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Death within 8 days after discharge to home from the emergency department

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Background: Deaths within 8 days after discharge have, in previous studies, been evaluated retrospectively based on review of hospital records and the cause of death. The aim of the study was to evaluate the association of death within 8 days after discharge to home from the emergency department with a non-causative diagnosis in a prospective cohort study. **Methods:** The records from the emergency department were filed by personal identification number and included information on gender, age, admission, discharge and diagnosis. The cause of death was obtained from a nation-wide registry by record linkage. Mortality per 100 000 within 8 days and the hazard ratio and 95% confidence intervals (CIs) were calculated for all causes of death in a time-dependent analysis. **Results:** A non-causative diagnosis had been given to 11% of those who died within 8 days after discharge home. The mortality per 100 000 within 8 days was 208.5, within 15 days 347.4 and within 30 days 648.6. In the analysis of deaths within 8 days, the hazard ratio was higher for men than women and increasing age was significantly associated with high mortality. The hazard ratio for non-causative diagnosis was 0.44 (95% CI 0.20–0.96) as compared to causative diagnosis, adjusted for gender and age. **Conclusion:** The mortality rate within 8 days of discharge found in the present study is considerably higher than findings in previous studies. Death shortly after discharge of patients with non-causative diagnosis may indicate a misjudgement of the patients' condition at the time of discharge.

Keywords: mortality, non-causative diagnosis, prospective, record linkage

Introduction

During the last decades the number of patients seeking the emergency department has increased year by year. As the emergency department is often the first choice that individuals make when they think they are in need of medical care it is important to learn about the emergency department users and their fate. More then 70% of the emergency department users are discharged home.[1,2]

Studies from emergency departments have shown that ~20% of the users who are discharged home receive a symptom-based or non-causative diagnosis.[1,2] There are indications that in patient discharge records, it is more common now than before[2] to enter a non-causative diagnosis in the category of 'Symptoms, sign, abnormal findings and ill-defined causes', referenced in the International Classification of Diseases (ICD) by the codes R00–R99.

The most alarming outcome for a patient discharged home would be death within a short time after the emergency department visit. One study gives information on death rates within 30 days of discharge.[3] Two more studies have looked into this matter, one of which has attempted to evaluate the relationship of the cause of death to the emergency department visit,[4] while the other reviewed whether the death was expected, and whether preventable medical errors were identified.[5] In both studies, analysing cases of death within eight days, retrospective qualitative methods were used to evaluate the emergency department records. Hospital records inevitably 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 (http://www.who.int/classifications/icd/en/). Thus, the procedures in the aforementioned studies may have induced a circular reasoning.

Non-causative diagnosis at discharge means that the responsible physician was not conclusive on the condition of the emergency department user. Using a computerized file of emergency department users discharged home we carried out a prospective study to evaluate the association of death within 8 days with a non-causative diagnosis recorded as the main last diagnosis at the emergency department.

Methods

The emergency department in the study is at Landspitali University Hospital, Hringbraut, Iceland and the primary source of data was computer records of attendances where patients were discharged home after clinical evaluation and treatment, over the inclusion period of 1995–2001. The study cohort comprised 30 221 visits to the emergency department by 19 259 individuals who were discharged home during the period. In 2001, the visits that resulted in discharge represent 72% of the total attendances. The material was described in previous publications,[2,6] so a brief summary will be given. All residents of Iceland are included in the National Registry under a unique personal identification number allocated at birth (a 10-digit number that includes the day, month and year of birth). Each visit to the emergency department is filed under the patient's identification number, enabling automatic and accurate record linkages with other registers using the same identification number. The computer records on emergency department visits also include information on age, gender, admission date and time, and the main discharge diagnosis according to the ICD, standardized to the 10th revision.

The emergency department serves patients aged ≥18 years. The pattern of main discharge diagnosis has been reported[2] and a rather similar pattern has been found at discharge from the emergency department of the San Francisco

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General Hospital.[1] At the Landspitali University Hospital and nearby hospitals, there are other emergency departments for psychiatry, gynaecology and obstetrics, as well as a special level one trauma centre. In addition to these services, within the primary health care system, access to a general practitioner is possible 24 h a day.

