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Emerg. Med. J. 2006;23:269-273
doi:10.1136/emj.2005.026690

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ORIGINAL ARTICLE

Mortality of the users of a hospital emergency department

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Emerg Med J 2006;23:269–273. doi: 10.1136/emj.2005.026690

Objective: To ascertain the annual number of users who were discharged home after visits to the emergency department (ED), grouped by age, sex, and number of visits during the calendar year, and to assess whether a higher number of visits to the department predicted a higher mortality.

Methods: This was a retrospective cohort study, with follow up of cause specific mortality through a national registry, in the Reykjavik area of Iceland. In total, 19 259 patients who visited the ED during the period 1995–2001 and who were discharged home at the Landspítali University Hospital, Reykjavik, Iceland, were enrolled. The main outcome measures were the standardised mortality ratio, with expected number based on national mortality rates, and hazard ratio calculations using time dependent multivariate regression analysis.

Results: The annual increase in visits to the ED among the patients discharged home was 7–14% per age group during the period 1995–2001, with the highest increase among older men. When emergency department users were compared with the general population, the standardised mortality ratio was 1.81 for men and 1.93 for women. Among those attending the ED two, three, or more times in a calendar year, the mortality rate was higher than among those coming only once in a year. The causes of death that led to the highest mortality among frequent users of the ED were neoplasm, ischaemic heart diseases, and external causes, particularly drug intoxication, suicides, and probable suicides.

Conclusions: The mortality of those who had used the ED and been discharged home was found to be higher than that of the general population. Frequent users of the ED had a higher mortality than those visiting the department no more than once a year. As the ED serves general medicine and surgery patients, not injuries, the high mortality due to drug intoxication, suicide, and probable suicide is interesting. Further studies are needed into the diagnosis at discharge of those frequently using the ED, in an attempt to understand and possibly prevent this marked mortality rate.

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Accepted for publication
30 September 2005

The number of individuals seeking emergency medical services, along with the total visits to hospital emergency departments (EDs), has increased in many developed countries during the past decades and has thus become a focus of public health discussion.^{1–3}

Some studies show that a majority of users consider themselves to need emergency treatment and care.^{4–5} Other studies maintain that ED users could be served equally well by general practitioners or within primary health care centres.^{6–7}

Several studies have focused on the frequent users of EDs.^{2–4,7–11} The definition of a frequent user varies between studies, however, and in most of the studies no attention was paid to whether the users of the ED were admitted to hospital or discharged home. Nor have the majority of the previous studies on EDs observed which medical specialist the users visited, generally analysing ED users as a rather homogenous group. In contrast, some studies have focused on certain groups of patients and are thus not suitable for describing ED activities as a whole.^{10–12} Few ED studies have been devoted to those discharged home, although one study from the USA dealt with such patients.¹³

In follow up studies on ED users in Stockholm, Sweden, the users had increased mortality compared with the general population,^{2–4,11,14} and frequent users of EDs had a twofold excess mortality.¹¹ In the cohort with the longest follow up time,¹¹ the three dominant causes of death were diseases of the circulatory system, tumours, and violent events. However, this study did not examine what medical specialist the users visited or whether the patients were discharged home or admitted to one of the hospital wards.¹¹

Previous descriptive studies on ED users of the Landspítali University Hospital in Reykjavik date from 1991 and are

limited to patients 70 years and older.^{12–15} It was thus considered of interest to analyse the use of this ED in more detail, primarily focusing on the patients discharged home.

The aim of the study was to describe the annual number of users who were discharged home after a visit to the ED, classified according to age, sex, and their number of visits in that calendar year, and to determine whether increasing numbers of ED visits predicted higher mortality.

METHODS

The ED in the study is at the Landspítali University Hospital (Landspítalinn haskólasjúkrahús, LSH), Reykjavík, Iceland, a hospital administered by the Ministry of Health and Social Security. This hospital is at the forefront of specialised and general health care in Iceland, and is the central base of knowledge for the nation's health service and the education of health professionals. The medical and nursing faculties of the University of Iceland are closely connected with the hospital. The National Bioethics Committee, the ethics committee of the LSH, and the Data Protection Commission approved the study.

