




Analgesic Use Among Adults with a Trauma-Related Emergency Department Visit: A Retrospective Cohort Study from Alberta, Canada

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ABSTRACT

Introduction: A better understanding of current acute pain-driven analgesic practices within the emergency department (ED) and upon discharge will provide foundational information in this area, as few studies have been conducted in Canada.

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Methods: Administrative data were used to identify adults with a trauma-related ED visit in the Edmonton area in 2017/2018. Characteristics of the ED visit included time from initial contact to analgesic administration, type of analgesics dispensed during and upon being discharged home directly from the ED (≤ 7 days after), and patient characteristics.

Results: A total of 50,950 ED visits by 40,505 adults with trauma were included. Analgesics were administered in 24.2% of visits, of which non-opioids were dispensed in 77.0% and opioids were dispensed in 49.0%. Time to analgesic

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initiation occurred more than 2 h after first contact. Upon discharge, 11.5% received a non-opioid and 15.2% received an opioid analgesic, among whom 18.5% received a daily dose \geq 50 morphine milligram equivalents (MME) and 30.2% received $>$ 7 days of supply. Three hundred and seventeen adults newly met criteria for chronic opioid use after the ED visit, among whom 43.5% received an opioid dispensation upon discharge; of these individuals, 26.8% had a daily dose \geq 50 MME and 65.9% received $>$ 7 days of supply.

Conclusions: Findings can be used to inform optimization of analgesic pharmacotherapy practices for the treatment of acute pain, which may include reducing the time to initiation of analgesics in the ED, as well as close consideration of recommendations for acute pain management upon discharge to provide ideal patient-centered, evidence-informed care.

Keywords: Administrative data; Analgesia; Emergency department; Retrospective

Key Summary Points

Why carry out this study?

Pain is one of the most common presenting complaints by adults in the emergency department (ED). However, few studies have investigated analgesic practices within the ED in Canada.

This study answered the question of what are the current acute pain-driven analgesic practices within the ED and upon discharge for adults in Alberta, Canada.

What was learned from this study?

Analgesics were administered in 24.2% of trauma-related ED visits by adults, of which the majority were non-steroidal anti-inflammatory drugs, and time to analgesia initiation occurred more than 2 h after first contact in the ED.

Findings can be used to inform optimization of analgesic pharmacotherapy practices for the treatment of acute pain.

Further research into the continued development of non-opioid analgesics, as well as providing access to currently approved opioid alternatives will offer healthcare providers additional options for improved treatment of acute pain.

INTRODUCTION

Pain is the most common reason for seeking healthcare services and has been reported as the presenting complaint in up to 78% of emergency department (ED) visits [1]. Therefore, effective strategies for pain management are of great importance within this specific healthcare service [2]. Acute pain is commonly undertreated in the ED [3], and suboptimal management can result in adverse outcomes including the risk of progression to chronic pain [4]. According to the World Health Organization pain ladder, mild acute trauma-related pain can be managed with non-opioid analgesics such as non-steroidal anti-inflammatory drugs (NSAIDs), and opioids are suggested for moderate-to-severe acute trauma-related pain [5]. An understanding of opioid treatment recommendations in conjunction with safety concerns should be taken into consideration when using opioids to treat acute pain, as use can lead to tolerance and dependence, and in some cases, misuse [6]. Acute pain management also requires specific approaches for individuals with opioid and/or other addictions [7]. A better understanding of current acute pain-driven analgesic practices within the ED will provide foundational information in this area and may lead to the optimization of pain management strategies, as few studies have been conducted in Canada. Therefore, the objectives of this study were to describe the characteristics of adult trauma-related ED visits including types of analgesics administered, analgesic use upon discharge, as well as patient characteristics.

METHODS

Study Design

This retrospective cohort study used administrative health data without any intervention and was reported according to the strengthening of the reporting of observational studies in epidemiology (STROBE) guidelines [8]. Ethics approval for this study was received from the University of Alberta institutional review board (Pro00096969). No participants were placed at risk as a result of the study, and informed consent was not required.

