TITLE: Is it appropriate for patients to be discharged at the scene by paramedics?

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Potential Conflict of Interest:

Ian Rogers is a member of the Board of Directors and (Acting) Clinical Director of St John Ambulance Western Australia (SJA-WA). Glenn Arendts is a member of the SJA-WA Medical Policy Committee. Tony Ahern is CEO of the SJA-WA. Judith Finn receives research funding from the SJA-WA. The authors alone are responsible for the content and writing of the paper.

Title:

Is it appropriate for patients to be discharged at the scene by paramedics?

Abstract

Background: Outcomes of patients who are discharged at the scene by paramedics are not fully understood.

Objective: We aimed to describe the risk of re-presentation and/or death in prehospital patients discharged at the scene.

Methods: We conducted a retrospective cohort study using linked ambulance, emergency department (ED) and death data. We compared outcomes in patients who were discharged at the scene by paramedics with those who were transported to ED by paramedics and then discharged from ED between January 1 and December 31, 2013 in metropolitan Perth, Western Australia. Occurrence of subsequent ambulance requests, ED attendance, hospital admission and death were compared between those discharged at the scene and those discharged from ED.

Results: There were 47,330 patients during the study period, of whom 19,732 and 27,598 patients were discharged at the scene and from ED, respectively. Compared to those discharged from ED, those discharged at the scene were more likely to subsequently: request an ambulance (6.1% vs. 1.8%, adjusted odds ratio [adj OR] 3.4; 95% confidence interval [CI] 3.0-3.9), attend ED (4.6% vs. 1.4%, adj OR 3.3; 95% CI 2.8-3.8), be admitted to hospital (3.3% vs. 0.8%, adj OR 4.2; 95% CI 3.4-5.1). Those discharged at the scene tended towards an increased likelihood of death (0.2% vs. 0.1%, adj OR 1.8; 95% CI 0.99-3.2) within 24 hours of discharge compared to those discharged from ED.

Conclusion: Patients attended by paramedics who were discharged at the scene had more subsequent events than those who were transported to and discharged from ED. Further consideration needs to be given to who is suitable to be discharged at the scene by paramedics.

Introduction

Prehospital ambulance services play a vital role in emergency medical systems. Ambulance service paramedics respond to calls for help from people who believe that they require urgent medical assessment, treatment on scene and/or transportation to a hospital. There is increasing interest in strategies to reduce the proportion of patients transported to ED by ambulance.[1] There are patients who, after an ambulance is requested, are reviewed by paramedics at the scene and not transported to ED. Some of these 'discharged at scene' patients will have received treatment from the paramedics, e.g. for minor lacerations; others will have been assessed and deemed to not require further clinical intervention, e.g. coughs and colds; and some patients will simply refuse to be transported to ED.

A decision as to whether a patient can be safely discharged at the scene must be made with recognition of the risk of the patient's condition worsening due to a delay in the initiation of treatment.[2] Ambulance services need to monitor the subsequent outcomes for patients discharged at the scene for routine quality improvement.[3] The outcomes of interest include: subsequent ambulance request, ED presentation, hospital admission and death, (excluding death at the scene and at ED), within 24 hours of the initial callout.[3]

Previous studies have reported that the proportion of patients who were discharged at the scene by paramedics ranged from 5% to 30%.[4, 5] Of patients discharged at the scene, other studies have reported that 2% to 37% subsequently requested another ambulance attendance,[6, 7] 12% to 48% presented to ED,[8, 9] 1% to 23% were admitted to a hospital,[6, 10] and 0% to 1% died.[7, 9] These percentages may differ possibly because of methodological variability in follow-up periods (24 hours to two weeks), follow-up methods (telephone interview, hospital chart review), and the age group included in the study (all age groups, paediatrics, elderly patients). Previous research in this field has been descriptive in nature, with comparison of patient outcomes rarely made against a reference cohort.[4-7, 9-12] Furthermore, the sample sizes of the previous studies have been small.[4-13]

The aim of this study was to determine whether discharging patients at the scene by paramedics can be considered a safe practice. Specific objectives were to compare the occurrence of subsequent events between patients who were discharged at the scene by paramedics and those who were transported to and discharged from ED. We sought to identify factors associated with subsequent events after discharge at the scene, to examine the reasons for discharging high acuity patients at the scene, and to determine the appropriateness of discharge at the scene for all deaths that occurred within 24 hours after being discharged at the scene.

Methods

Study setting and population

This is a retrospective cohort study conducted in metropolitan Perth, Western Australia (WA) during the calendar year of 2013. The population of the Perth metropolitan area was 1.97 million in 2013.[14] St John Ambulance Western Australia (SJA-WA) is the sole road-based emergency ambulance provider. The total number of ambulance cases attended by SJA-WA paramedics in the Perth Metropolitan area was 229,494 in 2013.[15] SJA-WA ambulances are staffed by paramedics, who are required to undertake a three year University bachelor degree. There are 10 public hospital EDs and one private ED in Perth. In 2013, 530,237 patients presented at public hospital EDs in Perth, WA.[16]

Data sources

We used SJA-WA ambulance data collected between January 1 and December 31, 2013. SJA-WA paramedics routinely record their clinical management and patient information on an electronic patient care record (e-PCR) system using an iPad. Ambulance data were linked with ED information system (EDIS) data and the WA death registry. EDIS data were available for eight public EDs (data from two EDs were not accessible) and captured 90% of all attendances to public EDs in 2013.[16] Both EDIS and death data were used to identify subsequent events (e.g., ED representation, death) after discharge at the scene or discharge from ED. We linked these three data sources using probabilistic linkage techniques that incorporated date of birth, first and last names and residential address as key identifiers.[17] We used software (FRIL ver.2.1.5, Emory University and Centers for Disease Control and Prevention, Atlanta, Georgia, U.S.) for this purpose.[18] The software uses combinations of the key identifiers to identify the same individuals in different datasets and provides a score which indicates the likelihood of a correct link between cases in different datasets. We manually checked links if the score was close to a predetermined cut-off value. In this study, among 85,640 patients who were transported to one of the eight EDs by a SJA-WA ambulance, 82,437 cases (96.3%) were successfully linked to the relevant EDIS record. The reason for linkage failure was missing information in the ambulance record required to identify individuals (e.g., name, date of birth).

