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Ethics approval and consent to participate	The study did not interfere with the patients' treatment process. Data were collected from medical records after the completion of emergency care, ensuring that patient care or treatment was not affected. Furthermore, the study did not involve the use of biological samples, did not conduct any interventions on patients, and did not record any personal information, thereby ensuring complete anonymity. Therefore, ethical approval was not required for this study. All procedures in this study were approved by 115 Emergency Center in Ho Chi Minh City, Decision No. 206/QD-TTCC115, dated August 5, 2024.

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Abstract

Introduction: Trauma represents a significant proportion of prehospital emergency cases and ranks among the leading contributors to DALYs. Implementing pain relief interventions enhances patient survival rates, reduces disability prevalence, and ultimately improves overall quality of life. This study aims to explore the characteristics of prehospital trauma cases and factors associated with pain management in Ho Chi Minh City from 2022 to 2024.

Methods: All trauma patients managed by prehospital emergency teams in Ho Chi Minh City between 2022 and 2024 were retrospectively enrolled in this descriptive study.

Results: From 2022 to 2024, a total of 10,038 cases were included in the study, accounting for 20% of all emergencies handled by the prehospital emergency system. Males accounted for 61.7% of the cases, with the mean age of all trauma patients being 48 years (SD 22.3). Common injuries included limb lesion (36.3%), head injury (33.3%), and multiple trauma (9.0%). Doctors led 49% of emergency teams, and medical technicians led 20%. After excluding pre-arrival deaths or cardiac arrest cases (187 cases), 9,851 patients were included in the analysis of pain management. Pain relief was provided in 18.3% of cases, primarily NSAIDs (13.8%), paracetamol (5.5%), and opioids (1.2%). Poisson regression analysis, with a significance level of 0.05, showed higher likelihood of analgesic use among doctors as emergency team leader (aPR=1.79; 95% CI: 1.59–2.01); for female patients (aPR=1.17; 95% CI: 1.08–1.26); limb injury presented (aPR=1.98; 95% CI: 1.80–2.17); multiple trauma presented (aPR=1.30; 95% CI: 1.14-1.49); chest injury presented (aPR=1.52; 95% CI: 1.28–1.79); and for occupational accident cases (aPR=1.18; 95% CI: 1.06–1.31), compared to other respective groups. Conversely, the rate of analgesic use was lower among patients with head injuries (aPR=0.64; 95% CI: 0.57–0.71).

Conclusion: Effective pain management in patients is essential and should be promoted through appropriate interventions. Emphasis should be placed on patients with head injuries, ensuring equitable pain management across all patient groups.

Keywords: Trauma, Pain management, Pre-hospital emergency care

1. Introduction

Unintentional and violent trauma accounts for nearly 8% (4.4 million) of global deaths [1]. From low- to middle-income countries, trauma ranks among the top 10 causes of death, contributing to the top-10 causes of elevated Disability-Adjusted Life Years (DALYs), with Thailand reported 1,741.51 DALYs and Bangladesh reported 1,062.91 DALYs per 100,000 people [2].

The use of pain management interventions in emergency departments or by pre-hospital emergency teams improves patient survival and reduces disability rates, thus enhancing patients' quality of life [3]. Pain management focuses on evaluating pain and providing appropriate treatment to address the needs of residents in healthcare facilities who are experiencing pain. Treatment options may include medication, non-pharmacological method, or intervention by medical devices. Examples include heat or cold treatment, massage, transcutaneous electrical nerve stimulation (TENS), acupuncture, and advanced neurolytic techniques such as radiofrequency coagulation and cryotherapy [4].

According to the World Health Organization (WHO), pain management is classified into three levels: Level 1 for mild pain, Level 2 for moderate pain, and Level 3 for severe pain. At Level 1, patients are treated with monotherapy pain relief using medications such as paracetamol or NSAIDs. For Level 2, a combination of paracetamol and NSAIDs may be used, or tramadol can be administered. In pain management at the highest level, patients are prescribed opioids such as fentanyl [5]. Pain management interventions in emergency departments, such as immobilization splints (70%) and analgesic administration (40-60%), result in effective pain relief in less than 50% of cases [6, 7]. During the pre-hospital emergency phase, pain assessment is not performed in approximately one-third to one-half of cases. Even when pain is documented, inadequate pain management persists in 43% of adults and 85% of pediatric patients [8]. Current studies show that the rates of pain assessment and management in prehospital emergency care remain low, but they have not explored in depth the underlying causes or factors influencing clinical decision-making [8-10].

