The safety of non-transport decisions made by ambulance personnel: a retrospective study of subsequent hospital admission and 30-day mortality

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Abstract

Background: Ambulance missions do not always result in the patient being transported to a doctor or hospital after evaluation at the scene by ambulance personnel. Sometimes a patient is discharged at the scene but should have been transported for further examination and treatment. In this study, we aimed to identify and describe this group, and to investigate subsequent hospital admission within 72 hours and 30-day mortality, which may indicate the safety of leaving a patient at the scene after examination.

Method: This retrospective study was carried out in the Bergen health trust in western Norway and included ambulance missions from 2018. For each mission, we recorded the patient’s demographic information (age, gender, time of day), initial reason for contacting the emergency medical service (EMS), hospital admissions after non-transport, and time of death if within 30 days, in addition to some other variables.

Results: Among 33,183 included acute and urgent ambulance missions, 7.3% of the patients were discharged at the scene after evaluation by ambulance personnel. The median age in this group was 47 years (IQR 28–70 years), compared to 64 years (IQR 39–80 years) for all included missions. Following a non-transport decision, 4.8% of the patients were admitted to a public hospital within 72 hours (median age, 59 years; IQR 35–76 years), with mental and behavioral disorders (ICD-10 chapter V) being the most common reason for admission (24.8%). The 30-day mortality rate following non-transport mission was 2.4%. In this group, the median age was 83 years (IQR 73–90 years), and the most common reasons for contacting EMS were breathing difficulties or lung diseases (25.4%), and injuries or fractures (18.6%).

Conclusion: Our present analysis revealed low rates of hospital admission within 72 hours, and 30-day mortality, among patients left at the scene following evaluation by ambulance personnel. These findings do not suggest an unsafe rate of non-transport in the Bergen EMS. There remains a need for further evaluation of the factors involved in the decision not to transport a patient, and the safety of these decisions.
Background

Over recent years, there has been significantly increased pressure on the emergency medical system (EMS) and demand for ambulance assistance [1]. Patients requiring acute care rely on EMS capacity and availability [2]. However, it is also important to avoid unnecessary ambulance transports, and resultant overcrowding of the emergency department (ED). Therefore, ambulance personnel must evaluate whether each patient can be safely released at the scene or requires transport to a healthcare facility.

The responsibility of deciding whether a patient can be left at the scene places a heavy burden on ambulance personnel. Moreover, it has been questioned whether ambulance personnel have the necessary competence to correctly determine whether a patient requires transport. It may be unrealistic to expect a prehospital provider to make a correct decision without the diagnostic tools that are available in an ED [3]. Recent studies from Ireland and the US have shown that ambulance personnel under-triaged patients in 23% and 11% of cases, while 30% of transports to an ED were unnecessary [3, 4]. Another study from the US reported that the decision to leave a patient at the scene was incorrect in 9.3% of cases [5].

An ambulance mission may not result in patient transport to an ED or out-of-hours medical clinic for several reasons. Sometimes treatment at the scene, without subsequent transport to a hospital, is the most appropriate clinical response—for example, when a patient with known diabetes experiences an episode of hypoglycemia. In other cases, an ambulance call may be unnecessary because the caller and the call-taker in the emergency medical communication center (EMCC) perceived the patient’s condition as more severe than determined by the ambulance personnel who subsequently examines the patient. On the other hand, in some cases, a patient is discharged at the scene but was actually in need of acute care and should have been transported to a doctor for examination. This incorrect decision could potentially delay patient transport, and thus delay necessary treatment. However, patient over-triage is cost-ineffective and can also lead to delays in patient care [2].

Although ambulance personnel are trained to recognize a patient in critical condition and to initiate the correct treatment and transport, many other factors can influence the decision of whether to transport a patient. O’Hara and colleagues report that non-transport decisions are based on the following factors: chronic conditions, preferences of the patient or the family, availability of other referral options, and risks associated with hospital admissions [6]. System policies and staff expertise are also important factors affecting the decision of whether to transport a patient [7].
Non-transport, and consequently delayed diagnosis and treatment, of patients may result in increased illness severity or even mortality, and may increase the total health service costs through the need for additional service contacts [7]. A study in Western Australia reported a 7-day mortality rate of 0.5% for patients released at the scene compared to 0.3% for patients transported to an ED and later discharged after examination by a doctor [8]. This raises questions regarding patient safety following a non-transport decision. In this study, we aimed to investigate whether ambulance personnel’s decisions to not transport a patient were safe.