Participants

We included all patients who were attended by SJA-WA paramedics and discharged at the scene (scene discharge group), or transported to ED by paramedics and discharged from ED (ED discharge group). We defined the index event as a paramedic attendance to a patient which resulted in discharge at the scene, or transportation to and discharge from an ED. If a patient was re-attended by paramedics after the first index event and then discharged at the scene, or transported to and discharged from ED, this second event was considered as a separate index event unless the time interval between the events was shorter than seven days (168 hours).[8] During the study period, there was no guideline or clinical decision tool regarding patient discharge at the scene in the existing SJA-WA clinical practice guidelines.[19] Following patient assessment, paramedics were allowed to discharge a patient when, in their clinical judgement, they felt it was unnecessary to transport the patient to ED. If paramedics discharged a patient, an 'Ambulance Not Required Form' needed to be completed and signed by the paramedics and the patient or a person who was responsible for ongoing care of the patient. Patients who were transferred from another hospital to ED, transported by appointment, declared dead at the scene or died at ED were excluded. Cases with a missing date of birth were excluded because we could not compute the age of such patients, which is an important predictor for patient outcome, and date of birth is used to identify subsequent events through probabilistic linkage. Cases with missing prehospital triage level (described below) were also excluded because we considered that in such cases paramedics were not able to obtain enough information to determine the triage level and, therefore, the patient's information could be unreliable. We examined systematic differences in characteristics (e.g., age, sex, etiology) between cases with and without missing data to determine whether information was missing at random.

Variables

We extracted the following information from the data sources: patient age, sex, prehospital triage level (described below), vital signs (systolic blood pressure, oxygen saturation, Glasgow Coma Scale [GCS] and body temperature) measured during the prehospital phase, day of week (weekend or not), time of day (night [23:00-7:00] or not), transportation from a nursing home (residential care facility), preceding ambulance request 7 days prior to the index event, and etiology category determined by paramedics (trauma, illness, neurological, intoxication, abdominal, cardiac, respiratory, psychosocial, musculoskeletal, debility, urology, infection, other, unknown). The SJA-WA prehospital triage system uses an ordinal scale ranging from 1 (requiring immediate care) to 5 (to be treated within 120 minutes). The triage level is routinely assigned for each patient unless a patient refuses to be assessed by paramedics and used as the default for triage at ED. We considered that a patient had an abnormal vital sign if the patient fulfilled one of the following criteria: systolic blood pressure <90mmHg, oxygen saturation <95%, GCS <15, and body temperature ≥38^{0}C. These cut-off values were selected based on SJA-WA clinical practice guidelines and the Revised Trauma Score.[19, 20]

Study outcomes

We considered subsequent ambulance request, ED attendance, hospital admission after ED assessment and death within one day (24 hours), three days (72 hours) and seven days (168 hours) after discharge from the scene or ED. The three different follow-up periods were used to facilitate comparisons with previous studies. The times of discharge from the scene and ED were obtained from the ambulance data and EDIS data, respectively.

We reviewed high acuity patients in the 'scene discharge' group to identify the reason for the discharge. We defined high acuity patients as those whose prehospital triage level was 1 (requiring immediate care) or 2 (requiring care within 10 minutes). One author (HT) reviewed a clinical summary of such cases written by paramedics and selected one of the following five nominated reasons: refusal/decline, symptom improved, miscoding (a recorded prehospital triage level was incorrectly assigned a high acuity level), other or no details available. Another reviewer (IJ, see the Acknowledgement) checked the correctness of the categorization. Disagreement between the reviewers was resolved by consensus.

We also reviewed cases in which a patient died within one day (24 hours) after discharge at the scene. Seven reviewers, including five emergency physicians (HT, DF, IR, AC, PS) and two registered nurses with experience in prehospital ambulance research (TW, JF), examined details of each case using patient information sheets and 'Ambulance Not Required Forms' recorded by paramedics and determined the appropriateness of the discharge. The following five criteria were discussed for each case: 1. Was the patient disposition appropriate?; 2. Did the patient refuse transportation to ED?; 3. Was the death plausibly related to the presenting complaint?; 4. Was the clinical reasoning for the discharge explained?; and 5. Did a predetermined end-of-life care plan exist? Any disagreement among reviewers was resolved through discussion and consensus.

Data analysis

Characteristics listed in the Variables section above were compared between 'scene discharge' and 'ED discharge' groups. Logistic regression models were used to estimate unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs). The OR for each study outcome variable compares the odds in the 'scene discharge' group to those in the 'ED discharge' group. Models were adjusted for age, gender, triage level, existence of abnormal vital signs, weekend attendance, night attendance, transportation from nursing home, preceding ambulance request within seven days (168 hours) prior to the index event and etiology group determined by paramedics. When age had a linear relationship with the outcome variable, it was included as a continuous variable, but when the relationship was curved (i.e. the coefficient of age-squared was significant, indicating a quadratic relationship), we categorised age into four groups (<14 years, 14-69 years, 70-79 years and 80 years or older).[21] Etiologies determined by paramedics were collapsed into two categories (etiology associated with external causes [injury and intoxication] and all other etiologies) if there were less than 10 outcomes for one of the etiologies. Adjustment for prehospital triage level was excluded from models for subsequent deaths because there were fewer than 10 outcomes even after five triage levels were collapsed into two levels. Backward stepwise variable selection was used with the likelihood ratio as the criterion to determine variables to be removed. We excluded cases with missing date of birth and/or prehospital triage level from these analyses as described earlier. Sensitivity analyses were conducted using logistic regression by including both cases with and without missing data. The outcomes (subsequent ambulance request, ED presentation, hospitalisation and death within one, three and seven days after discharge from the scene or ED) were adjusted for weekend attendance, night attendance, and transportation from a nursing home because these were available for all cases. Further, characteristics and outcomes were compared between cases with and without missing date of birth and/or prehospital triage level to identify systematic differences between them.

Chi-square tests were used to compare categorical variables. All statistical analyses were performed using IBM SPSS version 21.0 (IBM, Armonk, NY), and statistical significance was set at 5%.