Pre-hospital emergency care is a critical part of the patient survival chain, aiming to provide early and advanced medical intervention [11, 12]. The pre-hospital emergency system in Ho Chi Minh City consists of an independent unit, Emergency Center 115, and 42 emergency satellite stations located at district hospitals and private hospitals, utilizing the resources of these hospitals. These stations receive information of medical emergency cases from the Emergency Operating Center of Emergency Center 115 and then carry out the necessary emergency response [13]. Every day, 45-50 ambulances operate across Ho Chi Minh City, each ambulance with a driver, a doctor (general practitioner) or medical technician (with three years of medical training), and a nurse. While only doctors or medical technicians are authorized to prescribe medications, nurses may apply splints or administer analgesics following their emergency indication.

While there are no formal guidelines in place for administering pain relief medication at Emergency Center 115, the emergency team leaders are empowered to make decisions on patient care and treatment. In the pre-hospital emergency system of Ho Chi Minh City, ambulances are equipped with medications and medical equipment in accordance with the regulations of the Ministry of Health (Decision 01/2008), including splints and analgesics such as morphine, NSAIDs, and paracetamol to facilitate pain management in trauma cases [14].

This study aimed to identify the characteristics of pre-hospital trauma patients and factors associated with pain management interventions (paracetamol, NSAIDs, opioids) within emergency medical service (EMS) of Ho Chi Minh City from 2022 to 2024.

2. Materials and Methods

2.1. Study design and participants

This study employed a descriptive design, utilizing retrospective data from pre-hospital trauma cases managed by EMS of Ho Chi Minh City during the study period. Cases were excluded if patients transported themselves to medical facility (declined emergency service), medical records were inaccessible or lacked essential information on either diagnosis, treatment, or the reason for the emergency call. Additionally, patients who had died or experienced cardiac arrest prior to the arrival of the emergency team were not included in the analysis.

2.2. Variables

a) Area:

The classification of areas into "urban" and "suburban" was based on the administrative boundaries defined by the People's Committee of Ho Chi Minh City. Specifically, urban areas included 16 inner districts and Thu Duc City, while suburban areas comprised the 5 remaining outer districts. This classification is consistent with the organizational structure used by the Emergency Center 115.

b) Response Time Variables:

- **Active time** (minutes): the interval from the initial emergency call request to the time an ambulance is dispatched.
- **Arrival time** (minutes): the interval from ambulance dispatch to arrival at the scene.
- **Transport time** (minutes): the interval from leaving the scene to arriving at the hospital.

c) Trauma and Intervention Variables:

- **Type of trauma** refers to the specific types of injuries categorized according to the anatomical location on the patient's body. Categories include head trauma, limb trauma, chest trauma, abdominal trauma, lacerations and multiple trauma (two or more severe injuries in at least two areas of the body or two or more severe injuries in one body area) [15].

- **Cause of trauma** identifies the factors or circumstances leading to the patient's injury, with values such as traffic accidents, occupational accidents, and domestic accidents.
- **Intervention measures** are medical procedures performed upon patient contact at the scene and during transport, with six categories: immobilization, fluid therapy, pain relief, oxygen administration, intubation, and glucose administration.
- **Pain relief medications** used in patients include paracetamol, NSAIDs, and opioids.
- **Team leader** holds the primary responsibility for decision-making regarding interventions and managing coordination on the ambulance. This role is categorized into four types: doctor, medical technician, nurse, and unidentified.

d) Vital Signs Variables:

- **Heart rate** (beats per minute): classified as abnormal if <60 or >124 [16].
- **Blood pressure** (mmHg): classified as abnormal if systolic pressure is <90 or >140, or diastolic pressure is <60 or >90 [16].
- **Respiratory rate** (breaths per minute): classified as abnormal if ≤ 12 or >24 [16].
- **SpO_2** (%): classified as abnormal if SpO_2 <90 [16].

2.4. Data Collection Process

Data collection involved two steps. Firstly, all pre-hospital emergency patient records during the study period were extracted from the Emergency Dispatch software into an Excel file. In the "reason for emergency call" and "diagnosis" fields, a list of keywords (including "trauma", "lacerations", "abrasion", "burn", "fracture", "dislocation", "break", "fall") were applied in accordance with the Medical Dispatch Priority System and the guidelines for Pre-Hospital Medical Records at Emergency Center 115 to identify injury cases [17, 18]. Secondly, each medical file identified in step 1 was screened and eliminated if either the diagnosis field included the keywords "patient self-transported", "no longer requires emergency services", or was left blank, or if the diagnosis was not related to the injury from abovementioned list of keywords. Furthermore, cases without complete information on the reason for calling emergency services, treatment, and diagnosis in the medical record were also excluded. A flowchart outlining the data cleaning process is provided in the supplementary material (Flowchart 1).

