

BMJ Open Differences between cases admitted to hospital and discharged from the emergency department after emergency medical services transport

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ABSTRACT

Objective Rising emergency medical services (EMS) utilisation increases transport to hospital emergency departments (ED). However, some patients receive outpatient treatment (discharged) while others are hospitalised (admitted). The aims of this analysis were to compare admitted and discharged cases, to assess whether cases that were discharged from the ED could be identified using dispatch data and to compare dispatch keyword categories and hospital diagnoses.

Design Retrospective observational study using linked secondary data.

Setting and participants 78 303 cases brought to 1 of 14 ED in the city of Munich, Germany, by EMS between 1 July 2013 and 30 June 2014.

Main outcome measures Characteristics of admitted and discharged cases were assessed. Logistic regression was used to estimate the association between discharge and age, sex, time of day, ambulance type and dispatch keyword category. Keyword categories were compared to hospital diagnoses.

Results 39.4% of cases were discharged. They were especially likely to be young (OR 10.53 (CI 9.31 to 11.92), comparing <15-year-olds to >70-year-olds) and to fall under the categories 'accidents/trauma' (OR 2.87 (CI 2.74 to 3.01)) or 'other emergencies (unspecified)' (OR 1.23 (CI 1.12 to 1.34) (compared with 'cardiovascular'). Most frequent diagnoses came from chapter 'injury and poisoning' (30.1% of the 10th revision of the international statistical classification of disease and related health problems (ICD-10), yet these diagnoses were more frequent at discharge (42.7 vs 22.0%) whereas circulatory system disease was less frequent (2.6 vs 21.8%). Except for accidents/trauma and intoxication/poisoning many underlying diagnoses were observed for the same dispatch keyword.

Conclusion Young age and dispatch for accidents or trauma were the strongest predictors of discharge. Even within the same dispatch keyword category the distribution of diagnoses differed between admitted and discharged cases. Discharge from the ED does not indicate that urgent response was unnecessary. However, these cases could be suitable for allocation to hospitals with low inpatient bed capacities and are of particular interest for future studies regarding the urgency of their condition.

Strengths and limitations of this study

- Large sample which includes 78 303 cases brought to the emergency department by emergency medical services after emergency calls in an urban region.
- Linkage of dispatch data with hospital data made it possible to identify which cases were in need of subsequent admission and to study hospital diagnoses of prehospital cases.
- Main limitations are that 30% of dispatches could not be linked to hospital records, and that diagnosis information was missing for 20% of discharged cases.

INTRODUCTION

Prehospital emergency medical services (EMS) provide immediate medical care to acutely ill and injured patients. Demand for EMS in Germany is rising, with an increase of 105% since 2001.¹ An increase in EMS activation in both, urban and rural regions of Bavaria was observed over the past 10 years.² Rising use of EMS and emergency departments (ED) contributes to ED crowding and scarcity of hospital admission capacities. The negative consequences of ED crowding on patient outcomes are well established.³ A growing proportion of ED outpatient treatments has been observed in Germany.⁴ There is also evidence that emergency care and ambulance services are accessed for primary care and low-urgency health problems.^{5 6} Other studies report discharge rates after EMS transport of as high as 70%⁷ and classify 16% of EMS patients as potential candidates for primary healthcare.⁸ A certain amount of overtriage is accepted and expected to prevent overlooking critically ill patients that in consequence suffer from adverse outcomes, but it also consumes resources and causes unnecessary crowding of specialised resources. Reasons of and therefore solutions for ED crowding lie largely outside of

the ED.³ Whereas it is difficult to guide patients that walk into the ED, dispatchers and EMS crews are involved in the emergency care processes at an early stage and play a central role for the allocation of resources to patients and of patients to hospitals. Grusd and Kramer-Johansen found that patients who do not need prehospital interventions can be identified at dispatch⁹ and Eastwood *et al* suggest that cases not suitable for an ED presentation can be referred to alternative care pathways after secondary telephone triage.¹⁰

Knowing which caller characteristics are associated with discharge from the ED and whether the dispatchers assessment of the complaints reflect later diagnoses of admitted and discharged cases might help contribute to dispatch and patient allocation decisions in patients that are less likely to need acute care beds, and point to groups that are worth a closer look regarding the suitability for other settings. The aims of this study were therefore to compare admitted and discharged cases, to assess whether information accessible at dispatch can help differentiate between cases who will need subsequent admission to a hospital and those who likely will not and to investigate differences between dispatch keywords and hospitals diagnoses of admitted and discharged cases.

METHODS

Design and setting

This is a retrospective observational study using secondary data gathered for an evaluation of the provision of care by the ED in the city of Munich.¹¹ In 2014, about 1.5 million people lived in the city of Munich. The Munich dispatch centre covers an area of about 980 km² with 1.8 million inhabitants.