Ethics approval for this study was granted by the Curtin University Human Research Ethics Committee (approval number: HR127/2013). Obtaining consent from participants was waived by the committee. This study was conducted as part of a project supported by the Western Australian Department of Health Targeted Research Fund (reference number: F-AA-00788). The complete study protocol has been published.[22]

Results

Excluding patients who were transferred from another hospital to the ED, transported by appointment, declared dead at the scene or in the ED, SJA-WA paramedics attended 127,574 cases in the Perth metropolitan area during 2013 (Figure 1). Among those attended by paramedics, 107,842 (84.5%) patients were transported to a hospital and 19,732(15.5%) were discharged at the scene by paramedics (Figure 1). Among patients who were transported to a hospital, 85,640 (79.4%) were transported to one of the eight public hospital EDs in the Perth metropolitan area (Figure 1). Among the 27,598 who were discharged from ED, 401 (1.5%) cases were excluded because of missing date of birth and/or prehospital triage level thus the remaining 27,197 cases comprise the ‘ED discharge’ group(Figure 1). Among those who were discharged at the scene, 8,636 (43.8%) cases were excluded from analysis because of missing date of birth and/or prehospital triage level, and the remaining 11,096 cases comprise the scene discharge group (Figure 1).

Patients who were discharged at the scene were more likely to be aged ≥70 years, have a lower triage level (3 - 5), have normal prehospital vital signs, request an ambulance at night and have requested an ambulance seven days prior to the index event, but less likely to be transported from a nursing home (Table 1).

The 'scene discharge' group had between two to four times higher risk of experiencing subsequent events than the 'ED discharge' group: the occurrence of subsequent ambulance requests (6.1% vs 1.8%), ED attendances (4.6% vs 1.4%), hospital admission (3.3% vs 0.8%) and deaths within one day (0.2% vs 0.1%) (Table 2). These differences in proportions increased for the longer observation periods (three and seven days) than one day (Table 2). The 'scene discharge' group was significantly more likely to experience one of the four outcomes (ambulance request, ED attendance, hospitalization and death) than the 'ED discharge' group after adjusting for nominated confounders (Table 2). While more than half of the subsequent events occurred within one day (24 hours) in the 'scene discharge' group, less than a third of the events occurred within one day in the 'ED discharge' group (Table 2).

Older age, the existence of abnormal vital signs and etiology were common predictors for all subsequent events (Tables 3 & 4). Male sex and preceding ambulance request within seven days prior to the index event were common predictors for ambulance request, ED attendance and hospital admission (Table 3). A prehospital triage level of 1 was not associated with subsequent ambulance request, ED attendance or hospital admission.

Among 564 scene discharge cases with a high acuity level, 395 (70%) patients refused/declined transportation to ED. One reason for non-transportation other than refusal was improved symptoms (n=28), commonly in hypoglycemic patients and post-ictal patients (Table 5). Other reasons for non-transportation included the patient being in a palliative care setting and attendance of a registered nurse who was responsible for care of the patient. The occurrence of subsequent ambulance requests, ED attendance and hospital admission in scene discharge cases with a high acuity level were fewer than those in scene discharge cases with lower acuity level (prehospital triage level=3,4 or 5): respectively, ambulance request 3.9% (22/564) vs 6.2% (650/10,532) (p=0.03); ED attendance: 3.2% (18/564) vs. 4.7% (496/10,532) (p=0.10); hospital admission: 2.3% (13/564) vs. 3.3% (348/10,532) (p=0.19). The occurrences of subsequent death within one day were 0.7% (4/564) for scene discharge patients with high acuity level and 0.1% (15/10,532) for scene discharge patients with low acuity level (p=0.002). Three of the four high acuity discharged patients who died refused transportation to ED, and one was known to be at the end of life.

Among the 'scene discharge' group, 19 patients died within one day after discharge at the scene. On clinical review of the ambulance record, discharge at the scene was considered inappropriate for five patients, of whom four refused transportation to ED. Eleven deaths (58%) were related to a condition present at the index event, clinical reasoning after discharge at the scene was explained in 13 patients (68%), and nine patients (47%) had a predetermined end-of-life care plan in place at the time of paramedic attendance.

Sensitivity analysis demonstrated that there was no significant difference in odds ratios for the nominated outcomes (ambulance request, ED presentation, hospitalisation and death) between analyses that included only cases without missing data and those that included cases both with and without missing data (Figure 2): although the odds ratios reduced, the 'scene discharge' group were still more likely to experience subsequent events than the 'ED discharge' group.

Comparison between cases with and without missing date of birth and/or prehospital triage level for the 'scene discharge' and 'ED discharge' groups are shown in Table 6. In the 'scene discharge' group, there were significant differences between cases with and without missing data. In contrast, cases with and without missing data were similar except for frequency of missing date of birth and existence of abnormal vital signs in the 'ED discharge' group. Cases with missing data in the 'scene discharge' group and those in the 'ED discharge' group were also similar except for transportation from nursing home and etiology. Names were more frequently missing in the with-missing data group than the without-missing data group in the scene discharge group (34.1% vs. 2.1%, $p<0.001$). There were no cases with missing names in the ED discharge group.

Discussion

The most important finding of this study is that discharging a patient at the scene was associated with a significantly increased risk of subsequent events compared to patients transported to and subsequently discharged from ED. We also found that older age and abnormal vital signs were common predictors for all subsequent events, i.e. subsequent ambulance request, ED attendance, hospitalisation and death within one, three and seven days. Further, we found that prehospital triage levels of 1 and 2 were strong predictors of subsequent death, but not for subsequent ambulance request, ED attendance or hospital admission.

We could not identify studies which compared outcomes between those who were and were not transported to ED using a large study cohort comparable to this study. Thus, it is uncertain whether the occurrence of subsequent events after discharge at the scene in this study is high or low. Many previous studies used telephone follow-up to identify subsequent events and reported percentages of patients who made a subsequent ambulance request from 7% to 37%.[5, 7, 10] However, these percentages could be biased because of the high loss to follow-up (around 40%).[5, 7, 10] Moss et al. used the established database for ambulance providers in San Diego, US to identify subsequent ambulance calls within 48 hours after refusing transportation.[6] In their study, they reported fewer subsequent ambulance requests (10 out of 431 patients [2%]) within 48 hours after discharge than our study (6.8%). The reasons for this difference are not clear, but might include differences in characteristics of the study cohort, clinical skills of paramedics, or accessibility and availability of health care services in the community.

Patients who were assigned a high acuity level were not at higher risk of a subsequent ambulance request, ED attendance or hospital admission than those assigned triage level 5 (Table 3). A probable explanation for this is that most patients who were assigned a high acuity level were likely to be transported to ED and admitted to hospital.