The Norwegian EMS
The Norwegian health system is divided into primary care and specialist healthcare. The EMS comprises ambulance and air ambulance services and the EMCC, all under the specialist healthcare system. An ambulance must be staffed with at least one certified ambulance personnel. To be licensed, one must have two years of high school and two years of vocational training in the EMS. It is also possible to obtain a bachelor’s degree in paramedic medicine [9]. EMCCs are staffed by nurses and dispatchers (often ambulance personnel), and the operators undergo additional training. Nurses answer emergency phone calls and triage patients, while resource coordinators dispatch ambulances.

All Norwegian EMCCs use the same triage tool: the Norwegian Index for Medical Emergency Assistance [10], which applies various criteria based on the reported clinical signs and symptoms. Using this information, calls are prioritized into three categories: “acute”, “urgent”, and “regular” calls. The calls are also categorized into index codes according to main complaint or the reason for requesting an ambulance. In the Bergen health trust, the ambulance personnel on the scene use the South African Triage Scale (SATS); a standardized emergency medical triage system for evaluating the patients and the urgency of a situation [11]. After examining a patient, ambulance personnel make the decision of whether to transport the patient or not.

Methods
Aim of investigation
Here we aimed to identify and describe the group of patients who received an “urgent” or “acute” ambulance mission and were then released at the scene following examination, as well as to study these patients’ health events following the missions. It was of particular
interest to investigate the ambulance service’s decision not to transport these patients. The present results could potentially be used to improve the education and training of ambulance personnel and EMCC staff, as well as the operating procedures, thereby increasing patient safety in the EMS.

**Study design**
This retrospective study was carried out in the Bergen health trust, which includes 17 ambulance stations and one EMCC, covering 24 municipalities with a total population of 455,000 inhabitants [12]. The Bergen health trust is the only EMS provider in the area and is responsible for all types of ambulance transport. There are three hospitals in the area, of which one is a private institution covering approx. 30% of the population. However, this hospital does primarily admit general medical patients and some orthopaedic conditions (e.g. not patients in need of PCI, major trauma cases, gynecological / obstetric patients, ophthalmology and ENT).

**Data collection**
A dataset including all ambulance missions during 2018 was extracted from the EMCC’s electronic record system database (Acute Medical Information System, AMIS). The data included index codes, urgency level, time and place, patient gender and age, whether the patient was transported, and to which facility if transported. These data were then linked with the hospital’s patient record system. From this combined data set, we could identify the ambulance missions that did not include patient transport, but where the patient was admitted to a hospital within 72 hours or died within 30 days after the non-transport ambulance mission. Data on hospital admission could not be identified from the private hospital due to privacy reasons. The datafile was de-identified prior to statistical analysis and evaluation.

**Inclusion and exclusion criteria**
From a total 59,566 ambulance missions, we selected the patients in the triage groups “urgent” and “acute” as triaged by EMCC, thus excluding missions with the lowest degree of urgency (Fig. 1). Other missions were excluded for the following reasons: patient ID unknown; cancelled missions; patient transported by another ambulance; missions where the transport was ordered by a doctor at a hospital, an out-of-hours medical clinic, or a general practitioner; and patients who were pronounced dead when the ambulance arrived on scene.
Outcomes
Among all of the identified ambulance missions where the patient was not transported to the hospital or another healthcare facility, we further extracted those where the patient was admitted to hospital within 72 hours or died within 30 days after the decision to discharge the patient at the scene. The following demographic variables were analyzed and compared: gender, age, time of day, day of the week, municipality type and degree of urgency. The municipalities were categorized by “rurality” as urban (Bergen), semi-urban (Os, Fjell, and Askøy), or rural (the 20 other municipalities).
The main cause for requesting an ambulance was identified according to the index code made by the EMCC [10] and categorized. For the group of patients who were admitted to a hospital within 72 hours, we recorded the main cause of admittance, classified according to ICD-10. In both groups, information was also collected to determine whether a doctor was present or consulted via phone before the ambulance personnel left the patient at the scene, in addition to the reported reasons for non-transport.

To examine whether any demographic factors significantly increased the risk of dying after a non-transport decision, we performed a survival analysis for the missions followed by patient death within 30 days, compared to all non-transport missions. The following variables were included in the analysis: age, gender, time of day, day of the week, municipality type, degree of urgency and total number of missions for each patient ending in non-transport for the study period of 2018.

**Ethical approval**
The Regional committee for medical and health research ethics (REK), decided that the study was quality improvement. According to national regulations, such studies require approval by the hospital, which was obtained. The data was stored on a secured server, and a de-identified file was constructed and used for the analysis.