The German healthcare system offers different types of emergency care in different environments. Prehospital medical services can be accessed via the national emergency telephone number 112. Calls are managed by regional dispatch centres that operate full time and coordinate emergency and non-emergency ground and air ambulances and the fire brigade. Call-takers and dispatchers are trained paramedics or firefighters who underwent dispatch training. A local, non-standardised, keyword-based dispatch manual which is mainly based on chief complaints and reported events is used to decide on the type and number of prehospital EMS units to be dispatched to the scene of the emergency. Levels of EMS response include ambulances designated to non-emergency transport, paramedic staffed ambulances and rapid response cars and helicopters staffed with prehospital emergency physicians. Prehospital emergency physicians need a specialty board certification for emergency medicine. A physician will be dispatched according to a prespecified catalogue when vital signs are suspected to be unstable or when the condition implicates a high probability of need for invasive interventions. Physicians can also be activated at the discretion of the dispatcher for tactical reasons or when they are requested by the

paramedics on site. According to suitability and intake capacity a dispatcher will suggest a hospital to which an EMS patient should be transported to. This suggestion is usually accepted by ambulance crews, although they can, in consultation with the dispatch centre, decide on another destination if special medical considerations prevail. Physicians can decide whether a patient is left on scene. If hospitals temporarily de-register to the dispatch centre from acute care, EMS units have to travel to alternative locations, which usually results in longer transport times and deducts units from their home base.

A dispatcher can refer callers that do not need an EMS response to on-call or ambulatory services provided by the Association of Statutory Health Insurance. On-call doctor services can be accessed directly through 116 117 for urgent but non-emergency conditions. Patients can access all ambulatory emergency care services on their own initiative, or seek care at a hospital's ED.

Data sources and sample

Between 1 July 2013 and 30 June 2014, routinely collected information of all cases presenting to 1 of 14 ED of 14 major hospitals in Munich was pooled into a study data base. Dispatch information was extracted from a database that holds routinely generated data from the computer-assisted dispatch systems of Munich's central dispatch centre and surrounding dispatch centres and billing information. During the study period, 524 716 cases presented to the 14 EDs and 110 484 emergency dispatches where a patient was transported to a destination in the city of Munich were recorded by the dispatch centres, of which 78 307 (71%) could be matched to an ED record. Four emergency dispatches were excluded, as the keywords indicated a non-emergency transport. All data was anonymised and is therefore case-based, not patient-based. Repeated presentation by the same patient or EMS activation for the same patient could not be accounted for.

Hospital data included basic case information (age, sex, admission status) and information about diagnoses (codes from the German version of the 10th revision of the international statistical classification of disease and related health problems (ICD-10-GM)). Dispatch data includes dispatch keywords, type of ambulance deployed, time stamps and receiving hospital. Billing data includes patient age, an essential identifier for the linkage of hospital and dispatch data. A probabilistic approach was used to link billing and dispatch records, and then dispatch and hospital records. Time stamps of dispatch and billing data were compared and patient age could be assigned to 86% of dispatch records. Second, patient age and admission time of dispatch and hospital records were compared. All records with an exact match of patient age and an arrival time within a 20 min interval were linked which was the case for 80% of records. When several records matched, the records with the smallest difference in arrival time were linked. This process was repeated for the remaining records, first through extending the admission time interval to 40 min, and then extending