[Insert Flowchart 1: Data Cleaning Steps]

2.5. Bias Control

Selection bias was minimized by strictly adhering to the inclusion and exclusion criteria for case selection, ensuring that only patients who met the study's criteria were included in the analysis. This approach reduced the likelihood of bias during the sampling process. Additionally, information bias was controlled by using specific variables and sequential keywords to accurately filter and extract data from medical records. This method ensured that the data collected from the records was precise and consistent, minimizing errors from external factors. Potential confounders were identified based on previous literature and clinical relevance, including variables such as age, sex, injury type, area, time of day, and team leader qualification. To adjust for these confounding factors, a multivariable Poisson regression model with robust variance estimation was applied.

Variables with a p-value < 0.05 in univariate analysis were considered for inclusion in the final model using a backward stepwise selection method. Model fit was assessed using the BIC to determine the most appropriate set of covariates, thereby minimizing residual confounding.

2.6. Statistical method

The data were exported from the Emergency Dispatch software of Emergency Center 115 in Ho Chi Minh City in Microsoft Excel format. Researchers performed in-depth processing and analysis using Stata 16.0. The study did not use imputation methods to handle missing data. Descriptive statistics were conducted using frequency and percentage to describe qualitative variables, median and interquartile ranges to describe quantitative variables that do not follow a normal distribution, as determined by the Skewness/Kurtosis test. A p-value > 0.05 was considered indicative of a normal distribution. Chi-squared tests is considered statistically significant when the p-value is less than 0.05 and the assumptions of the test are met, specifically that at least 80% of the cells in the contingency table have an expected count of 5 or more. Univariate Poisson regression with the robust option was used to examine the association between the dependent variable (analgesic interventions) and related factors.

A multivariable Poisson regression model with robust standard errors was applied to estimate adjusted prevalence ratios (aPR) for factors associated with analgesic use. The final multivariable model was selected using a backward stepwise approach based on the Bayesian Information Criterion value. Model diagnostics were reported, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Variance Inflation Factor (VIF) to assess the model's goodness-of-fit and multicollinearity. Associations were assessed by estimating prevalence ratios (PRs) with 95% confidence intervals (CIs), and statistical significance was defined as a p-value of less than 0.05.

2.7. Ethical considerations

The study collected data from the medical records of trauma patients after emergency care was provided, thus not affecting participants' treatment process. Additionally, no patient names were recorded, no biological samples were used, and no interventions were conducted on patients, ensuring that the study had no impact on patient subjects. Therefore, ethical approval was not required for this study. The Scientific Council of the Emergency Medical Center 115 approved the conduct of the study under Decision No. 206/QD-TTCC115, dated August 05, 2024, and authorized its completion under Decision No. 279/QD-TTCC115, dated October 11, 2024.

3. Results

A total of 45,459 pre-hospital emergency cases were recorded during the study period, of which 11,907 cases (26.2%) involved trauma. After applying the exclusion criteria to trauma-related emergency, 10,038 cases (84.3%) were included in the descriptive analysis. However, only 9,851 cases (82.7%) were included in the association analysis after excluding cases of cardiac arrest and death before the emergency team arrived, as these patients were not eligible for pain management interventions.

3.1. Characteristics of Study Participants

[Insert Table 1: Characteristics of study participants]

Over half of the emergency responses were conducted in the afternoon and evening, and males accounted for 61.7%. The emergency team was typically led by a doctor (49.0%). Traffic accidents were the leading cause of injuries (39.5%), while limb injuries were the most common type of injury (36.3%). The active time of less than 2 minutes and the arrival time of less than 13 minutes account for 23.6% and 58.2%, respectively.

[Insert Chart 1: Characteristics of analgesic use (n=9,851)]

Only 29.3% of pre-hospital trauma patients were administered analgesics. Among these, Paracetamol was the most commonly used (13.8%), while opioids were used in only 1.2% of cases.

[Insert Table 2: Factors associated with analgesic use (n=9,851)]

The final multivariable model demonstrated good fit with an AIC of 7657.15, a BIC of 7820.791, and the mean VIF was 1.39, indicating no significant multicollinearity. The rate of analgesic use was higher among the emergency team leader was a doctor (aPR = 1.79; 95% CI: 1.59–2.01) compared to a medical technician; for female patients (aPR = 1.17; 95% CI: 1.08–1.26) compared to male patients; for patients diagnosed with limb injuries (aPR = 1.98; 95% CI: 1.80–2.17) compared to those without limb injuries; for those with multiple trauma (aPR = 1.30; 95% CI: 1.14–1.49) compared to those without multiple trauma; for patients with chest injuries (aPR = 1.52; 95% CI: 1.28–1.79) compared to those without chest injuries; and for those involved in occupational accidents (aPR = 1.18; 95% CI: 1.06–1.31) compared to those without occupational accidents. Conversely, the rate of analgesic use was lower among patients with head injuries (aPR = 0.64; 95% CI: 0.57–0.71) compared to those without head injuries (Table 2).