Source of data

In this study, the primary source of data was computer records from the Department of Information Technology at the LSH, over the period 1995–2001. All residents of Iceland are included in the National Registry under a unique personal identification number, which everyone receives at birth (a 10 digit number that includes the day, month, and year of birth). Each visit to the ED is filed under the patient's

Abbreviations: ED, emergency department; LSH, Landspítalinn haskólasjúkrahús; SMR, standardised mortality ratio

personal identification number, enabling automatic and accurate record linkages. This database on ED visits also includes information on sex, admission date and hour, the main discharge diagnosis (International Classification of Diseases, 10th revision), and whether the person was discharged home after examination and treatment or was admitted to one of the hospital wards. The study was confined to new attendances and was also restricted to those who were discharged home from the ED; it did not include those referred to other departments or institutions.

The ED serves internal medicine patients and general surgery patients aged 18 years and older. The target population was 178 000 people in the year 2001. At the same hospital and nearby hospitals, there are other EDs for psychiatry, paediatrics, gynaecology and obstetrics, and a special casualty ward. In addition to these services, the primary health care system is accessible 24 hours a day. The structure and the finance of the healthcare system decide people's access to the ED, so a short description is given. Public health and healthcare, including the ED service, are financed by government taxes and all residents are covered by national health insurance schemes that pay the bulk of the cost for the patient. The fee that visitors must pay upon visiting the ED is similar to fees in the primary healthcare sector or for specialists in out of hospital practices that are also connected with national health insurance schemes. With regard to sickness and minor injuries, general practitioners and the health authorities encourage patients to consult their local healthcare centre as the first point of contact; however, patients are free to visit specialist practices or the varying EDs at hospitals, including the ED at LSH. The Icelandic healthcare system operates no referral system for secondary or tertiary levels of care, although every doctor can of course refer patients to a higher level of care and should do so as occasioned by medical indications.

Record linkages

The first record linkage based on individual identification numbers permitted a count of the number of visits per person and calendar year during the 7 year inclusion period (1995–2001). Subsequently, the patients were categorised into groups, corresponding to the highest number of visits in any single calendar year.

Through the second record linkage with the National Registry, everyone who had migrated from Iceland during the follow up period (1995–2002) was identified, along with those who had no identification number (as they were not of Icelandic nationality). Both of these groups were excluded from the follow up, as it was not possible to ascertain their vital status on the basis of the National Registry. The third record linkage—that is, with the National Cause of Death Registry, was performed to find the cause of death, which is registered as derived from death certificates. Both the National Registry and the National Cause of Death Registry are maintained at Statistics Iceland, where the causes of death have been coded according to the International Classification of Diseases (9th and 10th revisions, standardised to the 10th revision), and according to the European shortlist, with 65 categories for cause of death.

Follow up

The follow up with regard to death started upon the date of each patient's discharge home after their first visit to the ED and concluded upon their death or upon the closing date of the study at the end of 2002, whichever occurred first. The individual might switch to a higher category group by attending either twice or three or more times during a calendar year, thus the risk time was accordingly computed in more than one category.

Statistical methods

The annual number of ED visits was divided both by sex and three age groupings: 18–49 years, 50–69 years, and 70 years and older. To evaluate the increase in visits throughout the period 1995–2001, we related the visits per year to the annual population of the Reykjavik capital city area (with a 2001 population of 178 000), using a Poisson regression model and computing 95% confidence intervals (CI).

The mortality of ED users were compared with the mortality of Iceland's general population. This was based on the 5 year age and sex specific death rates of the population, 1996–2000, and conventional methods of calculating the standardised mortality ratio (SMR) and 95% CI¹⁶ were applied.

The hazard ratio was computed for all causes of death and for selected categories of death causes in a time dependent analysis using multivariate regression and BMDP software,¹⁷ whereby sex 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.

RESULTS

Number of visits

In total, 30 221 visits were made to the ED during 1995–2001 by patients who were discharged home, and the total number of patients was 19 259, which means that many of the patients made several visits. The number of patients visiting the ED increased annually (except on 1997) during the period 1995–2001 (table 1), and the number of patients who used the ED and were then discharged home also rose in the course of the period, with the increase being more apparent among the older age groups and particularly among men (table 2).