Data Source

Data from the National Ambulatory Care Reporting System (NACRS), Discharge Abstract Database (DAD), Practitioner Claims, Pharmaceutical Information Network (PIN), and the Drug Optimization, Sustainability, and Evaluation (DOSE) database were linked to the Population Registry that contains demographic information for all Albertans with Alberta Health Care Insurance Plan (AHCIP) coverage; all Alberta residents are eligible and over 99% participate. NACRS and DAD include information on all individuals discharged from facility-based ambulatory care clinics including EDs and hospitals, respectively; a most responsible diagnosis code and secondary codes are included. Practitioner Claims includes information on physician billing; up to three diagnostic codes can be listed per visit. PIN contains information on dispensed prescription medications from all community pharmacies. DOSE houses medication information from all hospital pharmacies and nine select ED sites located within the Edmonton area.

Cohort Selection

Eligibility criteria for the event-defined cohort included: (1) all ED visits by adults (≥ 18 years) in Alberta between April 1, 2017 and March 31, 2018 (inclusion period) that contained a trauma diagnosis code in the primary diagnostic field and did not contain any exclusionary trauma

diagnostic codes in any diagnostic field (see Table S1 in the electronic supplementary material), and (2) information from the ED site that the visit occurred was linkable to the DOSE database (i.e., the nine select ED sites located within the Edmonton area). Eligibility criteria for the subject-defined cohort included adults within the event-defined cohort who had AHCIP coverage for ≥ 2 years before and ≥ 1 year after their first trauma-related ED visit within the inclusion period (index ED visit). Cohorts were subgrouped according to mode of arrival to the ED (walk-in, ambulance) and the type of analgesic administered during the visit (both opioids and non-opioids, opioids only, non-opioids only, or none).

Measures

ED visit characteristics included the Canadian Triage and Acuity Scale (CTAS) level, trauma type and cause, as well as time from initial contact to analgesic administration, length of stay, and discharge destination. Characteristics of analgesics administered during the ED visit and dispensed ≤ 7 days after the index ED visit among those discharged home directly from the ED included route of administration, and drug class/name; opioids also included dose (morphine milligram equivalent [MME]), formulation, and days of supply [9]. Table S2 in the electronic supplementary material lists the analgesic drugs included.

Demographic characteristics on the index ED visit date included age, sex, and urban/rural residence. Clinical characteristics were determined during the 2-year pre-index period that included a Charlson Comorbidity Index (CCI) score, and health conditions associated with a high-risk of opioid use disorder (chronic pain, mental illness [depression, dementia, and schizophrenia], substance abuse, and physical illness [cerebrovascular disease, chronic heart failure, chronic pulmonary disease, diabetes, liver disease, migraine, renal disease, and rheumatoid arthritis/collagen vascular disease]) [10–13]; Table S3 in the electronic supplementary material details the case definitions [14–18]. Individuals who met chronic opioid

use criteria (≥ 90 consecutive days of supply of opioids within a 1-year period, excluding buprenorphine and methadone used for treatment of opioid use disorder) was also reported [15].

Statistical Analyses

Continuous variables were reported using summary statistics (mean and standard deviation [SD], median and interquartile range [IQR], or minimum and maximum [min/max]), and categorical variables were reported using counts and percentages. Analyses were performed using SAS 9.4 software.

RESULTS

Cohort Selection

Of the 299,005 trauma-related ED visits by adults that occurred during the inclusion period in Alberta, 50,950 occurred at the nine ED sites where medication administration data (DOSE) was available; 40,505 met the criteria for the subject-defined cohort (Fig. 1).

ED Visit Characteristics

Among trauma-related ED visits, the most common mode was walk-in (80.6%), 46.0% were classified as semi-urgent, and 38.2% were a musculoskeletal trauma type (Table 1). Analgesics were administered in 24.2% of visits that occurred a median of 133 min (5 min/1888 max) after first contact in the ED. Those that arrived by ambulance (compared with walk-in) had higher proportions with a CTAS level of urgent or higher (78.8 vs. 42.5%) and who received analgesics (33.7 vs. 21.9%). Table S4 in the electronic supplementary material details ED visit characteristics by subgroupings.