Information on vital status was obtained from the National Registry for all patients on the hospital's emergency discharge records over the period, with the exception of patients who were not residents of Iceland or who had migrated from Iceland during the follow-up period (1995 through 2002). Through a record linkage with the National Registry, these non-resident patients were identified and then excluded from the follow-up, as it is not possible to ascertain their vital status on the basis of the National Registry. A second record linkage with the National Cause-of-Death Registry was performed to obtain the cause of death, and whether an autopsy was performed. Causes of death were recorded according to the causes reported on death certificates, coded according to the ICD and standardized to the 10th revision. Both the National Registry and the National Cause-of-Death Registry are maintained at Statistics Iceland.

The follow-up on mortality started on the date of each patient's discharge home after their first visit to the emergency department and ended on the date of death or on the 30th day after discharge, whichever occurred first. Individuals who made multiple visits to the emergency department were followed up after each visit, so that for some individuals, a risk period will have been computed several times. The follow-up period was divided arbitrarily into 8, 15 and 30 days after discharge from the emergency department to comply with descriptions given in previous studies[3–5] with the main focus on death within 8 days.

Mortality per 100 000 was calculated and 95% confidence intervals (CIs) were found assuming Poisson distribution.[7] Pearson chi-square was used for comparing categorical data and Fisher's exact test when a cell had an expected count of less than five. In cases where a non-causative diagnosis in the category of 'Symptoms, sign, abnormal findings and ill-defined causes', coded R00–R99 according to the ICD, (Z codes not included), has been reported at the time of discharge home from the emergency department, that diagnosis is considered to have no influence on the designation of the cause of death on the individual's death certificate. Such a diagnosis would rather indicate that the user's complaints were not understood as related to a disease or that the patient's disease was not yet diagnosed. In many of these cases, death within approximately 8 days may have been unforeseen and come as a surprise to the responsible doctor. Thus, deaths among individuals with a non-causative diagnosis were compared with deaths among those with a causative diagnosis in a regression analysis. Hazard ratios and 95% CI were computed for all causes of death in a time-dependent analysis using BMDP software.[8] We examined the diagnostic group of non-causative diagnosis versus causative diagnosis, and compared in separate analyses death within 8, 15 and 30 days. Gender was introduced as a dichotomous variable and age as a continuous variable in years.

The National Bioethics Committee, the Ethical Committee of the Landspitali University Hospital and the Data Protection Commission approved the study.

Results

Altogether 63 deaths (mean age 72, range 19–93) occurred within 8 days after discharge home from the emergency department, 104 deaths (mean age 74, range 19–98) within 15 days, and 196 deaths (mean age 73, range 19–98) within 30 days. The mortality per 100 000 was 208.5 (95% CI 160.2–266.7) for death within 8 days, 344.1 (95% CI 281.2–417.0) within 15 days and 648.6 (95% CI 560.9–746.0) within 30 days. The crude mortality rates for death within 8 days according to gender and age is shown in table 1.

The day at discharge is counted as day 0. Most deaths occur on day 1; however, instances of death are fairly evenly distributed over the period of 30 days.

The proportion of selected cause of death occurring within 8 and 30 days as compared to more than 30 days after discharge home from the emergency department was similar, with some important exceptions, as is shown in table 2. Cerebrovascular diseases were more frequently stated as a cause of death on the death certificates of those who died within 8 and 30 days compared to those who died more than 30 days after discharge. Aortic aneurism rupture was designated as cause of death in three cases among those who died within 8 days

Table 1 Number of discharges, number of deaths within 8 days, crude mortality per 100 000, and 95% CIs, according to gender and age

	No. of discharges to home	No. of deaths within 8 days	Mortality per 100 000	95% CI lower to higher
All	30 221	63	208.5	160.2–266.7
Gender				
Men	14 420	34	235.8	163.3–329.5
Women	15 801	29	183.5	122.9–263.6
Age (years)				
≤44	12 572	2	15.9	1.9–57.5
45–64	8258	13	157.4	83.8–269.2
65–74	4542	12	264.2	136.5–461.5
75–84	3561	26	730.1	476.9–1069.8
≥85	1288	10	776.4	372.3–1427.8