4. Discussion

Among the trauma cases included in the study, the majority of emergency responses occurred in district areas, with a smaller proportion taking place in rural areas. The proportion of male patients is lower than the 73.3% to 77.7% reported in some other studies [3, 19, 20]. This difference may be attributed to economic, social, and cultural factors within the community, such as males being more involved in traffic and more hazardous work, which increases their exposure to risks in daily life [3]. This is consistent with the finding that the most common causes of trauma were traffic accidents and domestic accidents.

Traffic accidents were identified as the main cause of trauma. Limb and head injuries were common. A study conducted from 2014 to 2020 also found that traffic accidents were the most common reason for emergency calls (20.3%) [20]. Similarly, a retrospective study at the University Hospital of Kigali in Rwanda showed that motor vehicle collisions accounted for 75% of accidents, with 61.4% involving motorcycles [19]. One reason for the high number of limb trauma cases in prehospital care could be that when accidents occur and the victim sustains a limb injury, they are unable to move on their own, and sometimes bystanders transport the injured to the hospital without any supportive equipment, which would cause pain. In contrast, head trauma, chest trauma, or multiple traumas often lead to altered mental status or respiratory distress, which can cause family members or bystanders to become anxious and transport the victim to the hospital using personal vehicles or public transport, without waiting for the ambulance to arrive.

The ambulance dispatch time and on-site arrival time were both reported within a relatively short interval, with moderate variability observed. These results are consistent with a retrospective study on 128,208 prehospital emergency cases in Ho Chi Minh City from 2014 to 2020 [20]. EMS accessibility depends heavily on the city's transportation system, traffic conditions, and infrastructure [20, 21]. According to the World Health Organization (WHO) recommendation, there should be at least one ambulance per 100,000 people [22, 23]. With an estimated population of around 13 million, including migrants, Ho Chi Minh City requires at least 130 ambulances to meet the WHO standard. However, Emergency Center 115 currently operates only 42 dedicated ambulances for pre-hospital emergency care, which is insufficient to meet the needs of the population. The shortage of ambulances can be attributed to multiple factors, including limited funding, insufficient investment in EMS, and challenges in expanding healthcare infrastructure to keep pace with the city's rapidly growing population. This shortfall severely impacts the efficiency of emergency response, potentially delaying critical care for patients in life-threatening situations.

Furthermore, emergency response remains heavily reliant on ground transportation, primarily ambulances and emergency motorcycles, which poses significant challenges in ensuring timely access to pre-hospital care. To enhance the effectiveness and responsiveness of the EMS, it is crucial to expand the ambulance fleet and integrate alternative transportation modes, such as waterway and air-based emergency services.

In cases where paracetamol was used, the proportion was similar to the study by Scholten et al. [24] (13.7 and 17,7%). The lower use of NSAIDs and opioids compared to paracetamol may be due to healthcare providers' concerns about the side effects of NSAIDs, such as the risk of gastrointestinal bleeding, acute kidney injury, and cardiovascular events, as well as the potential risks of opioids, including respiratory depression and anaphylaxis [10]. Additionally, Emergency Center 115 does not currently require pain assessment for trauma patients, which makes it difficult to determine the appropriate level of pain for prescribing pain relief. The emergency team leader may also influence the choice of analgesics, as 22% of trauma cases were handled by medical technician and nurses without a doctor present, which aligns with the findings of Signe et al. [25] (2023), who identified a correlation between the choice of pain medication and the personnel performing the emergency care.

Univariate Poisson regression analysis was performed for all variables to examine their individual associations with the dependent variable (use of analgesics). This approach allowed us to identify potential factors associated with the outcome and to determine which variables met the threshold for inclusion in the multivariable analysis. A multivariate Poisson regression analysis to determine factors associated with analgesic used. Firstly, selecting variables associated with a p-value threshold of < 0.05 in univariate analyses (sex, time, area, active time, arrival time, transport time, emergency team leader, head injuries, limb injuries, multiple trauma, chest injuries, abdominal injuries, traffic accident, occupational accident, patient transfer, receiving hospital, intravenous fluid, immobilization, blood pressure at arrival, SpO2 at arrival), referred to as model A. Secondly, variable association with p value > 0.05 (area, abdominal injuries, traffic accident, patient transfer, blood pressure at arrival) in model A were excluded, resulting in model B. Thirdly, after comparing model A and model B using the BIC, model B were selected for the lowest BIC value. To avoid omitting important variables, the variables excluded in model A were added to model B individually. The variable values in the alternative models showed p-values > 0.05; therefore, model B was retained. Variables such as time, receiving hospital, and SpO_2 at arrival were excluded from the multivariable analysis due to their contribution to a sample size reduction of over 40%, which could undermine the model's robustness. Additionally, existing literature suggests that these variables have limited relevance to the use of pre-hospital analgesics, further supporting their exclusion [26]. However, their univariate associations with the outcome remain relevant and are presented in the univariate analysis for completeness. Comparing Model C and Model B, Model C was selected for featuring the smallest BIC. It was found that the rate of pain relief medication use was higher in females than in males. Experimental studies on pain have shown a consistent pattern, where women exhibit higher sensitivity to pain, a greater ability to amplify pain sensations, and reduced pain inhibition compared to men [27]. Although the degree of this gender difference may vary across studies [28], this trend remains clear [27]. Several psychosocial, physiological mechanisms contribute to these gender differences in pain perception, including sex hormones, endogenous opioid function, genetic factors, coping abilities with pain, catastrophizing pain, and gender roles [27]. Among these, differences in sex hormones are an important factor influencing how pain is experienced in males and females. Sex hormones and their receptors are distributed in areas of the nervous system related to pain transmission. Estradiol and progesterone can both increase and decrease pain sensitivity, while testosterone generally has a more protective and pain-reducing effect [29].