Over the study period, there was a statistically significant increase in the incidence of visits among the men and the women of every age group (table 2).

Table 3 shows the number of patients discharged home according to the highest number of visits paid to the ED within a calendar year; 16% of the users of the ED had visited it twice or more during a single calendar year.

Mortality and general population

The mortality from all causes for both men and women who had visited the ED and been discharged home was higher than in the general population, with an SMR in all age groups of 1.81 ($p < 0.001$) and 1.93 ($p < 0.001$) for men and women respectively (table 4). The SMRs were highest for the middle aged (30 to 64 years old) and lower towards the highest ages (table 4).

Table 1 Total number of patients visiting the ED and the number discharged home during the inclusion period, 1995–2001

Year	Total number of patients		Number of discharged patients	
	Men, n (%)	Women, n (%)	Men, n (%)	Women, n (%)
1995	2534 (11.7)	2768 (11.8)	1143 (10.0)	1319 (10.2)
1996	2929 (13.5)	3138 (13.3)	1427 (12.5)	1655 (12.8)
1997	2865 (13.2)	3138 (13.3)	1414 (12.4)	1602 (12.4)
1998	3063 (14.1)	3252 (13.8)	1609 (14.1)	1761 (13.6)
1999	3215 (14.8)	3538 (15.0)	1794 (15.8)	2057 (15.9)
2000	3347 (15.4)	3730 (15.9)	1910 (16.8)	2227 (17.2)
2001	3763 (17.3)	3962 (16.8)	2093 (18.4)	2309 (17.9)
Total	21716	23526	11390	12930

Table 2 Annual increase in ED visits of patients discharged home during the inclusion period, 1995–2001, in relation to the population of the Reykjavik capital city area, in three age groups

Age (years)	Men		Women	
	Inc (%)	95% CI	Inc (%)	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

Inc, increase.

Mortality of internal comparison

More than 60% of the deaths were due to four categories of cause: malignant neoplasm (32.2%), ischaemic heart disease (21.2%), cerebrovascular disease (9.9%), and chronic lower respiratory disease (4.9%). By adding the external causes of injury and poisoning (5.2%), including their subgroups of accidental intoxication (1.0%), and suicide and probable suicide (1.9%), these categories accounted for over 73% of the overall death total of 2105. The hazard ratios for these causes of death and all causes are shown in tables 5 and 6. The ratios were higher for men than women in the categories of all causes of death, malignant neoplasm, ischaemic heart diseases, external causes of injury and poisoning, and suicide and probable suicide. Furthermore, hazard ratios rose along with increasing numbers of ED visits for the categories of all causes, malignant neoplasm, ischaemic heart diseases, external causes of injury and poisoning, accidental intoxication, and suicide and probable suicide, and non-significantly for chronic lower respiratory diseases. For cerebrovascular diseases, however, the ratio decreased with increasing numbers of visits to the ED, albeit non-significantly. Analysing men and women separately for the same causes of death yielded similar ratios, but with wider confidence intervals.

The category of external causes of injury and poisoning is a heterogeneous one, including traffic and falling accidents, any type of poisoning, and suicides and homicides. In the subcategory of accidental poisoning, ICD-10 numbers X40 to X49, 21 deaths were registered. In all but one of these diagnoses, drugs were involved, with no differentiation between prescribed medicine or illegal drug use. There was a single alcohol intoxication, leaving no industrial intoxication in this category. The category of suicides and probable

Table 3 Number of patients attending the ED who were discharged home, related to their highest number of visits in any single calendar year

No. of visits	No. of patients	%	Men	Women	No. of deaths
1 visit	16244	84.3	7589	8655	1672
2 visits	2213	11.5	1035	1178	320
3 visits	521	2.7	249	272	70
4+ visits	281	1.5	154	127	43
Total	19259	100	9027	10232	2105

suicides consisted of the ICD-10 numbers X60 to X84 and Y10 to Y34, and comprised 29 cases of suicide and 12 cases in which it remained undetermined whether injury was accidental or purposely inflicted.