Following up patients for one day (24 hours) might be more meaningful than longer follow up periods. We used three different follow-up periods: one day (24 hours), three days (72 hours) and seven days (168 hours). We found that more than half the subsequent ambulance calls, ED attendances and hospital admissions of the 'scene discharge' group occurred within 24 hours after discharge. Further, the longer the follow-up time, the more likely that the patient is affected by factors other than discharge at the scene.

In the majority of cases, the paramedics appear to have made a correct judgement with respect to transport to ED of high acuity patients. The high acuity patients in the 'scene discharge' group were less likely to experience subsequent ambulance request, ED discharge and hospital admission than low acuity 'scene discharge' patients. Although four patients died within 24 hours after discharge among 564 high acuity patients who were discharged at the scene, these deaths could not be attributed to an inappropriate decision by the paramedics to leave the patients at the scene (Table 5). Nonetheless, ambulance service providers may need to perform this kind of review regularly in order to ensure the quality of their services.

A review of cases in which a patient died within 24 hours after discharge at the scene identified cases where an ambulance was requested with no consideration of the patient's palliative status and/or their predetermined care plan. Given limited resources and increasing demand for ambulance services, increasing provision of community-based primary health care services for such patients may reduce unnecessary ambulance usage.[23, 24]

Cases with missing data in the 'scene discharge' group showed a lower risk of subsequent events than those without missing data. This difference might be explained by the inability to identify subsequent events for cases with missing data because of the unavailability of key identifiers (e.g., date of birth, name) that were used for the probabilistic linkage. If this information was available, more subsequent events might be identified. Among cases with missing data, more than half of the cases did not have date of birth or names recorded. Hence, subsequent events for patients in this group were not completely identified, and risks of subsequent events might be underestimated.

Strengths

This study has several strengths compared to previous studies. First, the sample size of this study is much larger than in previous studies. While the largest sample size was less than 1,000 in the previous studies,[10] we included approximately 40,000 cases in total. Secondly, we compared the outcomes of patients who were discharged at the scene against those who were transported to and discharged from ED, while the other studies rarely had a comparison group. The large sample size and the existence of a reference cohort also allowed us to estimate adjusted ORs for risk of subsequent events. Thirdly, we investigated four study outcomes (subsequent ambulance request, ED attendance, hospital admission and deaths) for three different follow-up periods (one, three and seven days after discharge) by linking three different data sources (ambulance, ED and death data). Most of the previous studies used ambulance data only and followed up patients by telephone interview, which is prone to loss of follow-up.[5-8, 10, 12, 13]

Limitations

This study has limitations which relate particularly to its retrospective design. There were quite a few cases (44%) with missing data in the 'scene discharge' group. We conducted sensitivity analysis to examine the robustness of the results and compared the characteristics and outcomes between cases with and without missing data to determine the mechanism of the missingness. Sensitivity analysis demonstrated that cases with missing data influenced the magnitude of the outcomes, but the direction of the results remained unchanged (Figure 2). Comparisons between cases with and without missing data indicated that data were missing not at random (Table 6). Therefore, multiple imputation was not appropriate.[25]

Missing information might be likely even if a prospective study design was used. There were more males, weekend cases, late night cases and intoxicated cases with missing data than in cases without missing data. Therefore, many patients in cases with missing data might have been affected by alcohol/drugs and refused to provide their identification and/or be assessed by paramedics.

Other limitations include the use of discharge from ED as a comparator and different practice regarding decision making in non-transportation of patients in WA. Patients may have better outcomes if transported to ED than discharged at the scene. However, if patient condition is not severe, e.g., flu, the outcome of the patient may be similar whether the patient was discharged at the scene or transported to ED. Thus, we believe that the use of ED discharge as a comparator is acceptable if risks of outcomes are adjusted for severity of patient condition. In WA, SJA-WA paramedics can make a decision to not transport a patient without medical approval. This practice may be different to other locations, and the generalisability of the findings gained in this study may be limited.

Future studies may need to consider the opportunity for those patients not transported to hospital to be referred to other health care services. Through case review we found a number of requests for an ambulance that could be considered to be inappropriate; e.g., ambulance request to patients in palliative care settings. Community-based primary health care services have a potential to manage patients who do not need transportation to ED more appropriately than ambulance services.[24] Community health care services in WA can provide various services including palliative care 24 hours a day, every day of the year. Strategies to increase the availability of and accessibility to such community health care services for patients who do not require transportation to and care in ED may lead to a reduction in inappropriate ambulance requests.

Conclusion

In this study, patients who were discharged at the scene by paramedics had a significantly higher risk of subsequent ambulance request, ED attendance, hospital admission and death than those who were transported to and discharged from ED. Further research is required to identify those patients for whom it is appropriate for paramedics to discharge at the scene.

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Declaration of Interest

Ian Rogers is a member of the Board of Directors and (Acting) Clinical Director of St John Ambulance Western Australia (SJA-WA). Glenn Arendts is a member of the SJA-WA Medical Policy Committee.

Tony Ahern is CEO of the SJA-WA. Judith Finn receives research funding from the SJA-WA. The authors alone are responsible for the content and writing of the paper.

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Table 1. Characteristics of the study cohorts