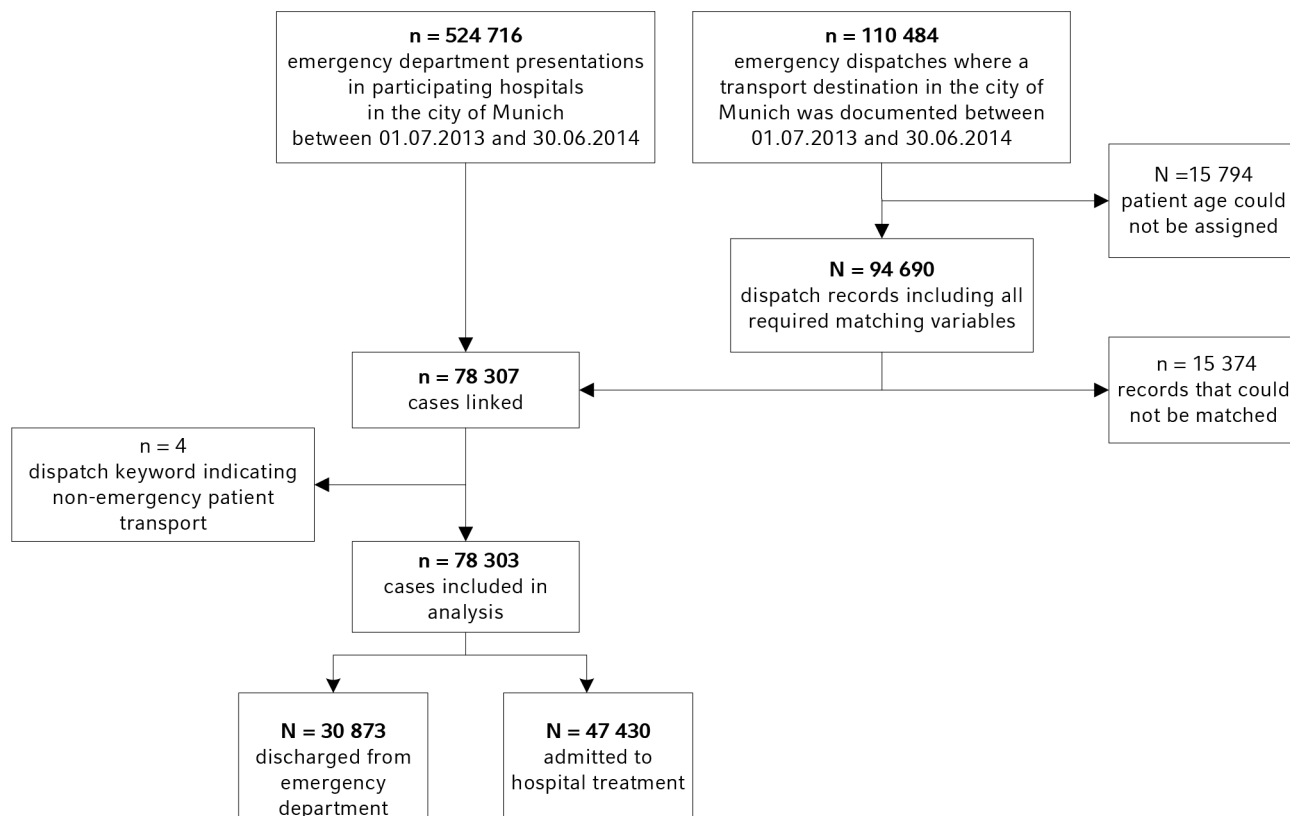


Figure 1 Study design and case selection.

the age criterion to a 5-year range. The study design and case selection are illustrated in [figure 1](#).

Cases were classified as discharged when there was no documentation for admission to the same hospital on the day of ED presentation. Information about admitted cases came from a standardised data set that hospitals are required to collect according to section 21 of the Hospital Remuneration Act (KHEntgG). Participating hospitals provided comparable information about discharged cases from their hospital information system. Records with identical items recorded within the first hour after admission were considered duplicates and removed from the dataset. Recording a primary diagnosis is only mandatory for admitted cases. The amount of missing data is displayed in the results section. More than one diagnosis was recorded for 5.1% of discharged cases. In this case, the diagnosis with the highest estimated resource requirement was chosen as the primary diagnosis. Since dispatch keywords are not standardised, 293 different keywords were condensed and classified into 15 categories (see online supplementary material).

Analysis

The sample was characterised by calculating medians with IQR for continuous variables and frequencies and proportions for categorical variables. Statistical tests (χ^2 test for categorical variables and the Wilcoxon-Mann-Whitney U test for continuous variables) were performed to evaluate differences between admitted and discharged cases. The probability of discharge was calculated for

case characteristics. Logistic regression was performed to estimate the adjusted likelihood of discharge. Covariates were selected based on their availability at dispatch and included age, sex, dispatch keyword category, and day and time of admission at the ED. The nine most frequent dispatch keyword categories and ICD-10 diagnosis chapters are displayed. Remaining diagnosis chapters and keyword categories are summarised as ‘other chapters’ and ‘other keywords’. Age was categorised into five groups. The final model was selected based on Akaike information criterion.^{12 13} A subgroup analysis was conducted for age groups and results from the stratified models are displayed. The frequencies of hospital diagnoses stratified by dispatch keyword category are presented in cross-tabulated tables. Analysis was performed using R statistical software (R Foundation for Statistical Computing, Vienna, AT).

Ethics and reporting

Analyses are based on retrospective data that are irreversibly anonymised. The ethical review committee therefore waived obligation to advise according to the law on faculties. The reporting of this study is in accordance with Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for the reporting of observational studies in epidemiology.

Patient and public involvement

Patients or the public were not involved in the design and conduct of this research.

Table 1 Characteristics of ED cases transported by EMS

	Total	Admission status		P value*
	n=78 303	Discharged n=30 873	Admitted n=47 430	
Age, median (IQR)	60.0 (45)	40.0 (41)	70.0 (33)	<0.0001
Sex, n (%)				<0.0001
Male	35 888 (45.8)	14 735 (47.7)	21 153 (44.6)	
Female	35 646 (45.5)	13 249 (42.9)	22 397 (47.2)	
Missing	6 769 (8.6)	2 889 (9.4)	3 880 (8.2)	
Response, n (%)				<0.0001
Ambulance without physician	56 856 (72.6)	25 933 (84.0)	30 923 (65.2)	
Ambulance with physician	21 447 (27.4)	4 940 (16.0)	16 507 (34.8)	
Time of admission, n (%)				<0.0001
08:00–18:00 hours	33 787 (43.1)	13 897 (45.0)	19 890 (41.9)	
18:00–08:00 hours	44 516 (56.9)	16 976 (55.0)	27 540 (58.1)	
Day of week n (%)				0.25
Monday–Friday	56 019 (71.5)	22 016 (71.3)	34 003 (71.7)	
Saturday–Sunday	22 284 (28.5)	8 857 (28.7)	13 427 (28.3)	
Dispatch keyword category, n (%)				<0.0001
Accident/trauma	23 975 (30.6)	13 810 (44.7)	10 165 (21.4)	
Cardiovascular	18 404 (23.5)	5 226 (16.9)	13 178 (27.8)	
Internal disease (unspecified)	7 112 (9.1)	2 018 (6.5)	5 094 (10.7)	
Neurological	5 684 (7.3)	1 152 (3.7)	4 532 (9.6)	
Respiratory	5 025 (6.4)	869 (2.8)	4 156 (8.8)	
Paediatric	3 925 (5.0)	2 803 (9.1)	1 122 (2.4)	
Gastrointestinal	3 856 (4.9)	1 178 (3.8)	2 678 (5.6)	
Other emergency (unspecified)	3 449 (4.4)	1 176 (3.8)	2 273 (4.8)	
Intoxication/poisoning	2 970 (3.8)	1 150 (3.7)	1 820 (3.8)	
Other keywords	3 903 (5.0)	1 491 (4.8)	2 412 (5.1)	
Primary ICD-10 diagnosis, n (%)				<0.0001
XIX Injury, poisoning	23 592 (30.1)	13 169 (42.7)	10 423 (22.0)	
IX Circulatory system	11 115 (14.2)	792 (2.6)	10 323 (21.8)	
XVIII not elsewhere classified	8 625 (11.0)	3 695 (12.0)	4 930 (10.4)	
V Mental and behavioural disorders	4 485 (5.7)	1 258 (4.1)	3 227 (6.8)	
XI Digestive system	3 975 (5.1)	597 (1.9)	3 378 (7.1)	
X Respiratory system	3 844 (4.9)	505 (1.6)	3 339 (7.0)	
VI Nervous system	3 620 (4.6)	681 (2.2)	2 939 (6.2)	
I Infectious and parasitic	2 636 (3.4)	459 (1.5)	2 177 (4.6)	
XIII Musculoskeletal system	2 442 (3.1)	1 232 (4.0)	1 210 (2.6)	
Other chapters	7 676 (9.8)	2 248 (7.3)	5 428 (11.4)	
Missing	6 393 (8.0)	6 237 (20.2)	56 (0.1)	