**Statistical analysis**
Descriptive methods were used to characterize the sample. The survival data were analysed using Kaplan-Meyer methods, where differences between groups were tested by logrank and Gehan-Breslow tests. Due to the low number of events we abstained from estimating multivariate models. A p value of <0.05 was considered statistically significant. The data were analyzed using SPSS 26 (IBM Corp, Armonk, NY)) and R [13] and the graphics were derived using Matlab 9.0 (The Mathworks Inc, Natick, MA).

**Results**
**Non-transport rates**
After applying the exclusion criteria, the data set included 33,183 ambulance missions, of which 30,767 (92.7%) resulted in ambulance transport of the patient. The remaining 2416 (7.3%) patients receiving an urgent or acute ambulance mission were released at the scene following examination by the ambulance personnel. Table 1 shows characteristics of all
included ambulance missions, all missions ending in non-transport, patients who were admitted to a hospital within 72 hours after a non-transport mission and patients who died within 30 days after a non-transport mission.

Among the ambulance missions resulting in discharge at the scene, 57% of the patients were male. Median patient age was 47 years (IQR 28–70 years) in the non-transport missions, compared to 64 years (IQR 39–80 years) among all included ambulance missions.

Table 2 shows the index code chosen by the EMCC operator, based on the symptoms and signs reported in the emergency medical call.

| Variable                      | All included missions (n = 33,183) | Non-transport missions (n = 2416) | Hospital admission within 72 h (n = 117)* | Death within 30 days (n = 59) |
|-------------------------------|-----------------------------------|-----------------------------------|------------------------------------------|-------------------------------|
| Gender                        |                                   |                                   |                                          |                               |
| Male                          | 17,236 (52%)                      | 1365 (57%)                        | 52 (44%)                                 | 33 (56%)                      |
| Female                        | 15,947 (48%)                      | 1051 (44%)                        | 65 (56%)                                 | 26 (44%)                      |
| Age in years                  |                                   |                                   |                                          |                               |
| Median (IQR)                  | 64 (39–80)                        | 47 (28–70)                        | 59 (35–76)                               | 83 (73–90)                    |
| <20                           | 2494 (8%)                         | 284 (12%)                         | 15 (13%)                                 | 0                             |
| 20–60                         | 12,647 (38%)                      | 1309 (54%)                        | 45 (39%)                                 | 6 (10%)                       |
| >60                           | 18,042 (54%)                      | 823 (33%)                         | 57 (49%)                                 | 53 (77%)                      |
| Time of day                   |                                   |                                   |                                          |                               |
| Day (07–19)                   | 19,722 (59%)                      | 1131 (47%)                        | 72 (62%)                                 | 30 (51%)                      |
| Night (19–07)                 | 13,461 (41%)                      | 1285 (53%)                        | 45 (38%)                                 | 29 (49%)                      |
| Day of week                   |                                   |                                   |                                          |                               |
| Monday–Thursday               | 18,637 (56%)                      | 1261 (52%)                        | 58 (50%)                                 | 26 (44%)                      |
| Friday–Sunday                 | 14,546 (44%)                      | 1155 (48%)                        | 59 (50%)                                 | 33 (56%)                      |
| Urgency                       |                                   |                                   |                                          |                               |
| Acute                         | 14,326 (43%)                      | 1212 (50%)                        | 60 (51%)                                 | 35 (59%)                      |
| Urgent                        | 18,857 (57%)                      | 1204 (50%)                        | 57 (49%)                                 | 24 (41%)                      |
| Municipality type             |                                   |                                   |                                          |                               |
| Urban (Bergen)                | 21838 (66%)                       | 1475                              | 67 (57%)                                 | 33                            |
| Semi-urban (Os/Fjell/Askøy)   | 4254 (13%)                        | 389                               | 23 (20%)                                 | 10                            |
| Rural (other)                 | 7091 (21%)                        | 552                               | 27 (23%)                                 | 16                            |
| 30-day mortality              | 4%                                | 2.40%                             | 2.60%                                    |                               |

* Numbers only from public hospitals. Data on hospital admission from the private hospital were not accessible due to privacy reasons. Expecting this rate to be similar to the rest of the population, the estimated number of admissions would have been 170.
Table 2 Reasons for requesting an ambulance for all non-transport missions

| Index code made by EMCC                     | n (%)    |
|--------------------------------------------|----------|
| Injuries or fractures                      | 538 (22.3%) |
| Breathing difficulties or lung diseases    | 374 (15.4%) |
| Stroke or reduced consciousness           | 191 (7.9%) |
| Fire or electrical injuries               | 182 (7.5%) |
| Psychiatry or intoxication                | 170 (7.0%) |
| Unconscious patient                       | 138 (5.7%) |
| Hypothermia                                | 106 (4.4%) |
| Heart and circulatory diseases            | 104 (4.3%) |
| Seizures                                   | 62 (2.6%)  |
| Uncertain issue                           | 424 (17.5%) |
| Other*                                     | 127 (5.2%)  |
| **Total**                                  | 2416 (100%) |