The results indicate that a longer ambulance dispatch time was associated with a decrease in the use of pain relief medication. In contrast, a longer on-site arrival time was associated with an increased likelihood of administering pain relief medication, and this association was statistically significant. When the time of arrival is prolonged, patients experience protracted pain, which tends to become more difficult to manage. Longer on-site arrival times may lead to the worsening of the patient's condition, and complications may arise, such as muscle strain, infections, or an increased pain response due to the waiting time, leading to an increased need for pain relief medication [30]. Early pain control helps improve comfort, physiological stability, and the ability to assess the patient's condition [31, 32]. Studies show that the use of pain relief medication at the site of trauma and during transportation is highly effective, enhancing safety, reducing pain, and preventing related complications without prolonging the intervention time [32, 33]. The results indicate that patients diagnosed with limb injuries, multiple injuries, or chest trauma were more likely to receive pain relief medication.

However, the rate of pain relief medication use decreased in patients diagnosed with head injuries. Many types of pain relief medications used for head injury patients may affect the neurological recovery process [29]. Some pain relief medications may interfere with physical and mental recovery. A study by Ali in 2018 reported that the use of NSAIDs in patients with head injuries, particularly those with traumatic brain injury, to control pain could lead to hyponatremia, resulting in complications such as coma, confusion, dizziness, gait disturbances, muscle cramps, seizures, coma, and even death [34].

In addition, no statistically significant correlation was identified between the time of day, diagnosis of lacerations, diagnosis of abdominal injuries, traffic accidents, domestic accidents, the use of glucose, oxygen supply, intubation, vital signs upon arrival, and the characteristics of pain relief medication use.

This investigation features a comprehensive analysis of pain management in pre-hospital trauma care, drawing on a large dataset from the emergency system of Ho Chi Minh City over a substantial period from 2022 to 2024. By utilizing real-world data from medical records, the research enhances its applicability to clinical practice. Furthermore, by identifying factors associated with pain relief medication use, the findings provide valuable insights that can guide future protocols and training for emergency medical teams. Nonetheless, this study has several limitations that should be considered. First, as it is based on secondary data from medical records, the quality, completeness, and accuracy of the data may be affected and should be taken into account during analysis. Second, the study did not collect information on the pain levels of trauma patients; therefore, it was not possible to accurately assess the appropriateness of the analgesic interventions provided during pre-hospital emergency care. Third, the study did not explore potential barriers that may have contributed to the limited use of analgesics in the pre-hospital setting.

Future studies should specifically assess changes in pain levels before and after the administration of analgesics by pre-hospital emergency teams, as well as patient outcomes following hospital discharge. In addition, research should focus on identifying barriers that contribute to the limited use of opioid analgesics by healthcare providers in the pre-hospital setting.

5. Conclusion

The study reveals that the rate of pain relief medication use in prehospital trauma emergencies in Ho Chi Minh City is still relatively low, in which paracetamol is the most used while opioid usage remains limited. Factors such as gender, team leader expertise, and type of trauma significantly influence the use of pain relief medication. These findings highlight the necessity of developing clear clinical guidelines for appropriate and timely pain management to improve treatment quality and minimize patient harm.