*P values derived from χ^2 test for distinct variables and from Mann-Whitney U test for continuous variables. ED, emergency departments; EMS, emergency medical services.

RESULTS

Characteristics of ED cases transported by EMS

47 430 cases (60.6%) were admitted and 30 873 (39.4%) were discharged. Characteristics of both groups are reported and compared in [table 1](#). The comparison of

admitted and discharged cases shows that discharged cases were much younger (median of 40 vs 70 years, $p<0.0001$). The share of males in this group was slightly higher (47.7% vs 44.6%, $p<0.0001$). Discharged cases were less frequently brought in by an ambulance assisted

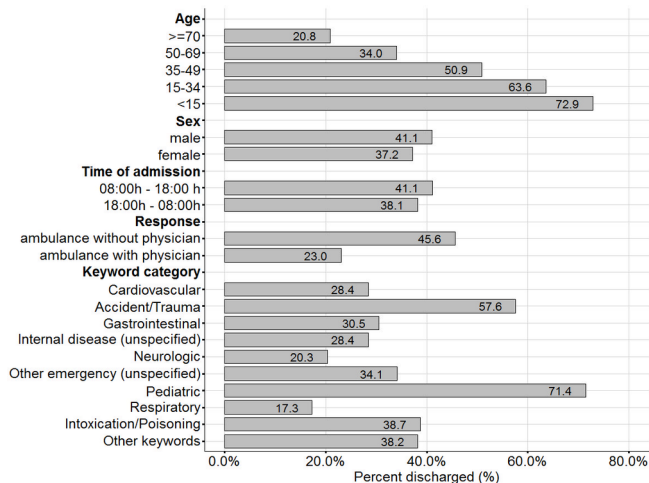


Figure 2 Probability of being discharged from emergency department after emergency medical service transport.

by emergency physicians (16.0% vs 34.8%, $p < 0.0001$). The most common keyword category was “Accident/Trauma” (44.7%) in case of discharge and “Cardiovascular” (27.8%) in case of admission. The most frequent diagnoses were within the main ICD-10 diagnosis chapter XIX (Injury, Poisoning), regardless of admission status.

Factors associated with discharge from ED after EMS transport

Figure 2 displays the proportion of cases discharged for different case characteristics. Whereas only 20.8% of cases over the age of 70 were discharged, 72.9% of cases under the age of 15 left the hospital after being seen in the ED. 45.6% of cases arriving in a paramedic-staffed ambulance were discharged, whereas only 23.0% were discharged when the ambulance crew was supported by an emergency physician. The proportion of discharged cases also varied according to dispatch keyword category, with highest discharge rates for keywords indicating the involvement of children or accidents/trauma and lowest discharge rates for keywords indicating respiratory or neurological problems.

Results from logistic regression analysis adjusting for all included variables are displayed in figure 3. After adjustment, the odds of discharge still increased with age: compared with cases over 70 years of age, cases under 15 years of age had 10 times higher odds of being discharged (OR 10.53, CI 9.31 to 11.92). The adjusted odds of discharge were 6% higher for women compared with men (OR 1.06, CI 1.02 to 1.10). Arrival between 18:00 and 8:00 (nighttime) decreased the odds of discharge by 26% (OR 0.74, CI 0.72 to 0.77). Compared with cases reporting a cardiovascular problem to the dispatcher, dispatch for intoxication or poisoning, respiratory, neurological or gastrointestinal and unspecified internal disease decreased the odds of being discharged, whereas odds of discharge were higher in case of dispatch for accidents or trauma, when children were involved and when the reported problem was not specified by the dispatcher.

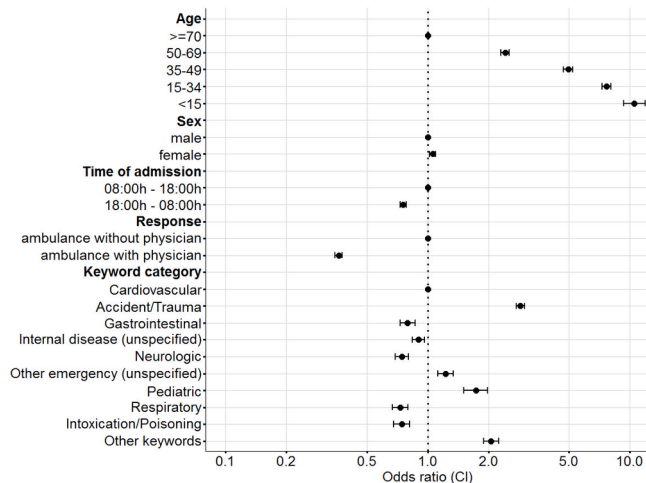


Figure 3 Adjusted ORs and CI (95%) for discharge.

