categorized as high-quality data overall and ranked in the same category as data from 23 developed countries, including the US and the UK (Mathers et al., 2005). According to Statistics Iceland, the autopsy rate in the country is approximately 19%. The autopsy rate in the studies was 17% overall (I, III). Among those who died within 8 days, the rate was 18 % and for those who died within 30 days, the rate was 19% (V).

It may be assumed that any possible deficiency in the quality of the data acquired from death certificate records is proportionally equally distributed across the different categories compared in the studies, so this potential bias may not actually affect the reliability of our results (I, III, IV, V).

5.10 Methodological considerations

To avoid bias, all patients who had migrated from Iceland or were not residents of Iceland were excluded from the study, as it was not possible to ascertain their vital status in the National Cause-of-Death Registry. This restriction diminished the quantity of data; however this proportion of patients is small compared to the total number of discharged patients from the ED.

Attendees who had at any time received a non-causative diagnosis (R00-R99) were defined as the target group when studying the association of these diagnoses and mortality (III). This procedure means that some patients in the target group may have had other diagnoses including mental and behavioural disorders (F00-F99), as the patients may have attended the ED more than once. The consequence is that the diagnosis of mental disorders fulfilled the criteria of a confounder. According to Rothman, a confounder must be associated with the disease and causally related to the disease; and there must be an association between the confounder and exposure. The confounder must not be an intermediate factor between exposure and disease (Rothman et al., 2008).

Similarly, mental and behavioural disorders and non-causative diagnoses may act as uncontrolled confounders in the study of the association between the number of visits to the ED and mortality (I). Furthermore, alcohol abuse (F10) may also be an uncontrolled confounder in the analysis of patients with mental disorders (III).

In epidemiology, there are different views on the definition of retrospective or prospective studies. In our first article, we assumed that the study was retrospective, but later on we changed our view and

now consider our register-based follow-up studies as prospective. Supporting this view is the fact that the formulation of the hypotheses and the record linkage of the hospital records with the National Cause-of-Death Registry were initialled by the authors and done after the collection of the cohort.

The quality of the hospital records is unknown to us but all patients received diagnoses at discharge from the ED. The diagnoses at discharge from the ED may be considered to reflect the routine procedure at the ED.

5.11 Ethical considerations

These studies are built up using computer records of attendances at the ED of LUH of patients who were discharged home in the period 1995 to 2001. When preparing these studies, all respectful laws were followed with the goal of protection of privacy and patients' rights. Data in these studies concerns very delicate patient private issues and for that reason, personal identifiable information is not made accessible to parties who have no pertinent need to know, and in addition, personal identification numbers were encrypted. In publication of the results, recognition of personal identity has been made impossible.

The sponsors of the study had no involvement in the work of the authors, such as in study design, data collection, data analysis, data interpretation, or writing of the report.

The National Bioethics Committee (VSNa2003060015), the Ethical Committee of the Landspitali University Hospital, the Data Protection Commission (2003060328), Statistics Iceland and Chief Medical Executive approved the study.

5.12 Future studies

In these studies the associations of the non-causative diagnoses (ICD10, R00-R99) with suicide, fatal drug poisoning and death within shot time after discharge have been evaluated. It is of interest, in lager material, to break the category of non-causative diagnoses into individual diagnosis or subcategories in order to elucidate further their significance. Other and new studies on how and when the non-causative diagnoses are used are also indicated, as these diagnoses are used frequently at the present ED and previous studies of diagnoses at EDs show similar pattern.

The different diagnoses or categories of diagnoses at discharge from the ED seem to be risk factors for suicide and fatal drug poisonings. It is thus open that there are still other unknown diagnoses which indicate risk of suicide and other unsuspected deaths. Further studies for risk factors among the diagnoses at discharge are thus worthwhile.

Furthermore it is of interest to test the hypothesis that the association of non-causative diagnoses with death within a short time after discharge from the ED can be use to evaluate the performance of EDs. To do so new material from other EDs and other time periods are needed to either confirm or refute the findings of present study.

6 Conclusions and clinical implication

There was an annual increase in discharged visits to the ED during the seven-year period, with the highest rate of increase among older men. This increase contributed to a greater burden at the ED.

The most frequent discharge diagnoses were in the category of non-causative diagnoses. The number of visits to the ED predicted increased mortality. The most common causes of death were due to malignant neoplasms, ischemic heart diseases, cerebrovascular disease, chronic lower respiratory diseases, external causes of injury and poisoning including the subgroups accidental poisoning and suicide. The mortality of the ED users was higher compared to the general population, and those discharged with non-causative diagnoses and mental and behavioural disorders had increased mortality for all causes of death compared with the general population.

ED users discharged with a non-causative diagnosis, mental and behavioural disorders and the subgroup of alcohol abuse, had higher mortality due to external causes, and its subdivision, namely accidental poisoning and suicide, than did other users of the ED.

Frequent visits to the ED were a strong risk factor for suicide and fatal drug poisoning. The discharge diagnoses of mental disorders, alcohol use, drug intoxication and non-causative diagnoses were independent risk factors for suicide. The discharge diagnoses of alcohol use, drug intoxication and factors influencing health status were independent risk factors for fatal drug poisoning.

Health professionals at EDs should be careful when users have been discharged home from the ED more than once in a calendar year, especially those with diagnoses of: mental and behavioural disorders, alcohol abuse, drug intoxication, non-causative diagnoses and factors influencing health status.

The association of non- causative diagnoses at discharge with death within eight days can be used to evaluate the performance of the ED.

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