Among those that received analgesics during the trauma-related ED visit (Table 2), 77.0% received non-opioids and 49.0% received opioids (51.0% non-opioids only, 26.0% both non-opioids and opioids, and 23.0% opioids only; see Table S5 in the electronic supplementary

material). NSAIDs were the most commonly administered analgesia (70.7% among those that received an analgesic; 91.8% among those that received a non-opioid analgesic), followed by oxycodone (19.4% among those that received an analgesic; 39.6% among those that received an opioid) and morphine (17.5% among those that received an analgesic; 35.8% among those that received an opioid). The median opioid MME dose dispensed in the ED was 19 (IQR 28) (walk-in: 15 [IQR 21]; ambulance: 30 [IQR 28]).

Baseline Subject Characteristics

On the index ED visit date, the overall average age was 45 (SD 20) years, 53.8% were male, and the vast majority lived in urban areas (90.2%; Table 3). Overall, subjects had a mean CCI score of 0.5 (SD 1.2), and common comorbidities of interest ($> 10\%$) were chronic pain and depression. Those who arrived by ambulance (compared with walk-in) were more likely to be older (57 [SD 23] vs. 47 [SD 18] years of age), female (53.8 vs. 44.5%), and have a higher overall burden of disease (CCI score: 1.0 [SD 1.7] vs. 0.4 [SD 1.0]). Table S6 in the electronic supplementary material shows characteristics based on subgroupings.

Opioid Use Before and During the Index ED Visit

Individuals with opioid use (walk-in: 31.8–39.8 vs. 21.1–25.6%; ambulance: 36.6–43.9 vs. 30.7–30.8%), and those who met chronic opioid use criteria (walk-in: 14.9–17.2 vs. 9.6–10.0%; ambulance: 21.9–26.1 vs. 12.2–17.8%) during the 1-year period before the index ED visit were more likely to receive opioids during the index ED visit versus those that did not (see Table S7 in the electronic supplementary material).

Analgesic Medication Use Upon Discharge from the Index ED Visit

Table 4 details outpatient analgesic medication dispensations that occurred during the first 7 days after the index ED visit, among those