*Others include allergic reaction; sick child; stomach pain; infection; diabetes; gynecology and obstetrics; urinary tract; headache; skin/rash; bite/stick; ear, neck, and throat; eye diseases; violence or abuse

Hospital admission and death rates

Hospital admission rate to the private hospital could not be identified due to privacy reasons. Anticipating that the population covered by this hospital is similar to the rest, the estimated admission rate would have been 7% (170 patients). However, 117 (4.8%) patients were admitted to the two public hospitals within 72 hours after a non-transport ambulance mission. In this patient group, 56% were female, and the median age was 59 years (IQR 35–76 years) (Table 1). Table 3 shows the distribution of the ICD-10 categories for these patients as recorded by the receiving doctor at the hospital, whereas table 4 shows the index codes made by the EMCC when the request for an ambulance was made. The following index codes were most often recorded as reasons for requesting an ambulance: psychiatry or intoxication (23.9%), breathing difficulties or lung diseases (18.8%), injuries (16.2%) and heart and circulatory diseases (13.7%). The following ICD-10 main diagnostic groups were most often recorded as reasons for admittance: mental and behavioral disorders (24.8%), circulatory system diseases (15.4%), nervous system diseases (11.1%) and respiratory system diseases (10.3%). As seen in table 4, the majority of the patients were treated at the scene (50.4%) and a doctor was either present or consulted with in 77% of the cases. Of the 117 missions that were followed by hospital admission within 72 hours, three patients (2.6%) died within 30 days after non-transport.
**Table 3** The distribution of the ICD-10 categories recorded by the receiving doctor at the hospital

| ICD-10-chapter                                                                 | n (%)     |
|--------------------------------------------------------------------------------|-----------|
| Chapter IV (Endocrine, nutritional, and metabolic diseases)                    | 4 (3.4%)  |
| Chapter V (Mental and behavioral disorders)                                   | 29 (24.8%)|
| Chapter VI (Diseases of the nervous system)                                   | 13 (11.1%)|
| Chapter IX (Diseases of the circulatory system)                               | 18 (15.4%)|
| Chapter X (Diseases of the respiratory system)                                | 12 (10.3%)|
| Chapter XI (Diseases of the digestive system)                                 | 10 (8.5%) |
| Chapter XIV (Diseases of the genitourinary system)                            | 5 (4.3%)  |
| Chapter XVIII (Symptoms, signs, and abnormal clinical and laboratory findings)| 5 (4.3%)  |
| Chapter XIX (Injury, poisoning, and certain other consequences of external causes) | 9 (7.7%)  |
| Other*                                                                        | 10 (8.5%) |
| Unknown                                                                       | 2 (1.1%)  |
| Total                                                                         | 117 (100%)|

* Other includes chapter I (infectious diseases), II (neoplasms), III (diseases of the blood), VII (diseases of the eye), XII (diseases of the skin), and XIII (diseases of the musculoskeletal system)

Among all missions where the patient was discharged at the scene, 2.4% of patients died within 30 days. The median age of these patients was 83 years (IQR 73–90 years). Survival analysis revealed that the risk of dying after a non-transport mission was significantly increased with increasing age. The mortality rate after a non-transport mission was 0.4% for patients of <60 years old, compared to 6.3% for patients of >60 years old (Fig. 2, left panel). A patient’s 30-day mortality risk did not increase with a greater number of requests for an ambulance ending in non-transport (Fig. 2, right panel). Moreover, the risk of 30-day mortality after a non-transport mission was not significantly associated with gender, time of day, day of the week, or municipality type (rurality) (Supplement 1).
Fig. 2 Survival (Kaplan-Meyer) during the first 30 days after discharge at the scene according to age and number of ambulance requests