Table 2 Number of all causes of death and selected causes of death within 8 and 30 days after discharge home from the emergency department compared with number of deaths more than 30 days after discharge

Causes of death (ICD-10)	Death within 8 days *n* (%)	*P*-value*	Death within 30 days *n* (%)	*P*-value*	Death more than 30 days after discharge *n* (%)
All causes of death	63 (100)		196 (100)		1514 (100)
Malignant neoplasms (C00–C97)	17 (27.0)	0.33	65 (33.2)	0.94	498 (32.9)
Ischaemic heart disease (I20–I25)	13 (20.6)	0.45	40 (20.4)	0.17	376 (24.8)
Cerebrovascular disease (I60–I69)	12 (19.0)	0.06	28 (14.3)	0.21	170 (11.2)
Respiratory diseases (J00–J99)	6 (9.5)	0.94	13 (6.6)	0.23	140 (9.2)
Aortic aneurism (I71)	3 (4.8)	0.002	4 (2.0)	0.12	13 (0.9)
Cirrhosis of the liver (K70, K74, K75)	0		4 (2.0)	0.004	6 (0.4)
Suicide and undetermined injury (X60–X84, Y10–Y34)	1 (1.6)	0.85	6 (3.1)	0.29	29 (1.9)
All other causes of death	11 (17.5)	0.82	36 (18.4)	0.93	282 (18.6)

*Chi-square/Fisher's exact test.

and cirrhosis of the liver was the cause of death for four of those who died within 30 days after discharge.

The autopsy rate for all deaths among users of the emergency department discharged home was 17%, which is similar to the rate of 17.5% among those who died within 8 days and the rate of 19.4% for those who died within 30 days.

Patients discharged with a non-causative diagnosis represented 11.1% (7/63) of those who died within eight days, 13.5% (14/104) of those who died within 15 days and 15.3% (30/196) of those who died within 30 days after discharge home. Among the 30 cases (mean age 71, range 43–98) with a non-causative diagnosis, abdominal pain (R10.4) was reported for seven, other chest pain (R07.3) for three, fatigue (R53) for three, urine retention (R33) for two, syncope (R55) for two, convulsions (R56.8) for two, fever (R50.9) for two, gangrene (R02) for two, localized oedema (R60.0) for two, nausea and vomiting (R11) for one, coma (R40.2) for one, headache (R51) for one, apnoea (R06.8) for one and one presented abnormal findings (R89.8). The non-causative diagnosis of the seven cases who died within 8 days were: abdominal pain (R10.4) which was reported for four, nausea and vomiting (R11) for one, apnoea (R06.8) for one and fatigue (R53) for one. Counted among those with a causative diagnosis who died within 8 days were nine cases (mean age 82, range 70–92) with a diagnosis in the category of 'Factors influencing health status and contact with health services' according to the ICD, codes Z00–Z99. Of these, eight came under examination and observation (Z00.0, Z03.9, Z04.9), and one under problems related to social environment (Z60.9).

The result of the multivariate analysis is shown in table 3. Increasing age was significantly associated with death in all three time intervals. In all time intervals, the hazard ratios were lower for women compared with men, or approximately 0.7; however, only significantly lower than unity in the analysis of death within 30 days, where the hazard ratio was 0.73 (95% CI 0.55–0.97). The hazard ratios were lower for those with a non-causative diagnosis at discharge compared to those with a causative diagnosis in all three time intervals.