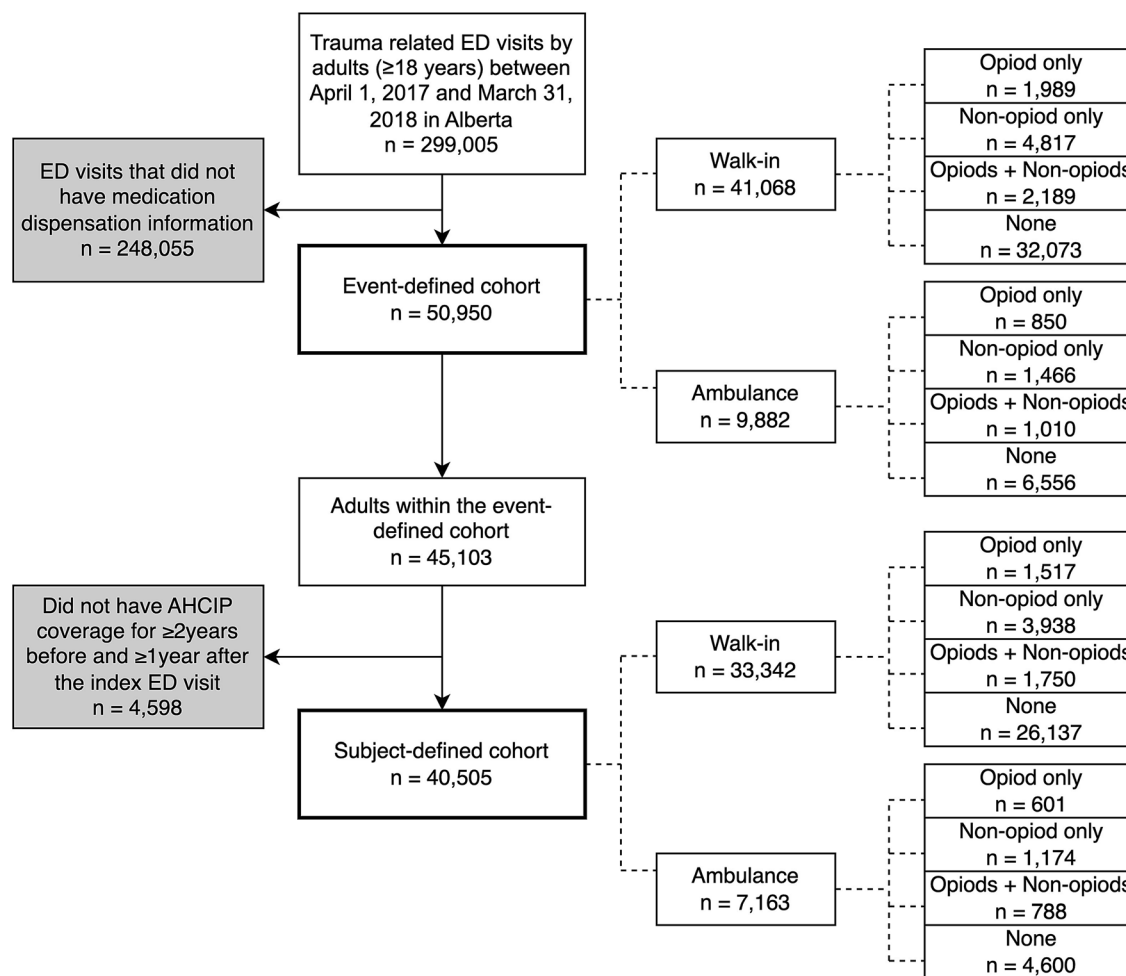


Fig. 1 Event-defined and subject-defined cohort selection. *AHCIP* Alberta Health Care Insurance Plan, *ED* emergency department

discharged home directly from the ED (86.7% of the subject-defined cohort). Among these individuals, 11.5% received ≥ 1 non-opioid analgesic, of which the vast majority received NSAIDs (90.2%), and 15.2% received ≥ 1 opioid dispensation. Among those that received an opioid dispensation, a median daily dose of 36 (IQR 20) MME with a 5 (IQR 7)-day supply was dispensed; 18.5% received ≥ 50 MME daily dose and 30.2% received > 7 days of supply. The vast majority of those with an opioid dispensation received an immediate-release formulation (98.1%) and an oral route of administration (99.0%); the most common types were codeine, tramadol, and oxycodone.

Those who met chronic opioid use criteria during the 1-year pre-index period (versus those that did not) had a higher proportion who received an opioid dispensation upon discharge 47.5 vs. 14.3%; Table 4). Among those who received an opioid dispensation upon discharge, those who met chronic opioid use criteria before the index ED visit (versus those that did not) had a higher proportion who received a daily dose ≥ 50 MME (37.0 vs. 16.8%) and > 7 days of supply (64.7 vs. 26.9%). Among 317 individuals who newly met chronic opioid use criteria during the 1-year period after being discharged home directly from the index ED visit, 43.5% received an opioid dispensation within the first 7 days; of these individuals,