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Table 1: Characteristics of participants

Characteristics		Trauma (n=10,038) n (%)	Analgesic Use (n=9,851) Yes n (%)	No n (%)
General Information				
Sex	Male	5716 (61.7)	933 (16.7)	4641 (83.3)
	Female	3547 (38.3)	750 (21.3)	2765 (78.7)
Time	07:00 – 12:59	2693 (26.8)	545 (20.5)	2115 (79.5)
	13:00 – 18:59	2813 (28.0)	533 (19.4)	2218 (80.6)
	19:00 – 00:59	3078 (30.7)	510 (16.9)	2514 (83.1)
	01:00 – 06:59	1454 (16.0)	215 (15.2)	1201 (84.8)
Area	Thu Duc City	775 (7.7)	34 (4.5)	724 (95.5)
	Urban	7789 (77.6)	1477 (19.3)	6186 (80.7)
	Suburban	1474 (14.7)	292 (20.4)	1138 (79.6)
Emergency Response Time				
Active time (minutes)	Median (Interquartile Range)	3 (2-5)	3 (1.5-4.6)	3 (2-5)
	< 2.0	2366 (23.6)	583 (25.0)	1745 (75.0)
	2.0 – 2.9	1444 (14.4)	261 (18.4)	1160 (81.6)
	3.0 – 5.9	4318 (43.0)	660 (15.6)	3572 (84.4)
	6.0 – 10.9	1252 (12.5)	209 (17.0)	1019 (83.0)
	≥ 11.0	658 (6.5)	90 (14.0)	552 (86.0)
Arrival time (minutes)	Median (Interquartile Range)	12 (10-16)	12 (10-17)	12 (10-15)
	< 7.0	1324 (13.2)	222 (17.0)	1081 (83.0)
	7.0 – 12.9	4512 (45.0)	725 (16.4)	3703 (83.6)
	13.0 – 30.9	3876 (38.6)	769 (20.2)	3030 (79.8)
	≥ 31.0	326 (3.2)	87 (27.1)	234 (72.9)
Transport time (minutes)	Median (Interquartile Range)	22 (17-30)	25.1 (20-35)	22 (15-29)
	< 16.0	2374 (23.7)	250 (10.6)	2116 (89.4)
	16.0 – 30.9	5806 (57.8)	959 (17.0)	4670 (83.0)
	31.0 – 45.9	1356 (13.5)	411 (30.4)	943 (69.6)
	46.0 – 60.9	315 (3.1)	122 (38.7)	193 (61.3)
	≥ 61.0	187 (1.9)	61 (32.6)	126 (67.4)
Team leader	Doctor	4917 (49.0)	1147 (23.9)	3662 (76.1)
	Medical Technician	2096 (20.9)	250 (12.0)	1830 (88.0)
	Nurse	202 (2.0)	4 (2.0)	198 (98.0)
	Unknown	2823 (28.1)	402 (14.6)	2358 (85.4)
Trauma and Intervention				
Diagnosis *(Yes)*	Limb injuries	3640 (36.3)	1080 (29.7)	2554 (70.3)
	Head injuries	3338 (33.3)	395 (12.0)	2918 (88.0)
	Lacerations	1731 (17.2)	285 (16.8)	1409 (83.2)
	Multiple trauma	906 (9.0)	192 (21.9)	684 (78.1)
	Chest injuries	461 (4.6)	113 (24.7)	345 (75.3)
	Abdominal injuries	198 (2.0)	49 (25.0)	147 (75.0)
Causes *(Yes)*	Traffic accident	3966 (39.5)	621 (16.0)	3263 (84.0)
	Occupational accident	1196 (11.9)	275 (23.2)	912 (76.8)
	Domestic accident	761 (7.6)	136 (18.3)	607 (81.7)
Patient	Yes	9152 (91.2)	1786 (19.5)	7359 (80.5)

Characteristics		Trauma (n=10,038) n (%)	Analgesic Use (n=9,851)	
			Yes n (%)	No n (%)
transfer	No	886 (8.8)	17 (2.4)	689 (97.6)
Receiving hospital	General hospital	8180 (89.4)	1417 (17.3)	6756 (82.7)
	Specialized hospital	493 (5.4)	160 (32.5)	333 (67.5)
	Trauma specialized hospital	479 (5.2)	209 (43.6)	270 (56.4)
Intervention *(Yes)*	Immobilization	3695 (36.8)	1073 (29.1)	2619 (70.9)
	Intravenous fluid	2394 (23.9)	965 (40.7)	1405 (59.3)
	Oxygen supply	641 (6.4)	131 (20.9)	495 (79.1)
	Endotracheal intubation	80 (0.8)	6 (8.8)	62 (91.2)
	Glucose	55 (0.6)	6 (10.9)	49 (89.1)
Vital signs				
Pulse at Arrival	Abnormal	132 (1.9)	27 (20.5)	105 (79.5)
	Normal	6729 (98.1)	1428 (21.2)	5300 (78.8)
Blood pressure at Arrival	Abnormal	1270 (14.0)	285 (22.5)	981 (77.5)
	Normal	7815 (86.0)	1475 (18.9)	6311 (81.1)
Respiratory rate at Arrival	Abnormal	126 (1.4)	25 (19.8)	101 (80.2)
	Normal	8789 (98.6)	1743 (19.9)	7031 (80.1)
SpO2 at Arrival	Abnormal	197 (2.3)	19 (9.8)	174 (90.2)
	Normal	8539 (97.7)	1703 (20.0)	6805 (80.0)