DISCUSSION

The study investigated the ED visits of patients who were discharged home, their frequency of visits, and whether frequent visits predicted mortality. The annual increase in visits to the ED of patients who were discharged home was 7% or greater in every age group during the period 1995–2001. The mortality of these patients was higher than that of the general population. In addition, their mortality was higher if they attended the ED either twice or three or more times during the same year, rather than making only one visit within the calendar year.

The vast majority of the patients had decided on their own, perhaps together with relatives, to visit the ED, as there was no compulsory referral system in operation. Only a minority of the patients had been referred there by other doctors, so that general medical aspects were more likely to involve the course of later events, for example, whether the patients were admitted to a hospital ward or discharged home after medical examination and treatment. People visiting an ED might well be in poorer health than the general population,^{10 11} therefore, we might assume a higher mortality rate among them, even if their condition did not require admission to a hospital ward. Frequent visits to an ED might actually reflect a serious underlying disease such as malignant neoplasm or atherosclerotic disorders. These arguments are sensible when mortality from chronic prevalent diseases is considered, keeping in mind that the ED in the study serves internal medicine and general surgery patients. Nevertheless, the increased mortality due to injury and poisoning that

Table 4 Observed and expected number of deaths, SMRs, and 95% confidence intervals among 9027 men and 10 232 women who used the ED and were discharged home, followed up during the period 1995–2002

Age group	Men				Women			
	Obs	Exp	SMR	95% CI	Obs	Exp	SMR	95% CI
18–19	1	0.39	2.56	0.03 to 14.27	0	0.31	0.00	11.83*
20–24	5	2.60	1.92	0.62 to 4.49	8	1.47	5.44	2.34 to 10.72
25–29	10	2.42	4.13	1.98 to 7.60	3	1.01	2.97	0.60 to 8.68
30–34	13	2.61	4.98	2.65 to 8.52	5	1.22	4.10	1.32 to 9.56
35–39	8	3.50	2.29	0.98 to 4.50	10	1.12	8.93	4.27 to 16.42
40–44	16	4.43	3.61	2.06 to 5.87	15	2.79	5.38	3.01 to 8.87
45–49	25	7.12	3.51	2.27 to 5.18	21	4.78	4.39	2.72 to 6.72
50–54	34	10.45	3.25	2.25 to 4.55	27	8.01	3.37	2.22 to 4.90
55–59	63	19.54	3.22	2.48 to 4.13	48	13.67	3.51	2.59 to 4.66
60–64	63	24.78	2.54	1.95 to 3.25	44	17.62	2.50	1.81 to 3.35
65–69	89	46.40	1.92	1.54 to 2.36	74	33.47	2.21	1.74 to 2.78
70–74	170	83.71	2.03	1.74 to 2.36	106	50.44	2.10	1.72 to 2.54
75–79	196	124.45	1.57	1.36 to 1.81	138	90.50	1.52	1.28 to 1.80
80–84	178	133.22	1.34	1.15 to 1.55	181	138.10	1.31	1.13 to 1.52
85–104	217	134.42	1.61	1.41 to 1.84	337	161.92	2.08	1.86 to 2.32
18–104	1088	600.05	1.81	1.71 to 1.92	1017	526.43	1.93	1.81 to 2.05

Obs, observed; Exp, expected; SMR, standardised mortality ratio; CI, confidence intervals. * No lower CI limit.

Table 5 Adjusted hazard ratio (HR) from multivariate regression and a 95% confidence interval (CI) for all causes of death and selected categories of deaths (ICD-10 in parentheses), according to sex, age (in years), and the patient's highest number of visits in any single calendar year

	All causes of death (A00-Y89)			Malignant neoplasms (C00-C97)			Ischaemic 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	Ref	366	1.0	Ref	265	1.0	Ref	82	1.0	Ref
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*		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	Ref	541	1.0	Ref	350	1.0	Ref	181	1.0	Ref
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+ 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

Ref, reference value. *Age in years.

presented itself in the study fits poorly with this reasoning, and the association between mortality due to injury and poisoning and frequent visits underlines patient vulnerability.¹¹

Patients attending the ED are registered at the time of discharge, although the quality of registration has not been evaluated. The use of the personal identification numbers in the recode linkages is considered to have strengthened the study, as 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 they had attended the ED during the study period. The usual method to evaluate the quality of the work and efficacy of the ED is to study how long after the visits the death occurred. That was not the objective of this mortality study and will have to wait for future analysis. According to Statistics Iceland, the necropsy rate is approximately 20%. No study is available on the quality of the registration of the cause of death on death certificates in Iceland; however, we believe that the quality of these are proportionally equally distributed into the different categories compared in the study, so bias has not been introduced.