Table 1 Trauma-related emergency department characteristics

| | All visits (<i>N</i> = 50,950) | Mode of arrival to the ED | |
|---|------------------------------------|---------------------------------|---------------------------------|
| | | Walk-in (<i>N</i> = 41,068) | Ambulance (<i>N</i> = 9882) |
| <i>CTAS level, n (%)</i> | | | |
| Resuscitation | 203 (0.4%) | < 10 (NA) | 197 (2.0%) |
| Emergent | 4022 (7.9%) | > 2020 (> 4.9%) | 1992 (20.2%) |
| Urgent | 21,039 (41.3%) | 15,441 (37.6%) | 5598 (56.7%) |
| Semi-urgent | 23,419 (46.0%) | 21,378 (52.1%) | 2041 (20.7%) |
| Non-urgent | 2267 (4.5%) | 2213 (5.4%) | 54 (0.6%) |
| <i>Trauma type, n (%)</i> | | | |
| Musculoskeletal | 19,462 (38.2%) | 15,110 (36.8%) | 4352 (44.0%) |
| Open wound, including amputation | 11,730 (23.0%) | 10,101 (24.6%) | 1629 (16.5%) |
| Superficial | 9586 (18.8%) | 7898 (19.2%) | 1688 (17.1%) |
| Other and unspecified | 5440 (10.7%) | 4638 (11.3%) | 802 (8.1%) |
| Internal organ | 3704 (7.3%) | 2473 (6.0%) | 1231 (12.5%) |
| Burn and corrosion | 776 (1.5%) | 651 (1.6%) | 125 (1.3%) |
| Crushing | 163 (0.3%) | 150 (0.4%) | 13 (0.1%) |
| Nerves and spinal cords | 49 (0.1%) | 29 (0.1%) | 20 (0.2%) |
| Blood vessels | 40 (0.1%) | 18 (0%) | 22 (0.2%) |
| <i>Trauma cause (can be ≥ 1 per encounter), n (%)</i> | | | |
| Unintentional fall | 19,041 (37.4%) | 13,755 (33.5%) | 5286 (53.5%) |
| Mechanical forces | 17,474 (34.3%) | 16,522 (40.2%) | 952 (9.6%) |
| Transport incidents | 6072 (11.9%) | 4023 (9.8%) | 2049 (20.7%) |
| Natural or environmental factors | 4902 (9.6%) | 4401 (10.7%) | 501 (5.1%) |
| Assault, excluding poisoning | 2442 (4.8%) | 1577 (3.8%) | 865 (8.8%) |
| Fire or burn | 703 (1.4%) | 610 (1.5%) | 93 (0.9%) |
| Self-harm, excluding poisoning | 296 (0.6%) | 172 (0.4%) | 124 (1.3%) |
| Other, excluding poisoning | 164 (0.3%) | 94 (0.2%) | 70 (0.7%) |
| Unintentional drowning and submersion | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |
| Suffocation | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |
| <i>Analgesics</i> | | | |
| Received an analgesic | 12,321 (24.2%) | 8995 (21.9%) | 3326 (33.7%) |
| Time from first contact until analgesia, minutes | | | |
| Mean (SD) | 160 (118) | 152 (109) | 180 (137) |

Table 1 continued

| | All visits (<i>N</i> = 50,950) | Mode of arrival to the ED | |
|---|------------------------------------|---------------------------------|---------------------------------|
| | | Walk-in (<i>N</i> = 41,068) | Ambulance (<i>N</i> = 9882) |
| Median (min; max) | 133 (5; 1888) | 127 (5; 1813) | 150 (6; 1888) |
| <i>Length of stay, minutes</i> | | | |
| Mean (SD) | 227 (206) | 193 (156) | 371 (304) |
| Median; min; max | 178 (0; 5676) | 160 (0; 5548) | 299 (1; 5676) |
| <i>Discharge destination: n (%)</i> | | | |
| Home without support | 42,569 (83.6%) | 37,218 (90.6%) | 5351 (54.2%) |
| Admitted to inpatient facilities | 4065 (8.0%) | 880 (2.2%) | 3185 (32.2%) |
| Left without being triaged/seen/treated | 2359 (4.6%) | 2051 (5.0%) | 308 (3.1%) |
| Transferred to another acute care | 661 (1.3%) | 351 (0.9%) | 310 (3.1%) |
| Home with support | 726 (1.4%) | 141 (0.3%) | 585 (5.9%) |
| Other | 529 (1.0%) | 418 (1.0%) | 111 (1.1%) |
| Transferred to non-acute care | 24 (0.1%) | < 10 (N/A) | 15 (0.2%) |
| Died | 17 (0.0%) | < 10 (N/A) | 17 (0.2%) |

CTAS Canadian Triage and Acuity Scale, *ED* emergency department; *Min* minimum, *Max* maximum *N/A* not applicable, *SD* standard deviation

26.8% received a daily dose ≥ 50 MME and 65.9% received > 7 days of supply.