		Scene discharge n (%)	ED discharge n (%)	Difference (95% CI)*
N		11,096	27,197	
Age (years)	0-13	846 (7.6)	1,067 (3.9)	3.7 (3.2 to 4.2)
	14-69	6,252 (56.3)	18,974 (69.8)	-13.5 (-14.6 to -12.4)
	70-79	1,303 (11.7)	2,839 (10.4)	1.3 (0.6 to 2.0)
	80 or older	2,695 (24.3)	4,317 (15.9)	8.4 (7.5 to 9.3)
Sex	Male	5,306 (47.8)	13,018 (47.9)	-0.1 (-1.2 to 1.0)
Triage level	1	129 (1.2)	262 (1.0)	0.2 (-0.03 to 0.4)
	2	435 (3.9)	6,586 (24.2)	-20.3 (-20.9 to -19.7)
	3	2,802 (25.3)	14,845 (54.6)	-29.3 (-30.3 to -28.3)
	4	3,310 (29.8)	4,788 (17.6)	12.2 (11.2 to 13.2)
	5	4,420 (39.8)	716 (2.6)	37.2 (36.3 to 38.1)
Abnormal vital sign		1,658 (14.9)	6,134 (22.6)	-7.7 (-8.5 to -6.9)
Weekend		3,347 (30.2)	8,301 (30.5)	-0.3 (-1.3 to 0.7)
Late night		3,097 (27.9)	7,092 (26.1)	1.8 (0.8 to 2.8)
From nursing home		734 (6.6)	2,057 (7.6)	-1.0 (-1.6 to -0.4)
Preceding ambulance request within 7 days		493 (4.4)	1,009 (3.7)	0.7 (0.3 to 1.1)
Etiology	Trauma	3,167 (28.5)	7,209 (26.5)	2.0 (1.0 to 3.0)
	Illness	2,866 (25.8)	4,177 (15.4)	10.4 (9.5 to 11.3)
	Neurological	645 (5.8)	2,561 (9.4)	-3.6 (-4.2 to -3.0)
	Intoxication	616 (5.6)	1,838 (6.8)	-1.2 (-1.7 to -0.7)
	Abdominal	518 (4.7)	2,610 (9.6)	-4.9 (-5.4 to -4.4)
	Cardiac	76 (0.7)	2,670 (9.8)	-9.1 (-9.5 to -8.7)
	Respiratory	508 (4.6)	1,397 (5.1)	-0.5 (-1.0 to 0.0)
	Psychosocial	330 (3.0)	1,072 (3.9)	-0.9 (-1.3 to -0.5)
	Musculoskeletal	233 (2.1)	1,294 (4.8)	-2.7 (-3.1 to -2.3)
	Debility	367 (3.3)	358 (1.3)	2.0 (1.6 to 2.4)
	Urology	74 (0.7)	315 (1.2)	-0.5 (-0.7 to -0.3)
	Infection	98 (0.9)	254 (0.9)	0.0 (-0.2 to 0.2)
	Other	592 (5.3)	1,120 (4.1)	1.2 (0.7 to 1.7)

Unknown	1,006 (9.1)	322 (1.2)	7.9 (7.3 to 8.5)

ED: emergency department

*:(patients who were discharged at the scene)-(pateints who were discharged from ED)

Table 2. Subsequent events after discharge at the scene and from ED (Scene discharge group vs. ED discharge group)

Subsequent event		Scene discharge n (%)	ED discharge n (%)	Unadj OR (95% CI)*	Adj OR (95% CI)*
	N	11,096	27,197		
Ambulance request	Within 1 day	672 (6.1)	490 (1.8)	3.5 (3.1-4.0)	3.4 (3.0-3.9)
	Within 3 days	995 (9.0)	1,115 (4.1)	2.3 (2.1-2.5)	2.1 (1.9-2.4)
	Within 7 days	1,305 (11.8)	1,827 (6.7)	1.9 (1.7-2.0)	1.7 (1.6-1.9)
ED attendance	Within 1 day	514 (4.6)	385 (1.4)	3.4 (3.0-3.9)	3.3 (2.8-3.8)
	Within 3 days	710 (6.4)	906 (3.3)	2.0 (1.8-2.2)	1.9 (1.7-2.2)
	Within 7 days	898 (8.1)	1,524 (5.6)	1.5 (1.4-1.6)	1.4 (1.2-1.5)
Hospitalisation	Within 1 day	361 (3.3)	221 (0.8)	4.1 (3.5-4.9)	4.2 (3.4-5.1)
	Within 3 days	500 (4.5)	498 (1.8)	2.5 (2.2-2.9)	2.3 (2.0-2.7)
	Within 7 days	634 (5.7)	808 (3.0)	2.0 (1.8-2.2)	1.8 (1.6-2.0)
Death	Within 1 day	19 (0.2)	30 (0.1)	1.6 (0.9-2.8)	1.8 (0.99-3.2)
	Within 3 days	32 (0.3)	47 (0.2)	1.7 (1.1-2.6)	1.9 (1.2-3.0)
	Within 7 days	56 (0.5)	84 (0.3)	1.6 (1.2-2.3)	1.8 (1.3-2.5)

ED: emergency department; Unadj OR: unadjusted odds ratio; Adj OR: adjusted odds ratio; CI: confidence interval

*: vs. ED discharge

Table 3. Summary of logistic regression models for subsequent ambulance request, ED attendance and hospital admission

		Subsequent ambulance request			Subsequent ED attendance			Subsequent hospital admission		
		Within 1 day OR (95% CI)	within 3 days OR (95% CI)	within 7days OR (95% CI)	Within 1 day OR (95% CI)	within 3 days OR (95% CI)	within 7days OR (95% CI)	Within 1 day OR (95% CI)	within 3 days OR (95% CI)	within 7days OR (95% CI)
Scene discharge (vs. ED discharge)		3.4 (3.0-3.9)	2.1 (1.9-2.4)	1.7 (1.6-1.9)	3.3 (2.8-3.8)	1.9 (1.7-2.2)	1.4 (1.21-1.5)	4.2 (3.4-5.1)	2.3 (2.0-2.7)	1.8 (1.6-2.0)
Age (years)	0-13	0.3 (0.2-0.5)	0.2 (0.2-0.4)	0.2 (0.1-0.3)	0.6 (0.4-0.8)	0.4 (0.2-0.5)	0.3 (0.2-0.5)	0.5 (0.3-0.9)	0.3 (0.2-0.6)	0.3 (0.2-0.6)
	14-69	1	1	1	1	1	1	1	1	1
	70-79	1.6 (1.3-1.9)	1.6 (1.4-1.9)	1.6 (1.5-1.8)	1.4 (1.1-1.7)	1.5 (1.3-1.8)	1.5 (1.4-1.8)	1.9 (1.5-2.5)	2.2 (1.8-2.7)	2.4 (2.1-2.9)
	80 or older	1.9 (1.6-2.2)	2.0 (1.8-2.2)	2.1 (1.9-2.3)	1.7 (1.4-2.1)	1.8 (1.6-2.1)	1.9 (1.7-2.1)	2.5 (2.1-3.0)	3.0 (2.5-3.5)	3.1 (2.7-3.6)
Male		1.2 (1.1-1.4)	1.3 (1.1-1.4)	1.2 (1.1-1.3)	1.3 (1.1-1.5)	1.3 (1.2-1.5)	1.3 (1.2-1.4)		2.3 (2.0-2.7)	1.2 (1.1-1.3)
Triage level	1		1.0 (0.7-1.7)	1.1 (0.7-1.5)			1.2 (0.8-1.8)	1.5 (0.7-3.2)		
	2		0.9 (0.7-1.04)	0.8 (0.7-0.97)			0.8 (0.6-0.9)	1.1 (0.8-1.6)		
	3		0.9 (0.8-1.07)	0.9 (0.8-1.04)			0.9 (0.8-1.02)	1.3 (0.99-1.6)		
	4		1.1 (0.9-1.2)	1.0 (0.9-1.2)			0.9 (0.8-1.09)	0.9 (0.7-1.2)		
	5		1	1			1	1		
Abnormal vital sign		1.5 (1.3-1.7)	1.4 (1.3-1.5)	1.3 (1.2-1.5)	1.5 (1.3-1.7)	1.4 (1.2-1.5)	1.3 (1.2-1.4)	1.7 (1.4-2.1)	1.5 (1.3-1.8)	1.4 (1.2-1.5)
Weekend				0.9 (0.8-1.0)						
From nursing home		1.3 (1.11-1.6)	1.2 (1.1-1.4)	1.3 (1.1-1.4)	1.4 (1.2-1.8)	1.4 (1.2-1.6)	1.4 (1.2-1.6)			1.2 (1.04-1.4)
Preceding ambulance request within 7 days		3.1 (2.5-3.7)		3.0 (2.6-3.4)	2.5 (2.0-3.1)	2.7 (2.2-3.2)	2.7 (2.3-3.1)	2.0 (1.5-2.7)	2.3 (1.8-2.8)	2.4 (2.0-2.9)
Etiology	Trauma	1	1	1	1	1	1	1	1	1
	Illness	1.7 (1.4-2.0)	1.7 (1.5-2.0)	1.7 (1.5-1.9)	1.7 (1.4-2.1)	1.7 (1.5-2.0)	1.7 (1.5-2.0)	1.9 (1.4-2.4)	1.7 (1.4-2.1)	1.7 (1.4-2.0)