When the model was stratified by age group, the strength of the association differed by age category but was reversed only for two keyword categories: Whereas dispatch for respiratory conditions was associated with discharge for cases under the age of 35, cases with respiratory problems aged 35 or older had higher odds of admission. In contrast, intoxication and poisoning led to decreased odds of discharge in younger cases but increased odds of discharge in older cases (table 2).

Hospital diagnoses

Most diagnoses were within chapter XIX, which includes injuries, poisoning and certain other consequences of external causes (table 1). Yet diagnoses from chapter XIX were more common for cases that were discharged (42.7% vs 22.0%). In contrast, diagnoses from chapter IX (diseases of the circulatory system) were more common when a case was admitted to the hospital (21.8% vs 2.6%). Diagnoses from chapters XIX (Injury, poisoning), XVIII (not elsewhere classified) and missing diagnosis information covered 75% of all diagnoses for discharged cases, whereas diagnoses of admitted cases were distributed across different diagnosis chapters.

The five most common three-digit ICD-10 codes in case of admission were F10 (mental and behavioural disorders due to use of alcohol), S06 (intracranial injury), I10 (essential (primary) hypertension), R55 (syncope and collapse), I63 (cerebral infarction). In case of discharge, the most common codes were S01 (open wound of head), S06 (intracranial injury), S00 (superficial injury of head), R55 (syncope and collapse), F10 (mental and behavioural disorders due to use of alcohol). These five most common three-digit ICD-10 codes accounted for about 20% of diagnosis codes in each group.

Dispatch keyword categories compared with hospital diagnoses

Tables 3 and 4 show the proportion of diagnoses from each ICD-chapter by dispatch keyword category for admitted and discharged cases. Regardless of the initial dispatch keyword, hospital diagnoses fell into many different

Table 2 Adjusted ORs and CI (95%) for discharge, stratified by age category

	<15 (n=5 075)		15–34 (n=15 346)		35–49 (n=10 859)		50–69 (n=15 995)		>=70 (n=31 028)	
	OR (CI)	P value	OR (CI)	P value	OR (CI)	P value	OR (CI)	P value	OR (CI)	P value
Sex (female)	1.04 (0.91 to 1.19)	0.57	1.01 (0.94 to 1.09)	0.84	1.31 (1.2 to 1.42)	<0.0001	1.17 (1.09 to 1.26)	<0.0001	0.90 (0.85 to 0.96)	<0.0001
Time (18:00–08:00 hours)	0.61 (0.53 to 0.69)	<0.0001	0.74 (0.68 to 0.80)	<0.0001	0.75 (0.69 to 0.82)	<0.0001	0.81 (0.75 to 0.87)	<0.0001	0.77 (0.73 to 0.82)	<0.0001
Response (with physician)	0.32 (0.28 to 0.37)	<0.0001	0.37 (0.34 to 0.4)	<0.0001	0.39 (0.35 to 0.43)	<0.0001	0.38 (0.35 to 0.41)	<0.0001	0.34 (0.31 to 0.37)	<0.0001
Dispatch keyword category										
Cardiovascular	Reference		Reference		Reference		Reference		Reference	
Accident/trauma	1.76 (1.09 to 2.82)	0.02	2.43 (2.19 to 2.71)	<0.0001	3.04 (2.72 to 3.41)	<0.0001	3.36 (3.05 to 3.7)	<0.0001	2.92 (2.69 to 3.18)	<0.0001
Other emergency (unspecified)	1.06 (0.56 to 1.98)	0.86	0.93 (0.77 to 1.12)	0.42	0.99 (0.81 to 1.21)	0.92	1.31 (1.1 to 1.56)	<0.0001	1.59 (1.36 to 1.85)	<0.0001
Gastrointestinal	1.89 (0.84 to 4.25)	0.13	0.73 (0.63 to 0.85)	<0.0001	0.73 (0.61 to 0.87)	<0.0001	0.76 (0.63 to 0.92)	<0.0001	0.87 (0.72 to 1.05)	0.14
Internal disease (unspecified)	1.24 (0.63 to 2.44)	0.53	0.65 (0.56 to 0.75)	<0.0001	0.97 (0.84 to 1.14)	0.74	0.95 (0.83 to 1.09)	0.46	1.03 (0.91 to 1.17)	0.65
Neurological	0.86 (0.37 to 2.01)	0.73	0.76 (0.64 to 0.91)	<0.0001	1.03 (0.86 to 1.24)	0.73	0.75 (0.64 to 0.88)	<0.0001	0.62 (0.53 to 0.71)	<0.0001
Respiratory	1.23 (0.59 to 2.55)	0.58	1.24 (1.01 to 1.53)	0.04	0.95 (0.77 to 1.19)	0.68	0.54 (0.45 to 0.64)	<0.0001	0.60 (0.51 to 0.70)	<0.0001
Intoxication and poisoning	0.86 (0.43 to 1.73)	0.67	0.5 (0.44 to 0.57)	<0.0001	0.88 (0.73 to 1.05)	0.14	1.46 (1.2 to 1.77)	<0.0001	1.23 (0.74 to 2.03)	0.42
Other keywords	1.73 (0.77 to 3.86)	0.18	1.58 (1.34 to 1.86)	<0.0001	1.89 (1.55 to 2.29)	<0.0001	1.83 (1.53 to 2.19)	<0.0001	2.71 (2.36 to 3.12)	<0.0001

Dispatch keyword category 'pediatric' is omitted.