Among the missions followed by mortality within 30 days, 15% of patients were in a palliative condition, and 39% of these patients were staying in a nursing home at the time. As seen in table 4, the most common reason for non-transport was that the patient received treatment at the scene (40%). In most of the missions, a doctor was either present or consulted with by phone. However, in 15% of the cases, the decision to not transport the patient was made solely by the ambulance personnel. Most of the missions were categorized in the following index groups: difficulty breathing or respiratory diseases (25.4%), injuries or fractures (18.6%), and syncope or reduced consciousness (16.9%). Over half (59%) of the cases were acute.
Table 4 Characteristics of non-transport missions after which the patient was admitted to hospital within 72 hours or died within 30 days

| Index-group recorded by EMCC when request for ambulance was made | Death within 30 days | Hospital admission within 72h |
|---------------------------------------------------------------|----------------------|-----------------------------|
| Breathing difficulties or lung diseases                      | 15 (25.4%)           | 22 (18.8%)                  |
| Injuries                                                      | 11 (18.6%)           | 19 (16.2%)                  |
| Syncope or reduced consciousness                             | 10 (16.9%)           | 14 (12.0%)                  |
| Psychiatry or Intoxication                                   | 7 (11.8%)            | 28 (23.9%)                  |
| Neurology or cramps                                          | 5 (8.4%)             | 10 (8.5%)                   |
| Heart and circulatory diseases                               | 4 (6.8%)             | 16 (13.7%)                  |
| Diabetes                                                     | 2 (3.3%)             | 4 (3.4%)                    |
| Other *                                                      | 5 (8.4%)             | 4 (3.4%)                    |

| Doctor present at the scene or consulted with over the phone  | n (%) | n (%) |
|---------------------------------------------------------------|-------|-------|
| Present                                                      | 17 (28.8%) | 25 (21.4%) |
| Consulted with                                               | 29 (49.1%) | 65 (55.6%) |
| Not present or consulted with                                | 9 (15.3%)  | 20 (17.1%)  |
| Unknown                                                      | 4 (6.8%)   | 7 (6.0%)     |

| Reason for non-transport                                      | n (%) | n (%) |
|---------------------------------------------------------------|-------|-------|
| Treated at the scene                                         | 24 (40.1%) | 59 (50.4%) |
| Improvement before or when ambulance arrived                 | 4 (6.8%)  | 23 (19.7%)  |
| Patient didn’t want transport                                | 15 (25.4%) | 27 (23.1%)  |
| Preterminal                                                  | 2 (4%)     | 1 (0.9%)     |
| Unknown                                                      | 14 (23.7%)  | 7 (6.0%)     |

**Total** 59 (100%) 117 (100%)**

*Others include assistance for nursing home, message of concern, infections and abdominal pain

** Data on hospital admission from the private hospital could not be obtained due to privacy reasons. Expecting this rate to be similar to the rest of the population, the estimated number of admissions would have been 170.

Discussion

Occurrence of non-transport ambulance missions

The rates of ambulance non-transport missions vary widely among different countries. In the present study, we found that 7.3% of ambulance missions in the Bergen health trust in Norway did not result in patient transport. A recent systematic review that included studies from North America, Europe, Australia, Asia, and Africa reported that non-transport rates
varied from 4% to 94% [7]. Other studies have found non-transport rates of 40% in Finland [14], 38% in the UK [15], 26.2% in Netherlands [16], 15.5% in Australia [8], 13.8% in Sweden [17], and 12.9% in Denmark [18]. Comparatively, the non-transport rate in our study is low. There is not yet a consensus regarding the optimal non-transport rate for an ambulance service. Establishing an optimal rate would require further modelling of the cost-effectiveness of non-transport options, as well as the safety and appropriateness of different rates of non-transport [7].

Here we found that men were more likely to be discharged at the scene than women were. Patients in the non-transport group were also significantly younger compared to the total ambulance mission population. Other Nordic studies have described a higher probability of non-transport for women and younger patients [17, 13]. On the other hand, a study from the Netherlands found no significant difference for gender, although the non-transport group was significantly younger (mean age 48.5 years vs 60.7 years for all missions) [16]. When deciding whether to transport a patient, ambulance personnel must consider several important factors. Compared to younger patients, older patients generally have more comorbidities and a higher risk of more severe diseases, as well as a reduced ability to cope with an emergency situation [19]. This may explain why older patients are more likely to be transported to a hospital.

In our study, most non-transport cases were classified as injuries or fractures, followed by breathing difficulties or lung diseases, and stroke or reduced consciousness. A study in Sweden reported that most non-transport cases were non-specific or related to psychiatric problems [18]. In the Netherlands, the most common reasons for non-transport missions were diseases of the circulatory system (ICD-10:9); injuries or poisoning (ICD-10:19); or mental, behavioral, and neurodevelopmental disorders (ICD-10:5) [16]. Injuries appear to be a common main cause of non-transport missions. Other findings regarding the causes of non-transport missions were not similar to reports from other countries, which may be partly explained by the use of different classification systems.