Neurological	1.2 (0.9-1.6)	1.1 (0.9-1.4)	1.0 (0.9-1.2)	1.4 (1.05-1.9)	1.1 (0.9-1.4)	1.1 (0.9-1.4)	1.7 (1.2-2.4)	1.3 (0.9-1.7)	1.1 (0.9-1.5)
Intoxication	1.9 (1.4-2.4)	2.1 (1.7-2.5)	2.0 (1.7-2.4)	1.9 (1.4-2.5)	2.0 (1.6-2.5)	2.0 (1.7-2.5)	1.2 (0.7-1.9)	1.4 (0.997-1.9)	1.6 (1.2-2.1)
Abdominal	1.5 (1.2-2.0)	1.4 (1.14-1.7)	1.4 (1.2-1.6)	2.1 (1.6-2.8)	1.7 (1.4-2.1)	1.7 (1.4-2.0)	2.5 (1.8-3.4)	1.9 (1.5-2.5)	1.8 (1.4-2.2)
Cardiac	0.9 (0.6-1.3)	1.1 (0.8-1.4)	1.4 (1.1-1.7)	0.8 (0.5-1.2)	1.1 (0.9-1.5)	1.6 (1.3-1.9)	0.6 (0.3-1.2)	0.9 (0.6-1.3)	1.2 (0.9-1.6)
Respiratory	1.8 (1.3-2.4)	1.6 (1.3-2.0)	1.6 (1.4-2.0)	1.8 (1.3-2.5)	1.4 (1.1-1.9)	1.7 (1.4-2.1)	2.0 (1.4-3.0)	1.7 (1.2-2.2)	1.8 (1.4-2.3)
Psychosocial	2.5 (1.8-3.3)	2.3 (1.83-2.9)	2.5 (2.1-3.0)	2.7 (1.9-3.8)	2.2 (1.7-2.9)	2.4 (2.0-3.0)	2.0 (1.2-3.4)	1.6 (1.04-2.3)	1.9 (1.4-2.6)
Musculoskeltal	1.8 (1.3-2.5)	1.8 (1.4-2.3)	1.6 (1.3-2.0)	1.9 (1.3-2.7)	1.9 (1.5-2.4)	1.7 (1.3-2.1)	2.1 (1.3-3.3)	2.0 (1.4-2.8)	1.7 (1.3-2.3)
Debility	2.0 (1.5-2.8)	1.8 (1.4-2.3)	1.8 (1.5-2.3)	1.9 (1.3-2.8)	1.6 (1.2-2.2)	1.6 (1.3-2.1)	2.3 (1.5-3.5)	1.7 (1.2-2.5)	1.7 (1.3-2.3)
Urology	2.2 (1.4-3.5)	2.2 (1.6-3.1)	2.2 (1.7-3.0)	2.3 (1.4-3.9)	1.9 (1.3-2.9)	2.3 (1.7-3.2)	2.9 (1.6-5.2)	2.0 (1.2-3.2)	2.3 (1.6-3.4)
Infection	1.6 (0.9-2.9)	1.6 (1.1-2.5)	1.5 (1.0-2.2)	1.8 (0.96-3.4)	1.6 (0.97-2.6)	1.8 (1.2-2.7)	1.5 (0.7-3.6)	1.6 (0.9-3.0)	2.0 (1.3-3.2)
Other	1.1 (0.8-1.5)	1.3 (0.98-1.6)	1.3 (1.1-1.6)	1.0 (0.7-1.5)	1.0 (0.8-1.4)	1.2 (0.9-1.5)	1.0 (0.6-1.7)	0.9 (0.6-1.4)	0.9 (0.7-1.3)
Unknown	1.4 (1.1-1.9)	1.4 (1.1-1.7)	1.3 (1.1-1.6)	1.9 (1.4-2.6)	1.6 (1.3-2.1)	1.6 (1.3-2.1)	2.1 (1.4-3.0)	1.7 (1.2-2.3)	1.7 (1.3-2.2)

ED: emergency department; OR: odds ratio; CI: confidence interval

Table 4. Summary of logistic regression models for subsequent death

	Subsequent death		
	Within 1 day	Within 3 days	Within 7days
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Scene discharge (vs. ED discharge)	1.8 (0.99-3.2)	1.9 (1.2-3.0)	1.8 (1.3-2.5)
Age (years)	1.04 (1.02-1.1)	1.04 (1.03-1.1)	1.04 (1.03-1.1)
Male			1.58 (1.13-2.2)
Abnormal vital sign	4.6 (2.5-8.6)	4.3 (2.6-6.9)	4.0 (2.8-5.8)
Late night	1.7 (0.96-3.1)		
From nursing home	3.0 (1.5-5.9)	2.6 (1.5-4.3)	2.5 (1.7-3.8)
Etiology associated with non-external cause	2.1 (1.04-4.5)	2.2 (1.2-3.9)	1.7 (1.2-2.6)