Table 3 Number of deaths, hazard ratio, and 95% CI for all causes of death within 8, 15 and 30 days after discharge from the emergency department, according to non-causative discharge diagnosis

	Number of deaths	Hazard ratio	95% CI
			Lower to higher
Death within 8 days	63		
Age (years)		1.06	1.05–1.08
Men	34	1	Reference
Women	29	0.73	0.45–1.20
Causative diagnosis	56	1	Reference
Non-causative diagnosis	7	0.44	0.20–0.96
Death within 15 days	104		
Age (years)		1.07	1.06–1.09
Men	57	1	Reference
Women	47	0.69	0.47–1.02
Causative diagnosis	90	1	Reference
Non-causative diagnosis	14	0.54	0.31–0.95
Death within 30 days	196		
Age (years)		1.07	1.06–1.08
Men	105	1	Reference
Women	91	0.73	0.55–0.97
Causative diagnosis	167	1	Reference
Non-causative diagnosis	30	0.60	0.41–0.89

Adjustments are made in a multivariate analysis for gender and age.

Discussion

Our calculations show a significant association between non-causative diagnosis and decreased death rate adjusted for gender and age. The hazard ratio was low and the 95% CIs did not include unity in the analysis of death within 8 days, 15 days and 30 days after discharge home from the emergency department. If non-causative diagnosis indicate that the emergency department user's complaints were not related to disease or that a disease was not yet diagnosed somebody would have interpreted our observed association as indicating an efficient emergency department; however, given the lack of similarly conducted studies from other emergency departments, we must admit that we do not know whether death rate within a short time is acceptable or ordinary for patients discharged home from the emergency department with a non-causative diagnosis.

The proportion of deaths of patients discharged from the emergency department 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. Thus, the average percentage of the emergency department users with non-causative diagnosis of 20% reported in other studies was not reached.[2] Death from ruptured aorta aneurism was a common finding among those with unexpected death in the study of Kefer *et al.*[4] and was also found in the study of Sklar *et al.*[5] and in the present study.

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 50–52% of patients in the studies from the United States[4,5] and in 20% of the patients in United Kingdom.[3] The autopsy rate in the present study approximates the average autopsy rate of 20% officially reported by Statistics Iceland (https://www.hagstofa.is/temp/Dialog/varval.asp?ma=MAN05331&ti=Krufningar%20eftir%20kyni%20og%20aldri%201981-2005%20&path=../Database/mannfjoldi/danir/&lang=3&units=Fj%C3%83%C2%B6ldi/Hlutfall). A possible explanation is that post-mortem examinations were less frequently indicated in cases of death occurring shortly after a visit to the emergency department because the cause of death was considered fully understood as a result of these visits. Another possibility is that the US studies[4,5] were based on information from the medical examiners, but they may handle the most complicated cases and thus more often request autopsy.

The strength of our study lies in the use of the comprehensive population registries in Iceland, particularly the National Registry. The universal use of personal identification numbers has made record linkage possible, and together with the registered time and hour of visits to the emergency department, enabled us to count every attendance for each person. 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 cohort members. Those attending the emergency department 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. 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 certificate. 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 the medical examiner, who take care of autopsy

Table 4 Overview of studies on death within 8 days after discharge home from the emergency department

Reference	No. of discharges to home	Emergency department diagnosis	No. of death within 8 days (%)[a]	Cause of death	Mortality per 100 000	95% CI lower to higher
Kefer *et al*.[4]	325 904	All	42	All	12.9	9.3–17.4
		Non-causative	9 (21)	Various	2.8	1.3–5.2
			3 (7)	Aortic aneurism	0.9	0.2–2.7
Sklar *et al*.[5]	387 334	All	117	All	30.2	25.0–36.2
		Non-causative	13 (11)	Various	3.4	1.8–5.7
			1 (1)	Aortic aneurism	0.3	0.0–1.4
Baker and Clancy[3]	59 366	All	47	All	79.2	58.2–105.3
Present study	30 221	All	63	All	208.5	160.2–266.7
		Non-causative	7 (11)	Various	23.2	9.3–47.7
			3 (5)	Aortic aneurism	9.9	2.0–29.0

a: Percentages within each study.

and forensic investigations, after which the death certificate is issued (http://www.althingi.is/lagas/nuna/1998061.html). No funeral can take place unless the death certificate is in the hands of lawful authorities (http://www.althingi.is/lagas/nuna/1998061.html). Information on the quality of the recording of the cause of death on death certificates in Iceland is not available. However, 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 United States and the United Kingdom.[9]

One of the limitations of this study is the sole use of the main diagnosis at discharge to home from the emergency department; many of these users of the department surely also had other diagnoses. The non-causative diagnosis according to the category of 'Symptoms, signs, abnormal findings and ill-defined causes', codes R00–R99 in the ICD, is a varied collection. Users of the emergency department who died within a short time may have been frequent attendees who were well known at the hospital and the emergency department; however, we consider the registered main diagnosis at discharge to reflect the medical conclusion relating to the patients' complaints on the occasion of the specific visit.