**Subsequent hospital admission**

To evaluate patient safety in the acute healthcare system following the decision not to transport the patient, we examined subsequent health events. Among the missions in which patients were left at the scene, 4.8% of patients were admitted to a hospital within 72 hours later. However, this proportion may be 7.0% because data on admissions rate could not be obtained from the private hospital covering 31% of the population. Other studies have
reported similar and higher hospital admission rates for patients discharged at the scene. In a data linkage study from the UK, 6.8% of patients were admitted to a hospital within 72 hours following a non-transport ambulance mission [15]. Other studies have found an upper event rate of 10% for hospital admission within 72 hours after a non-transport mission [8]. An Australian study revealed a significantly increased risk of subsequent events among patients discharged at the scene compared to patients transported and later discharged from the ED; with 3.3% admitted to a hospital within 24 hours following a non-transport mission, compared to 0.8% subsequently admitted to a hospital after being transported and discharged from the ED [8].

To compare the index codes made by the EMCC when the initial request for an ambulance was made with the ICD-10 categories recorded by the receiving doctor at the hospital, might give us an idea of whether the cause of later admittance is similar to the reason for the initial request for an ambulance. Psychiatry or mental and behavioral changes is the largest group in both instances. Circulatory system diseases and respiratory system diseases are also common causes for both ambulance request and admittance to hospital. This suggests that the reason for contacting the EMCC and the reason for admittance is related for a majority of the patients. However, further insight into whether these causes are similar in the individual cases is necessary.

There was a high proportion of patients with psychiatric illness who became admitted to hospital within 72 hours after being left at the scene by ambulance personnel. A study in the US found that 30% of psychiatric patients treated in an ED were readmitted to a hospital within 30 days [20]. Patients with psychiatric diseases are vulnerable, and their diseases are often complex [21]. Our results suggest that alternative care options may be needed for these patients, for example mental health acute assessment teams [22].

If the patients who were admitted to a hospital within 72 hours had instead been admitted at first contact, disease complications could potentially have been avoided. Transport at the initial mission might also have been more cost-effective for the health service. However, it is also possible that the patient’s condition significantly worsened during the 72 hours after being discharged at the scene, such that there was no indication or need for admission at first contact, even though they were later admitted to hospital. Importantly, these arguments are just speculations. Evaluation of whether the right decision was made in individual cases will require further investigation of whether the initial reason for contacting the EMS is similar to the reason for admittance within 72 hours.
Mortality

In this study, we found a 30-day mortality rate of 2.4% among patients who were discharged at the scene. In most cases, a doctor was consulted before the patient was left at the scene. This places some of the responsibility on the doctor; however, when the doctor is consulted over the phone, the ambulance personnel must still examine and evaluate the situation to present information to the doctor.

A study in the US compared 30-day mortality rates after EMS missions and found that mortality was 4.9% for transported patients and 1% for those not transported [23]. This was consistent with their hypothesis that transported patients more commonly have illnesses of greater severity. However, their study population was small, and only two patients died. Their results are in line with our present findings, with 30-day mortality rates of 4% among patients in all ambulance missions, compared to 2.4% among the non-transported patients. A systematic review was conducted to describe safety among non-transported patients by investigating mortality and found several studies that reported death rates ranging from 0% (measured at day 1) to 2.3% (measured after 2 weeks) [15]. Another systematic review found the 30-day mortality rate to be up to 1.6% [24]. A prospective study from Iran reported a mortality rate of 5.1% up to one year after a non-transport decision [25].

Although the 30-day mortality rate in our study is higher than those reported in most other studies, we consider the rate to be acceptable. Most of the patients who died within 30 days after a non-transport mission were older than 80 years, with a mortality rate of 8.8%. Similarly, Coster et al. [15] reported that most deaths amongst patients discharged at the scene were in older age groups. In 39% of the missions in our study, the patient stayed at a nursing home, with 24-hour nurse presence and a doctor available during the daytime. In 15% of the non-transport missions, the patients were receiving palliative care. During these missions, the decision not to transport the patient was likely because the patient had a non-curable disease and was near the end of life, and treatment at the scene was intended to spare the patient from the burden of yet another hospital admission.

However, it is possible that in some of the non-transport cases, the patient should have been brought to a hospital for treatment, which might have affected the outcome. It is difficult to know whether the patient’s death could have been postponed or avoided if the patient was transported. Some patients might have died from causes other than the reason for the ambulance mission. The study from Iran [25] concluded that whether the mortality rate is acceptable is dependent on the real cause of death. This is also an important factor in our
study. Further investigation of the cause of death is necessary to attain greater insight into whether it was correct to leave a patient at the scene.