ED: emergency department; OR: odds ratio; CI: confidence interval

Table 5. Reasons for discharge at the scene of high acuity patients (prehospital triage level=1 or 2) and their outcomes (N=564)

Reason	Total n	Occurrence of subsequent events within one day (24 hours) Ambulance request n (%)	ED attendance n (%)	Hospital admission n (%)	Death n (%)
Refusal/decline	395	17 (4.3)	12 (3.0)	9 (2.3)	2 (0.5)
Miscoding	112	3 (2.7)	1 (0.9)	0	1 (0.9)
Symptom improved	28	1 (3.6)	2 (7.1)	1 (3.6)	0
Others	2	0	0	0	1 (50)
No details available	27	1 (3.7)	3 (11.1)	3 (11.1)	0

ED: emergency department

Table 6. Comparison between cases with and without missing data

		Scene discharge			ED discharge			
		No missing data n (%)	With missing data n (%)	Difference (95% CI)*	No missing data n (%)	With missing data n (%)	Difference (95% CI)†	Difference (95% CI)‡
N		11,096	8,636		27,197	401		
Missing date of birth		0	4,160 (48.2)	-48.2 (-49.3 to -47.1)	0	102 (25.4)	-25.4 (-28.4 to -22.4)	22.8 (9.8 to 26.0)
Sex	Male	5,306 (47.8)	4,498 (52.1)	-4.3 (-5.7 to -2.9)	13,018 (47.9)	197 (49.1)	-1.2 (-6.3 to 3.9)	3.0 (-2.0 to 8.0)
Abnormal vital sign		1,658 (14.9)	697 (8.1)	6.8 (5.9 to 7.7)	6,134 (22.6)	27 (6.7)	15.9 (13.4 to 18.4)	1.4 (-1.1 to 3.9)
Weekend		3,347 (30.2)	3,021 (35.0)	-4.8 (-6.1 to -3.5)	8,301 (30.5)	142 (35.4)	-4.9 (-9.6 to -0.2)	-0.4 (-5.2 to 4.4)
Late night		3,097 (27.9)	2,760 (32.0)	-4.1 (-5.4 to -2.8)	7,092 (26.1)	122 (30.4)	-4.3 (-8.8 to 0.2)	1.6 (-3.0 to 6.2)
From nursing home		734 (6.6)	265 (3.1)	3.5 (2.9 to 4.1)	2,057 (7.6)	30 (7.5)	0.1 (-2.5 to 2.7)	-4.4 (-7.0 to -1.8)
Preceding ambulance request within 7 days		493 (4.4)	253 (2.9)	1.5 (1.0 to 2.0)	1,009 (3.7)	20 (5.0)	-1.3 (-3.4 to 0.8)	-2.1 (-4.3 to 0.1)
Etiology	Trauma	3,167 (28.5)	2,013 (23.3)	5.2 (4.0 to 6.4)	7,209 (26.5)	33 (8.2)	18.3 (15.6 to 21.0)	15.1 (12.3 to 17.9)
	Illness	2,866 (25.8)	2,024 (23.4)	2.4 (1.2 to 3.6)	4,177 (15.4)	4 (1.0)	14.4 (13.3 to 15.5)	22.4 (21.0 to 23.8)
	Neurological	645 (5.8)	349 (4.0)	1.8 (1.2 to 2.4)	2,561 (9.4)	4 (1.0)	8.4 (7.4 to 9.4)	3.0 (1.8 to 4.2)
	Intoxication	616 (5.6)	854 (9.9)	-4.3 (-5.1 to -3.5)	1,838 (6.8)	13 (3.2)	3.6 (1.9 to 5.3)	6.7 (4.7 to 8.7)

Abdominal	518 (4.7)	189 (2.2)	2.5 (2.0 to 3.0)	2,610 (9.6)	0 (0.0)	9.6 (9.2 to 10.0)	2.2 (1.7 to 2.7)
Cardiac	76 (0.7)	46 (0.5)	0.2 (-0.01 to 0.4)	2,670 (9.8)	3 (0.7)	9.1 (8.2 to 10.0)	-0.2 (-1.1 to 0.7)
Respiratory	508 (4.6)	209 (2.4)	2.2 (1.7 to 2.7)	1,397 (5.1)	0 (0.0)	5.1 (4.8 to 5.4)	2.4 (1.9 to 2.9)
Psychosocial	330 (3.0)	276 (3.2)	-0.2 (-0.7 to 0.3)	1,072 (3.9)	3 (0.7)	3.2 (2.4 to 4.0)	2.5 (1.4 to 3.6)
Musculoskeletal	233 (2.1)	98 (1.1)	1.0 (0.7 to 1.3)	1,294 (4.8)	0 (0.0)	4.8 (4.5 to 5.1)	1.1 (0.7 to 1.5)
Debility	367 (3.3)	146 (1.7)	1.6 (1.2 to 2.0)	358 (1.3)	0 (0.0)	1.3 (1.2 to 1.4)	1.7 (1.2 to 2.2)
Urology	74 (0.7)	09 (0.1)	0.6 (0.4 to 0.8)	315 (1.2)	0 (0.0)	1.2 (1.1 to 1.3)	0.1 (-0.03 to 0.2)
Infection	98 (0.9)	26 (0.3)	0.6 (0.4 to 0.8)	254 (0.9)	0 (0.0)	0.9 (0.8 to 1.0)	0.3 (0.1 to 0.5)
Other	592 (5.3)	295 (3.4)	1.9 (1.3 to 2.5)	1,120 (4.1)	1 (0.2)	3.9 (3.4 to 4.4)	3.2 (2.3 to 4.1)
Unknown	1,006 (9.1)	2,102 (24.3)	-15.2 (-16.3 to -14.1)	322 (1.2)	340 (84.8)	-83.6 (-87.1 to -80.1)	-60.5 (-64.7 to -56.3)
Ambulance request within 1 day	672 (6.1)	267 (3.1)	3.0 (2.4 to 3.6)	490 (1.8)	9 (2.2)	-0.4 (-1.8 to 1.0)	0.9 (-0.6 to 2.4)
ED attendance within 1 day	514 (4.6)	197 (2.3)	2.3 (1.8 to 2.8)	385 (1.4)	7 (1.7)	-0.3 (-1.6 to 1.0)	0.6 (-0.7 to 1.9)
Hospitalisation within 1 day	361 (3.3)	122 (1.4)	1.9 (1.5 to 2.3)	221 (0.8)	3 (0.7)	0.1 (-0.7 to 0.9)	0.7 (-0.2 to 1.6)
Death within 1 day	19 (0.2)	11 (0.1)	0.1 (-0.01 to 0.2)	30 (0.1)	1 (0.2)	-0.1 (-0.5 to 0.3)	-0.1 (-0.5 to 0.3)

*: (patients without missing data in scene discharge group) - (patients with missing data in scene discharge group)

†: (patients without missing data in ED discharge group) - (patients with missing data in ED discharge group)

‡: (patients with missing data in scene discharge group) - (patients with missing data in ED discharge group)

Figure legends

Figure 1. A flow diagram of the study cohort.