Table 3 Distribution of diagnoses within diagnosis Chapters by dispatch keyword category (%), discharged cases

Dispatch keyword category	Diagnosis chapter											Total
	I	V	VI	IX	X	XI	XIII	XVIII	XIX	Other	Missing	
Accident/trauma	0.2	0.7	0.5	0.6	0.2	0.5	3.0	2.7	65.5	3.4	22.6	100
Cardiovascular	1.7	6.0	3.1	7.4	1.4	2.4	4.3	28.3	14.3	9.5	21.6	100
Internal disease (unspecified)	2.0	6.8	4.3	5.4	1.1	3.6	10.3	19.5	16.4	13.6	17.1	100
Neurological	1.1	6.6	21.5	4.4	1.0	1.6	3.5	17.7	11.5	12.3	18.7	100
Respiratory	1.6	6.4	3.0	3.9	12.3	1.8	5.6	19.1	16.2	8.6	21.3	100
Other emergency (unspecified)	1.6	3.1	2.6	4.7	1.1	2.3	10.7	15.0	29.9	13.2	15.8	100
Paediatric	5.9	0.2	0.5	0.3	7.8	2.4	1.8	4.5	57.4	6.8	12.4	100
Gastrointestinal	4.9	1.0	0.8	1.4	0.5	15.1	3.4	31.0	8.4	17.9	15.5	100
Intoxication/poisoning	0.4	38.4	0.3	0.4	0.3	0.3	1.8	5.4	27.7	5.7	19.1	100
Other keywords	1.7	5.7	2.3	2.6	1.1	1.6	3.4	23.2	26.2	11.5	20.7	100

The most common diagnosis chapter is highlighted in bold.

chapters. Exceptions were dispatch for ‘accident/trauma’ and ‘intoxication or poisoning’, where the majority of diagnoses (accident/trauma: chapter XIX diagnoses for 65.5% of cases when discharged, 71.6% when admitted; intoxication/poisoning: chapter XIX plus chapter V diagnoses for 66.1% of cases when discharged, 85.5% when admitted) came from compatible chapters. Diagnoses for admitted cases did match the initial dispatch keyword category more often than diagnoses for discharged cases, but still fell into different chapters. The distribution of diagnosis chapters differed between admitted and discharged cases, even within the same keyword category. With the exception of dispatch for neurological or respiratory problems, the most common hospital diagnosis for discharged cases came from either chapter XIX (injury, poisoning) or XVIII (not elsewhere classified), regardless of dispatch keyword category.

The most common ICD-codes within chapter XVIII were R55 (syncope and collapse), R07 (pain in throat and chest) R10 (Abdominal and pelvic pain) and R42 (dizziness and giddiness).

DISCUSSION

Principal findings

Discharge on the same day following EMS transport to an ED was associated with young age, dispatch of an ambulance without additional emergency physician support and arrival during the day. Discharge also was dependent on the dispatch keyword, with particularly high discharge rates for emergencies related to accidents or trauma and unspecified emergencies. A broad range of underlying diagnoses was observed for almost all dispatch keyword categories.

Table 4 Distribution of diagnoses within diagnosis Chapters by dispatch keyword category (%), admitted cases

Dispatch keyword category	Diagnosis chapter											Total
	I	V	VI	IX	X	XI	XIII	XVIII	XIX	Other	Missing	
Accident/trauma	1.4	3.6	2.0	6.0	1.3	1.8	3.2	4.2	71.6	4.8	0.2	100
Cardiovascular	5.0	4.5	4.4	38.4	4.5	5.4	2.2	17.6	6.7	11.1	0.1	100
Internal disease (unspecified)	9.1	5.9	5.1	19.3	6.0	10.8	5.0	9.1	6.2	23.2	0.1	100
Neurological	3.8	4.9	30.6	31.2	3.6	2.0	1.2	8.7	3.0	10.9	0.1	100
Respiratory	5.6	2.2	2.2	28.2	38.6	3.6	1.5	6.0	3.1	9.0	0.2	100
Other emergency (unspecified)	5.2	5.2	5.3	19.4	5.0	9.2	6.6	8.2	17.3	18.5	0.2	100
Paediatric	6.6	1.2	3.8	0.5	21.4	2.5	1.0	9.1	46.4	7.3	0.1	100
Gastrointestinal	7.8	1.5	0.8	3.7	1.8	50.2	0.8	10.5	1.8	21.0	0.0	100
Intoxication/poisoning	0.7	69.3	0.9	1.7	0.9	1.5	0.3	6.2	16.2	2.1	0.2	100
Other keywords	4.0	9.2	9.2	20.8	4.7	3.4	1.0	16.4	17.9	13.2	0.1	100

The most common diagnosis chapter is highlighted in bold.