**Limitations**

Our present dataset was large, and we investigated a wide range of variables. However, our study has certain limitations. As this was a retrospective study, the results are based on what was documented in the record system, and not on prospective ambulance missions. It is possible that the ambulance personnel or EMCC operators did not document everything correctly. Moreover, several of the records were incomplete. A total of 2689 missions lacked a patient ID and were thus excluded, reducing the size of the dataset. Notably, 1420 of the missions lacking a patient ID did not result in transport to a hospital, constituting a rather large proportion (37%) of the total of patients discharged at the scene. This may have introduced bias. Theoretically, if the missions lacking a patient ID had twice the mortality rate, the total mortality rate for all non-transported patients would increase to 3.3%. On the other hand, if this group had 50% of the mortality rate, the rate would be 2%. Therefore, the missing patients would not change our overall conclusion that the mortality rate was low.

This study revealed several reasons for non-transport, including patients who refused to be transported for a doctor’s examination. In these cases, it was not the ambulance personnel’s decision to discharge the patient on scene. However, it remains their responsibility to inform the patient about the necessity of hospital admission in each case, and the possible adverse outcomes of demanding to be left at the scene. Another limitation might be the fact that some patients were receiving end-of-life care, with a do-not-resuscitate order and an agreement with their doctor that they would prefer to die at home or in a nursing home. Such patients were not excluded from the 30-day mortality group. It is also possible that we did not detect all patients who were receiving end-of-life care, as this information is not routinely recorded in AMIS.

In this study, we used the mortality rate and hospital admission rate within a certain period as an indicator of adverse outcome for non-transport patients. We were unable to identify the cause of deaths, and thus could not determine whether the cause of death was related to the original reason for the ambulance mission. This would have provided valuable information about whether the mortality rate is acceptable, and the non-transport decisions were correct. Future studies of this topic could use a short event period to increase the probability that subsequent events will be associated with the non-transport decision.
However, if the event period is too short, one might miss some events related to the discharge of the patient. Therefore, we decided on the timeframes of a 30-day mortality rate and 72-hour hospital admission rate following the non-transport decision. The fact that complete hospital admission data could not be obtained is a limitation, but the estimate of 7.0% is also fairly low compared to other studies.

Finally, the study was based on the specific EMS organization in Norway, limiting the transferrability of our results to countries with different organization of their healthcare systems.

**Conclusion**

Our study found low rates of hospital admission within 72 hours and mortality within 30 days following non-transport ambulance missions. Thus, the results do not suggest an unsafe practice of non-transport in the Bergen EMS. In Norway, the ambulance service does not routinely receive information about subsequent events following patient discharge at the scene. These event rates should be monitored to enable routine assessment of the safety of non-transport decisions, and to facilitate learning and improvement.

The exact relation between subsequent event rates and rates of non-transport ambulance missions remains uncertain. Further examination of this require investigating the causes of death and the reasons for later hospital admissions in individual cases, to determine whether they are related to the reason for the initial ambulance mission. Further, there is a need for more detailed evaluation and investigation of the specific factors involved in the decision not to transport a patient, and also the safety of these decisions.
**Abbreviations**

EMS: Emergency Medical System; ED: Emergency Department; EMCC: Emergency Medical Communication Centers; SATS: South African Triage Scale; AMIS: Acute Medical Information System; DIPS: The hospital’s patient record system; ER: Emergency Room; REK: Regional committees for Medical Research Ethics
Declarations

Ethics approval and consent to participate
The Regional committee for medical and health research ethics (REK), decided that the study was quality improvement. According to national regulations, such studies require approval by the hospital, which was obtained. The data was stored on a secured server, and a de-identified file was constructed and used for the analysis.

Consent for publication
Not applicable.

Availability of data and materials
The data that support the findings of this study are available from the Bergen health trust, but restrictions apply to the availability of such data. Data are however available from the authors upon reasonable request.

Competing interests
The authors declare that they have no competing interests.

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Author’s contributions
Study conception and design (KA, MSE, LM, GB). Data collection (LM, AL). Statistical analyzes (KA, MSE, LM, JA). Manuscript preparation (KA, MSE, GB). All authors read and approved the final manuscript.
References

1. Raatinemi L, Brattebø G. The challenge of ambulance missions to patients not in need of emergency medical care. Acta Anaesthesiol Scand. 2018;62:584-7.

2. Pekanoja S, Hoikka M, Kyngäs H, Elo S. Non-transport emergency medical missions - a retrospective study based on medical charts. Acta Anaesthesiol Scand. 2018;62:701-8.