Given the number of disease categories in this study, concern about the need of adjustment for multiple comparison may arise. There is no general agreement on how to approach this phenomenon,¹⁸⁻¹⁹ and some maintain that no correction is needed for multiple comparison.¹⁹⁻²⁰ Others advocate the use of confidence intervals rather than deciding merely from p values whether "significant" or "non-significant" results have been obtained.²¹ In the multiple regression analysis in this study, there was a common pattern for all causes and the seven categories of death—that is, there is increasing mortality with increasing number of ED visits except for cerebrovascular diseases, and thus we do not think

that there is a need to minimise the risks for multiple testing for the interpretation of the results.

Previous studies on frequent users of EDs have often assessed whether the users could be adequately served by primary healthcare,⁶⁻⁷ and patients who refer themselves without requiring specific hospital treatment have been described as "inappropriate" users of the respective ED.²² A uniform definition is lacking for labelling patients and their condition as "inappropriate",²² leading to the suggestion that the reasons for patient utilisation of the ED need to be studied further, particularly the social and psychological aspects.²²⁻²³ Frequent users of the ED have been considered a highly vulnerable group;²⁴ however, there are only a few follow up studies assessing the mortality of ED users,²⁻¹¹⁻¹⁴ and they all originate in Stockholm, Sweden. To our knowledge, this is the first report on mortality of ED users who were discharged home. Two of these previous studies had a very short follow up time of 1 and 2 years.²⁻¹⁴ The study by Hansagi and colleagues¹¹ was based on a 9 year follow up, which paralleled our study by observing a mortality pattern in which predominant causes of death were neoplasm, diseases of the circulatory system, and external causes of death, and in which heavy users of EDs had excess mortality in every diagnosis, but particularly from external causes, suicides, probable suicides, and alcohol/drug misuse.¹¹ Based on these results, Hansagi *et al* concluded that forms of care other than the ED should be considered for frequent ED users. The patients in the present study were discharged home and used general medical and surgical services, thus differ substantially from the Swedish ED users.¹¹ In a later study on frequent ED users, Hansagi *et al*² found that the Swedish patients were also frequent users of other healthcare services, including the primary healthcare sector, which makes it unclear how best to meet the needs of these

Table 6 Adjusted hazard ratio (HR) from multivariate regression and a 95% confidence interval (CI) for selected categories of death (ICD-10 in parentheses), according to sex, age (in years), and the patient's highest number of visits in any single calendar year

	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	Ref	70	1.0	Ref	11	1.0	Ref	25	1.0	Ref
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*		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	Ref	77	1.0	Ref	9	1.0	Ref	26	1.0	Ref
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+ 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

Ref, reference value. *Age in years.

vulnerable patients, considering their higher than expected mortality during the 1 year follow up period.

CONCLUSION

The annual increase in visits to the ED studied of patients who had been discharged home ranged from 7% to 14% per age groups during the period 1995–2001, with a highest increase among older men. The mortality of these patients was higher than that of the general population. Frequent users of the ED had a higher mortality than those visiting the department no more than once in a year. The leading causes of death among frequent users of the ED were neoplasm, diseases of the circulatory system, and the category of external causes, particularly drug intoxication, suicide, and probable suicide. Further studies are needed on the discharge diagnosis of frequent ED users who were discharged home, in an attempt to understand and possibly prevent this high mortality.

ACKNOWLEDGEMENTS

We wish to thank A B Haukdal for preparing data and H Sigvaldason for statistical advice and assistance.

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This study was supported by a grant from the Landspítali University Hospital Research Fund.

Competing interests: none declared

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