As far as we know, our study is the first published prospective study on the short-term mortality risk of individuals discharged home from the emergency department with non-causative diagnoses compared to those with causative diagnoses, adjusted for age and gender. In previous emergency department studies on death within 8 days, the crude mortality rate was considerably lower than that found in the present study.[3–5] An overview of these studies along with the present study is given in table 4.[3–5] Care must be taken in the discussion of these studies, as there are considerable differences in the methods used as well as geographical differences. The studies from Milwaukee,[4] Albuquerque,[5] USA, and the present study use the number of attendances as the denominator while the study from Southampton[3] uses the number of attended patients. It is unclear how multiple attendances were looked at and whether they were counted in that study. Nevertheless, the death rate within 8 days was highest in the present study and the 95% CIs did not include the rates in the other studies. In the two studies from the United States,[4,5] the proportions of patients with a non-causative diagnosis were 11–21% of those discharged who died within 8 days but the mortality for those with a non-causative diagnosis was also highest in the present study, table 4. In this discussion, a reservation must be made because gender and age differences between these populations are not taken into consideration when looking at these crude mortality rates.

In conclusion, we think that comparing mortality of users with a non-causative diagnosis at discharge home to mortality of those with a causative diagnosis is a valid tool for evaluating the efficiency of an emergency department and the hazard ratio can be used for comparison between emergency departments. Adjustment for age and gender is needed in that comparison. If such studies are done prospectively, an observation bias can be avoided. Register-based studies and record linkage seem to be necessary for the follow-up in studies on death shortly after discharge from the emergency department, as that approach not only ensures accurate follow-up but also blinds the investigators and the staff of the emergency department who are often involved and who cannot be disinterested in the department's performance.

What is already known on this topic?

- Retrospective observational studies have suggested that death after discharge from the emergency department is uncommon.
- Hypothesis-driven research on mortality after emergency department visits is lacking.

What does this study add?

- Prospective register-based study ensures accurate follow-up and yields higher mortality among patients discharged from the emergency department.
- The association of non-causative diagnosis at discharge with early death can be used to evaluate the performance of the emergency departments.

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References

1 Mandelberg JH, Kuhn RE, Kohn MA. Epidemiologic analysis of an urban public emergency department's frequent users. *Acad Emerg Med* 2000;7:637–44.

2 Gunnarsdottir SO, Rafnsson V. Seven-years evolution of discharge diagnoses of emeregncy department users. *Eur J Emerg med* 2007;14:193–8.

3 Baker M, Clancy M. Can mortality rates for patients who die within the emergency department, within 30 days of discharge from the emergency

department, or with 30 days of admission from the emergency department be easily measured? *Emerg Med J* 2006;23:601–3.

4 Kefer MP, Hargarten SW, Jentzen J. Death after discharge from the emergency department. *Ann Emerg Med* 1994;24:1102–7.

5 Sklar DP, Crandall CS, Loeliger E, et al. Unanticipated death after discharge home from the emergency department. *Ann Emerg Med* 2007;49:735–45.

6 Gunnarsdottir OS, Rafnsson V. Mortality of the users of a hospital emergency department. *Emerg Med J* 2006;23:269–73.

7 Armitage P, Berry G. *Statistical methods in medical research*, 2nd edn. Oxford: Blackwell Scientific Publication, 1991.

8 Dixon WJ, Brown M, Engelman L, Jennrich RI. *BMDP statistical software manual*. Berkeley/Los Angeles/Oxford: University of California Press, 1990.

9 Mathers CD, Fat DM, Rao C, Lopez AD. Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bull World Health Org* 2005;83:171–7.

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