3. Cummins NM, Dixon M, Garavan C, Landymore E, Mulligan N, O’Donnell C. Can advanced paramedics in the fields diagnose patients and predict hospital admission? Emerg Med J. 2013;30:1043-7.

4. Gratton MC, Ellison SR, Hunt J, Ma OJ. Prospective determination of medical necessity for ambulance transport by paramedics. Prehosp Emerg Care. 2003;7:466-9.

5. Schmidt TA, Atcheson R, Federiuk C, et al. Hospital follow-up of patients categorized as not needing an ambulance using a set of emergency medical technician protocols. Prehosp Emerg Care. 2001;5:366-70.

6. O'Hara R, Johnson M, Hirst E, et al. A qualitative study of decision making and safety in ambulance service transitions. Health Serv Deliv Res 2014;2(56)

7. O’Cathain A, Jacques R, Stone T, Turner J. Why do ambulance services have different non-transport rates? A national cross sectional study. PLoS One. 2018;13:e0204508.

8. Tohira H, Fatovich D, Williams TA, et al. Is it appropriate for patients to be discharged at the scene by paramedics? Prehosp Emerg Care. 2016;20:539-49.

9. The Norwegian Directorate of Education (Utdanningsdirektoratet). https://utdanning.no/yrker/beskrivelse/ambulansearbeider (2019). Accessed 23 Sep 2020.

10. Hardeland C, Dreyer K, Hesselberg N, et al. The Norwegian Index for Medical Emergency Assistance (Norsk indeks for medisinsk nødhjelp). 4th edition. Oslo: NAKOS; 2018.

11. Bergen Health Trust (Helse Bergen). https://helse-bergen.no/seksjon/mottaksklinikken/Documents/SATS%20Norge%20versjon%203.0%20brukerveiledning.pdf (2016). Accessed 26 Sep 2020.

12. Bergen Health Trust (Helse Bergen). About us. https://helse-bergen.no/omoss#opptaksomrade-kommunar-og-innbyggjartal (2020). Accessed 24 Aug 2020.

13. R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
14. Paulin J, Kurola J, Salanterä S, et al. Changing role of EMS -analyses of non-conveyed and conveyed patients in Finland. Scand J Trauma Resusc Emerg Med. 2020;28(1):45.

15. Coster J, O’Cathain A, Jacques R, Crum A, Siriwardena AN, Turner J. Outcomes for patients who contact the emergency ambulance service and are not transported to the emergency department: A Data Linkage Study. Prehosp Emerg Care. 2019;23:566-77.

16. Vloet LCM, de Kreek A, van der Linden EMC, et al. A retrospective comparison between non-conveyed and conveyed patients in ambulance care. Scand J Trauma Resusc Emerg Med. 2018;26(1):91.

17. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Djärv T. Non-conveyance in the ambulance service: a population-based cohort study in Stockholm, Sweden. BMJ Open. 2020;10:e036659.

18. Højfeldt SG, Sørensen LP, Mikkelsen S. Emergency patients receiving anaesthesiologist-based pre-hospital treatment and subsequently released at the scene. Acta Anaesthesiol Scand. 2014;58:1025-31.

19. Magnusson C, Källenius C, Knutsson S, Herlitz J, Axelsson C. Pre-hospital assessment by a single responder: the Swedish ambulance nurse in a new role: a pilot study. Int Emerg Nurs. 2016;26:32-7.

20. Henderson SC, Owino H, Thomas KC, et al. Post-discharge health services use for patients with serious mental illness treated at an emergency department versus a dedicated community mental health center. Adm Policy Ment Health. 2020;47:443-50.

21. Ford-Jones PC, Chaufan C. A critical analysis of debates around mental health calls in the prehospital setting. Inquiry. 2017; doi:10.1177/0046958017704608

22. Faddy SC, McLaughlin KJ, Cox PT, Muthuswamy SS. The mental health acute assessment team: a collaborative approach to treating mental health patients in the community. Australas Psychiatry. 2017;25:262–5.

23. Schmidt MJ, Handel D, Lindsell CJ, Collett L, Gallo P, Locasto D. Evaluating an emergency medical services-initiated nontransport system. Prehosp Emerg Care. 2006;10:390-3.

24. Ebben RHA, Vloet LCM, Speijers RF, et al. A patient-safety and professional perspective on non-conveyance in ambulance care: a systematic review. Scand J Trauma Resusc Emerg Med. 2017;25:71.
25. Peyravi M, Örtenwall P, Khorram-Manesh A. Can medical decision-making at the scene by EMS staff reduce the number of unnecessary ambulance transportations, but still be safe? PLoS Curr. 2015;7.