Table 3: Factors associated with analgesic use (n=9,089)

Characteristics	PR (95% CI)	p-value	Adjusted PR (95% CI)	Adjusted p-value
Sex				
Male	1	**<0.001**	**1**	**<0.001**
Female	**1.27 (1.16-1.38)**		**1.17 (1.08-1.26)**	
Time				
07:00 – 12:59	**1.34 (1.16-1.55)**	**<0.001**		
13:00 – 18:59	**1.27 (1.10-1.47)**	**0.001**	**-**	**-**
19:00 – 00:59	1.11 (0.95-1.28)	0.160		
01:00 – 06:59	1			
Active time *(minutes)*				
< 2.0	**1**		**1**	
2.0 – 2.9	**0.73 (0.64-0.83)**	**<0.001**	**0.80 (0.71-0.90)**	**<0.001**
3.0 – 5.9	**0.62 (0.56-0.68)**	**<0.001**	**0.82 (0.74-0.90)**	**<0.001**
6.0 – 10.9	**0.67 (0.58-0.78)**	**<0.001**	0.94 (0.82-1.08)	0.459
≥ 11.0	**0.55 (0.45-0.68)**	**<0.001**	**0.77 (0.64-0.94)**	**0.012**
Arrival time *(minutes)*				
< 7.0	1		1	
7.0 – 12.9	0.96 (0.83-1.10)	0.569	0.95 (0.84-1.07)	0.454
13.0 – 30.9	**1.18 (1.03-1.36)**	**0.013**	0.97 (0.86-1.10)	0.678
≥ 31.0	**1.59 (1.28-1.97)**	**<0.001**	**1.21 (1.01-1.47)**	**0.049**
Transport time *(minutes)*				
≤ 16.0	1		**1**	
16.0 – 30.9	**1.61 (1.41-1.83)**	**<0.001**	**1.26 (1.11-1.44)**	**<0.001**
31.0 – 45.9	**2.87 (2.49-3.31)**	**<0.001**	**1.63 (1.41-1.89)**	**<0.001**
46.0 – 60.9	**3.66 (3.05-4.39)**	**<0.001**	**1.80 (1.51-2.16)**	**<0.001**
≥ 61.0	**3.08 (2.43-3.91)**	**<0.001**	**1.61 (1.31-1.99)**	**<0.001**
Emergency team leader				
Doctor	**1.98 (1.74-2.25)**	**<0.001**	**1.79 (1.59-2.01)**	**<0.001**
Medical Technician	**1**		**1**	
Nurse	**0.16 (0.06-0.43)**	**<0.001**	**0.31 (0.11-0.82)**	**0.019**
Unknown	**1.21 (1.04-1.40)**	**0.011**	**1.73 (1.50-1.99)**	**<0.001**

Characteristics	PR (95% CI)	p-value	Adjusted PR (95% CI)	Adjusted p-value
Diagnosis ***(Yes)***				
Head injury	**0.55 (0.49-0.61)**	**<0.001**	**0.64 (0.57-0.71)**	**<0.001**
Limb injury	**2.55 (2.34-2.78)**	**<0.001**	**1.98 (1.80-2.17)**	**<0.001**
Laceration	0.90 (0.90-1.01)	0.086	-	-
Multiple trauma	**1.22 (1.07-1.39)**	**0.003**	**1.30 (1.14-1.49)**	**<0.001**
Chest injury	**1.37 (1.16-1.61)**	**<0.001**	**1.52 (1.28-1.79)**	**<0.001**
Abdominal injury	**1.37 (1.07-1.76)**	**0.011**	-	-
Causes (Yes)				
Traffic accident	**0.80 (0.74-0.88)**	**<0.001**	-	-
Occupational accident	**1.31 (1.17-1.47)**	**<0.001**	**1.18 (1.06-1.31)**	**0.001**
Domestic accident	1.01 (0.85-1.17)	0.999	-	-
Receiving hospital				
Specialized hospital	**1.87 (1.63-2.14)**	**<0.001**	-	-
Trauma specialized hospital	**2.51 (2.24-2.81)**	**<0.001**		
General hospital	1			
Intervention ***(Yes)***				
Glucose	0.59 (0.27-1.26)	0.178	-	-
Intravenous fluid	**3.63 (3.35-3.93)**	**<0.001**	**3.10 (2.84-3.38)**	**<0.001**
Oxygen supply	1.15 (0.98-1.35)	0.075	-	-
Immobilization	**2.45 (2.25-2.66)**	**<0.001**	**1.71 (1.57-1.86)**	**<0.001**
Endotracheal intubation	0.48 (0.22-1.03)	0.060	-	-
SpO2 at arrival				
Abnormal	**0.49 (0.32-0.75)**	**0.001**	-	-
Normal	1			