I Infectious and parasitic IX Circulatory system V Mental and behavioural VI Nervous system X Respiratory system XI Digestive system XIII Musculoskeletal system XIX Injury, poisoning XVIII not elsewhere classified Other chapters include: VII Eye IV Endocrine, nutritional and metabolic XVII Congenital malformations, Blood and blood-forming organs XII Skin VIII Ear II Neoplasms XVI Originating in perinatal period XV Pregnancy, childbirth XXI Factors influencing health XX External cause.

Keywords and diagnoses were more similar when a condition seemed easily recognisable, like accidents or trauma and intoxication or poisoning. The distribution of diagnosis chapters differed between admitted and discharged cases, usually even within the same keyword category. Compared with admitted cases, a larger proportion of discharged cases were diagnosed with injuries or poisoning, whereas the proportion of circulatory system diseases was smaller in this group. Some diagnoses (alcohol intoxication, concussion and syncope) were frequently assigned to both, admitted and discharged cases.

Strengths and weaknesses of the study

Even though it allows a more complete investigation of the rescue chain, few studies link dispatch and hospital data. The use of routinely collected data comes along with several potential sources for bias. One of them is that 30% of dispatch records could not be linked to a hospital record because common identifiers (time stamps or patient age) were documented incorrectly or not at all. We believe that missing identifiers are due to input errors which are likely to be completely random, but we cannot rule out that lack of documentation might indicate that these cases were either less or more critically ill. We consider an overlap of time stamps together with an overlap of transport destination and patient age as suitable criteria to achieve adequate matches. Yet we can't rule out that false matches introduced some noise to the analyses. Another major weakness is that diagnosis information was missing for one out of five discharged cases because it is not relevant for reimbursement of these cases and not all hospitals ensure that diagnosis information of patients discharged from the ED is routinely documented. We therefore report the amount of missing data in all analyses and did not include hospital diagnoses in the regression model. Discharged cases are misclassified when they are admitted on another day, to another hospital or if they die in the ED. Comparison of ICD-10 diagnosis with dispatch keyword categories implies some degree of imprecision, since dispatch keywords often describe emergency situations or medical conditions rather than suspected diagnoses. We could not study patient factors which are likely to be associated with the outcome or other variables, like socioeconomic status or access to care and could not capture comorbid conditions, which are known to increase the risk of short-term adverse outcomes for time-critical 112 callers with the same complaint.¹⁴ The study area is a metropolitan area and results might be different in rural regions or even in metropolitan areas with different prehospital treatment or admission practices.

Interpretations and comparison with other studies

40% of cases transported to the ED by EMS were not admitted to the hospital. Our results can't be transferred to areas with different population composition and healthcare infrastructure. This might explain why even higher discharge rates of 70% were observed in a mixed urban, suburban and rural area in the USA,⁷ where alternatives to hospital emergency care are different. Another study

from the USA reports a 50% discharge rate of ambulance patients in an urban area.¹⁵ Studies in the prehospital setting in Sweden and Australia have assessed more than one third of patients as not being in need of prehospital interventions or ambulance transport, despite of ambulance dispatch.^{16 17}

Age was the strongest predictor of discharge even after adjustment for other patient and dispatch characteristics. Particularly young adults and children were more likely to be discharged than older cases. Other studies have found younger patients to be candidates for primary healthcare⁸ and less likely to need paramedic treatment.¹⁷ The decision to access ambulance and urgent care services is influenced by access to primary care, individual circumstances, perceived urgency and beliefs that resources can only be provided by a particular healthcare provider.^{5 6} These reasons were mentioned, along with a need for reassurance, the desire for a second opinion and lack of insurance, by parents who bring their child to the ED for minor illnesses. In these cases a 'wait and see' approach seems especially undesirable and the accurate assessment of the child's condition proves difficult to parents.¹⁸ These factors may also be important for EMS missions involving children. Conversely, elderly patients usually bear a higher amount of morbidity and a higher degree of frailty. An increased probability of admission or death after transport to ED was observed for a number of dispatch codes for cases over the age of 65.⁷ The lack of safe discharge arrangements for geriatric patients¹⁹ might make hospital admission the best option, even if the acute emergency situation is resolved. Age did modify the estimates, but rather impacted on the strength than the direction of the association, especially when looking at dispatch keyword categories. This might be because the spectrum of disease behind the same category is probably broad. If diseases behind the same keyword category vary by age group ORs of discharge between keywords categories subsequently shift.

Odds of discharge were lower when emergency physicians were dispatched. We expected the presence of a physician to be a marker of severity and thus decreased likelihood of hospital discharge, as physician dispatch is triggered by a higher probability of critically ill/injured patients and invasive interventions on scene.

Arrival at night also decreased the odds of discharge. Such cases could be of higher acuity. There may also be fewer alternatives to admission available, or decision-making may be postponed due to limited diagnostic availability or absence of senior physicians at the ED at night.