Figure 2. Sensitivity analysis. Odds ratios for experiencing subsequent events (ambulance request, emergency department presentation, hospitalization and death) within 24 hours, 3 days and 7 days after the index event were not significantly different between when cases without missing data were used and when cases with and without missing data were used.

*: odds ratios were adjusted for age, gender, triage level, existence of abnormal vital signs, weekend attendance, night attendance, transportation from nursing home, preceding ambulance request within seven days and etiology for analyses that included cases without missing data, and weekend attendance, night attendance and transportation from nursing home for analyses that included cases with and without missing data. Error bars represent 95% confidence intervals.

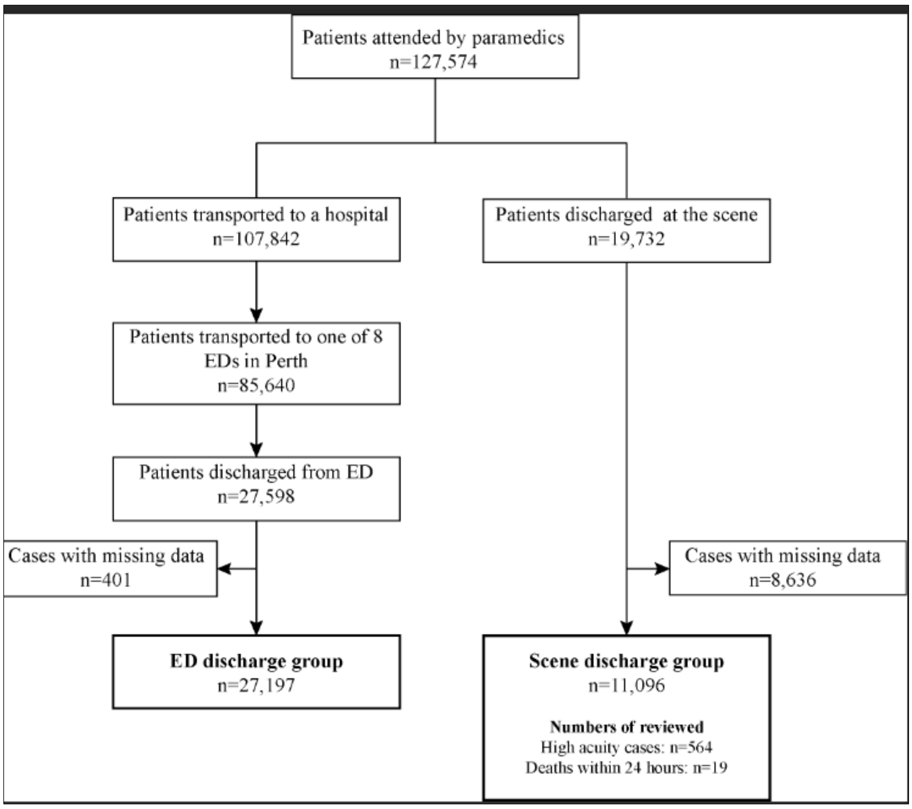

Figure 1

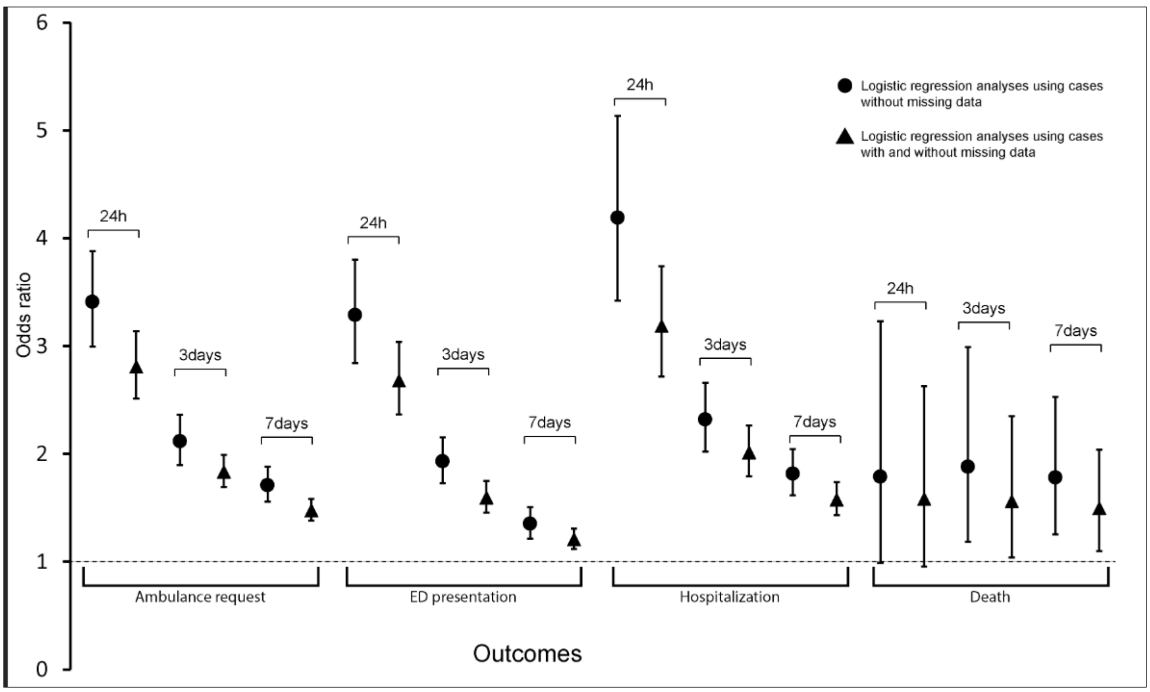

Figure 2