Poisson regression was used to evaluate the association between various factors and analgesic use, adjusted for sex, time, area, active time, arrival time, transport time, emergency team leader, head injuries, limb injuries, multiple trauma, chest injuries, abdominal injuries, traffic accident, occupational accident, patient transfer, receiving hospital, intravenous fluid, immobilization, blood pressure at arrival, SpO2 at arrival.

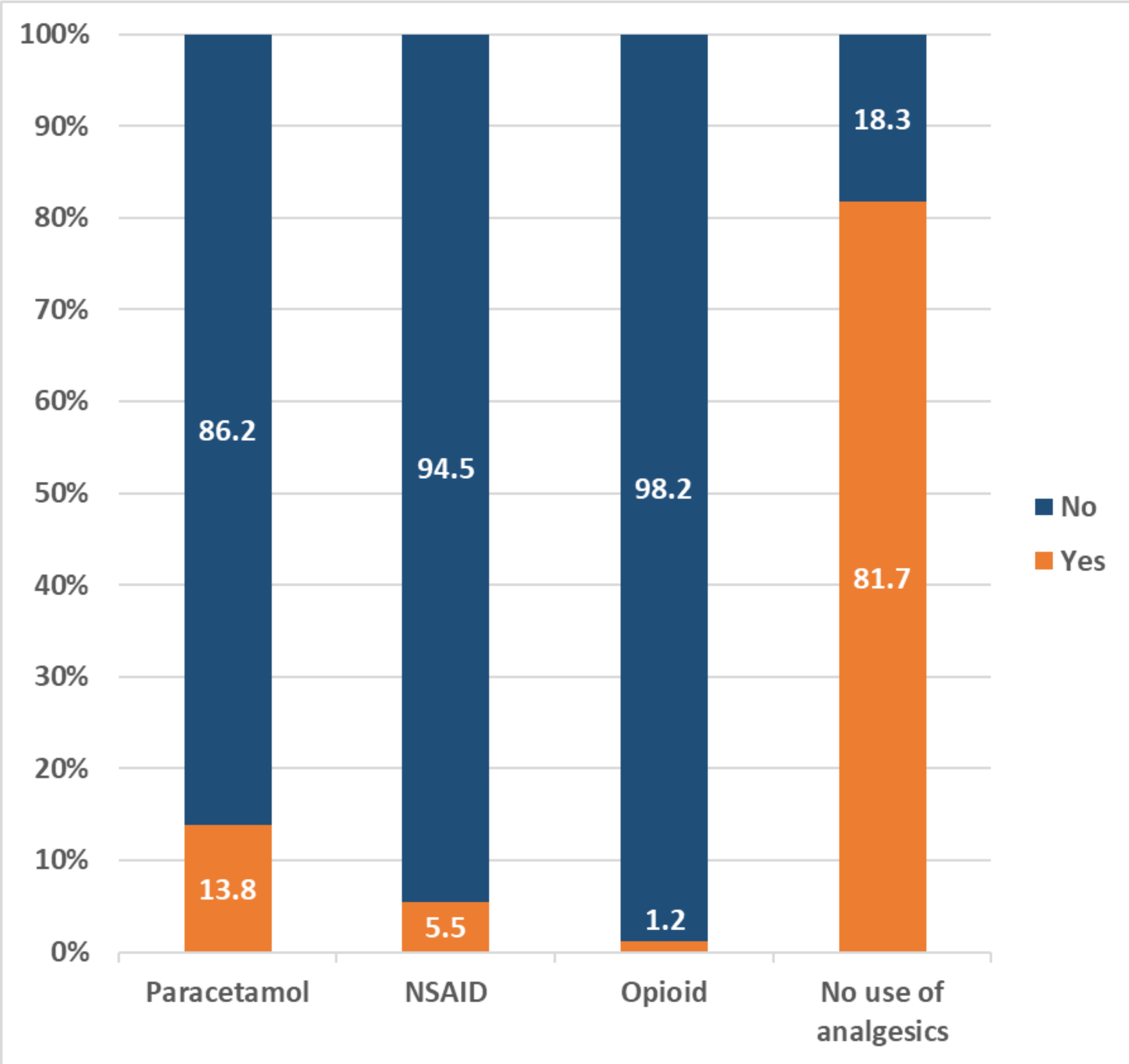

Chart 1: Characteristics of analgesic use (n=9,851)