We hypothesised that certain dispatch keyword groups would clearly mark situations or health problems that usually do not lead to subsequent hospital admission. Other studies have identified a number of situations that were less likely to lead to hospital admissions or EMS transport or were considered suitable for referral to other levels of care. They include assaults and unconsciousness or fainting in younger patients,⁷ paediatric cases, psychiatric conditions, patients with low pain scores,¹⁷

nausea/vomiting/diarrhoea, seizures/epilepsy, back pain, pain during urination/haematuria, mental illness and unspecified disease.⁸ Low-acuity dispatch codes included abdominal pain, assault, back pain, pregnancy and childbirth, injuries and psychiatric conditions²⁰ and were validated in the same area,²¹ but did not turn out to be low-acuity in another community.²² Non-transport after EMS dispatch was especially more common after assault/sexual assault, unknown problem/man down, traffic/transportation accidents, unconscious/fainting²³ and mental, behavioural and neurodevelopmental disorders.²⁴ Our analysis shows that, compared with dispatch for cardiovascular problems, odds of discharge were especially high for cases transported after accidents or trauma, emergencies involving children and emergencies where dispatchers did not specify the reason for dispatch. We already discussed reasons why young age might increase the odds of discharge. Higher odds of discharge after accidents and injuries might be because diagnostic resources that are only available in a hospital setting are required for a thorough examination of these cases, after which they can frequently be cleared. Injury severity and whether these patients were readmitted for elective surgery remains unknown. However, that they could initially be discharged suggests that, overall, injury severity was presumably low. A need of hospital-specific resources could also apply to emergencies where the problem can't be specified by the dispatcher. Determining the priority level of unclear calls is particularly difficult, and they are therefore often provided with a either lower or higher response than needed.^{25 26}

The spectrum of disease differed between discharged and admitted cases, with a higher proportion of chapter XIX (Injury, poisoning) diagnoses in discharged and more ICD-10 chapter IX (circulatory system) diagnoses in admitted cases. Except for two keyword categories (accident/trauma and intoxication/poisoning), a broad range of underlying diagnoses was reflected by the same initial complaint for both admitted and discharged patients. Keyword category and hospital diagnosis were more similar when a condition seemed easily recognisable, like accidents or trauma and intoxication or poisoning. These situations might be more intuitive for patients and bystanders to describe. Discrepancies between keyword and diagnosis might point to patient groups that are probably more difficult to manage and were observed slightly more frequently for discharged cases. The distribution of cases across diagnosis chapters differed between admitted and discharged cases, even within the same keyword category. This suggests that the disease spectrum of both groups differs, even if similar complaints are initially expressed.

At dispatch, the correct assessment of urgency is more important than diagnostic accuracy. Still, complaints influence patient management. Prehospital emergency conditions usually do not present themselves as 'textbook examples'.²⁶ Especially non-surgical emergency patients often lack diagnosis-specific symptoms.²⁷ The analyses show that some conditions are very common in both

groups. They included alcohol intoxication, concussion and syncope. Standard operating procedures have been defined to handle these conditions in the ED²⁸ to safely identify patients with high risk of adverse outcomes and might be useful for a standardised assessment of emergency calls as well.

The dispatch centre is the earliest point of time in the rescue chain at which triage might occur, but due to limited information it is also one of the most difficult ones.²⁹ Most emergency response systems accept a certain level of over-triage as a safety margin^{16 30} but over-triage is also costly and can result in resources not being available to someone who needs them. The dispatcher allocates ambulances and specialised prehospital units³¹ and plays a key role in identifying the best resources for the caller or patient,³⁰ which mostly depends on an accurate assessment of the urgency and acute symptoms, and not on the overlap of dispatch data with later confirmed diagnosis or discharge from the ED. Odds of discharge and overlap with diagnosis are therefore not suitable to assess the quality of response decisions and not good criteria to base response decisions on. Yet, patient groups that are frequently discharged could be of particular interest or further more detailed analyses with regard to the urgency of their conditions. Information about the probability of discharge may furthermore be helpful to allocate patients to hospitals when hospital beds are congested.

There are other variables that probably impact on discharge or distort the relationship between included variables and discharge, and not considering them has consequences for the interpretation of estimates. They were not included in the analysis as they are not available at dispatch and not part of the routine data collection, and they are usually not available at the point where a response decision is made. Two important factors are morbidity and socioeconomic status. Socioeconomic status brings a higher burden of disease, and patients with low socioeconomic status are more likely to use acute and hospital care.³² Socioeconomic differences between chronic diseases seem to vary, with larger disparities for stroke, diseases of the nervous system, diabetes mellitus and arthritis.³³ Socioeconomic status is therefore likely linked with certain dispatch keyword categories and for instance low odds of discharge for neurological keywords might partially be masked by socioeconomic status. Regardless of the initial complaint, previous illness and comorbid conditions might always complicate treatment and therefore also decrease the odds of discharge. As morbidity increases with age, a part of the effect of age might actually be traced back to comorbid conditions.

CONCLUSION

Discharge was especially likely when patients were young or after dispatch for accidents/trauma. Except for accidents/trauma and intoxication/poisoning many underlying diagnoses were observed within dispatch categories. Even within the same dispatch keyword category, the

distribution of hospital diagnoses differed between admitted and discharged cases, indicating a differing spectrum of disease. Discharge from the ED after EMS transport can't be equated with low potential for critical illness or injury or no need for prehospital resources. Rapid transport may be necessary to exclude worrisome differential diagnoses or to treat conditions using resources that are not available outside of a hospital setting. Yet, the findings could guide allocation of ambulances to hospitals when hospital bed capacities are low, so that transport capacities are quickly available again. Frequently discharged patients are also worth a closer look regarding the urgency of their condition to manage the growing demand for emergency medical resources. To accurately identify patients that are not severely ill or injured and for a better evaluation of resource allocation, acuity should be assessed in addition to symptom keywords at dispatch.

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