DISCUSSION

Using administrative data, adult trauma-related analgesic practices within Edmonton area EDs were characterized; analgesics were administered in 24.2% of visits, of which the majority were NSAIDs, and occurred more than 2 h after first contact in the ED. Those who met chronic opioid use criteria before the ED visit were more likely to receive opioids during and upon discharge from the ED than those who did not meet criteria. Among the 317 individuals who newly met chronic opioid use criteria after being discharged home directly from the index ED visit, 43.5% received an opioid dispensation upon discharge.

As outlined by Ahmadi et al. (2016), providing appropriate and timely pain management to trauma patients has been shown to be beneficial, including the promotion of early healing, reduction of physiological stress responses, shortened length of hospital stay, decreased risk of progression to chronic pain, and reduced rate of morbidity and mortality [4]. The British Royal College of Emergency Medicine states that patients with severe pain should have analgesics administered within 15-min of arrival to the ED or at triage, and those with moderate pain should have analgesics offered at triage [19]. However, the proportion of individuals that receive analgesics and the time to initial administration appears to vary widely. A large multicenter study that assessed pain management within USA and Canadian EDs found that 60% of patients who presented with moderate-to-severe pain received analgesics

Table 2 Analgesics administered during trauma-related emergency department visits

| | All visits (<i>N</i> = 50,950) | Mode of arrival to the ED | |
|--|------------------------------------|---------------------------------|---------------------------------|
| | | Walk-in (<i>N</i> = 41,068) | Ambulance (<i>N</i> = 9882) |
| Visits with ≥ 1 administration of any analgesic, <i>n</i> (%) | 12,321 (24.2%) | 8995 (21.9%) | 3326 (33.7%) |
| <i>Non-Opioids</i> | | | |
| Visit with ≥ 1 administration of a non-opioid, <i>n</i> (%) | 9482 (77.0%) | 7016 (78.0%) | 2476 (74.4%) |
| Route of administration | | | |
| Oral | 4703 (49.6%) | 3461 (49.3%) | 1242 (50.2%) |
| Parenteral | 5412 (57.1%) | 3958 (56.4%) | 1454 (58.7%) |
| Drug class | | | |
| Non-steroidal anti-inflammatory drugs | 8707 (91.8%) | 6474 (92.3%) | 2233 (90.2%) |
| General anesthetics | 1130 (11.9%) | 798 (11.4%) | 332 (13.4%) |
| Gabapentinoids | 40 (0.4%) | 18 (0.3%) | 22 (0.9%) |
| <i>Opioids</i> | | | |
| Visit with ≥ 1 administration of an opioid, <i>n</i> (%) | 6038 (49.0%) | 4178 (46.4%) | 1860 (55.9%) |
| Morphine milligram equivalent (median, IQR) | 19 (21) | 15 (21) | 30 (28) |
| Formulation | | | |
| Immediate-release | 6031 (99.9%) | 4175 (99.9%) | 1856 (99.8%) |
| Controlled release | 22 (0.4%) | 11 (0.3%) | 11 (0.6%) |
| Route of administration | | | |
| Oral | 3864 (64.0%) | 2861 (68.5%) | 1003 (53.9%) |
| Parenteral | 3161 (52.4%) | 1904 (45.6%) | 1257 (67.6%) |
| Drug name | | | |
| Oxycodone | 2390 (39.6%) | 1787 (42.8%) | 603 (32.5%) |
| Morphine | 2162 (35.8%) | 1343 (32.1%) | 819 (44.1%) |
| Codeine | 1163 (19.3%) | 872 (20.9%) | 291 (15.7%) |
| Hydromorphone | 764 (12.7%) | 407 (9.7%) | 357 (19.3%) |
| Fentanyl | 742 (12.3%) | 449 (10.8%) | 293 (15.8%) |
| Tramadol | 182 (3.0%) | 141 (3.4%) | 41 (2.2%) |
| Methadone | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |

ED emergency department; IQR interquartile range, N/A not applicable,

Table 3 Baseline characteristics of subjects who had a trauma-related emergency department visit

| | All subjects (<i>N</i> = 40,505) | Mode of arrival to index ED visit | |
|---|--------------------------------------|-----------------------------------|---------------------------------|
| | | Walk-in (<i>N</i> = 33,342) | Ambulance (<i>N</i> = 7163) |
| <i>Demographic characteristics</i> | | | |
| Age (years) | | | |
| Mean (SD) | 45 (20) | 43 (18) | 57 (23) |
| Category, <i>n</i> (%) | | | |
| 18–24 | 6267 (15.5%) | 5599 (16.8%) | 668 (9.3%) |
| 25–34 | 8797 (21.7%) | 7824 (23.5%) | 973 (13.6%) |
| 35–44 | 6901 (17.0%) | 6075 (18.2%) | 826 (11.5%) |
| 45–54 | 5799 (14.3%) | 4939 (14.8%) | 860 (12.0%) |
| 55–64 | 5439 (13.4%) | 4509 (13.5%) | 930 (13.0%) |
| ≥ 65 | 7302 (18.0%) | 4396 (13.2%) | 2906 (40.6%) |
| Sex | | | |
| Male | 21,797 (53.8%) | 18,490 (55.5%) | 3307 (46.2%) |
| Female | 18,708 (46.2%) | 14,852 (44.5%) | 3856 (53.8%) |
| Residence location | | | |
| Urban | 36,514 (90.2%) | 30,074 (90.2%) | 6440 (89.9%) |
| Rural | 3991 (9.9%) | 3268 (9.8%) | 723 (10.1%) |
| <i>Clinical characteristics</i> | | | |
| Charlson Comorbidity Index | | | |
| Score | | | |
| Mean (SD) | 0.5 (1.2) | 0.4 (1.0) | 1.0 (1.7) |
| Category, <i>n</i> (%) | | | |
| 0 = no comorbid condition | 30,391 (75.0%) | 26,256 (78.8%) | 4135 (57.7%) |
| 1–2 = mild comorbidity | 7994 (19.7%) | 5936 (17.8%) | 2058 (28.7%) |
| 3–4 = moderate comorbidity | 1369 (3.4%) | 774 (2.3%) | 595 (8.3%) |
| ≥ 5 = severe comorbidity | 751 (1.9%) | 376 (1.1%) | 375 (5.2%) |
| Pre-existing conditions of interest, <i>n</i> (%) | | | |
| Chronic pain | 6971 (17.2%) | 5073 (15.2%) | 1898 (26.5%) |
| Depression | 5930 (14.6%) | 4427 (13.3%) | 1503 (21.0%) |
| Diabetes | 3936 (9.7%) | 2607 (7.8%) | 1329 (18.6%) |
| Chronic pulmonary disease | 3678 (9.1%) | 2686 (8.1%) | 992 (13.9%) |
| Cancer | 1710 (4.2%) | 1238 (3.7%) | 472 (6.6%) |

Table 3 continued

| | All subjects (<i>N</i> = 40,505) | Mode of arrival to index ED visit | |
|---|--------------------------------------|-----------------------------------|---------------------------------|
| | | Walk-in (<i>N</i> = 33,342) | Ambulance (<i>N</i> = 7163) |
| Drug abuse | 1560 (3.9%) | 1059 (3.2%) | 501 (7.0%) |
| Chronic opioid use | 1246 (3.1%) | 818 (2.5%) | 428 (6.0%) |
| Dementia | 1130 (2.8%) | 312 (0.9%) | 818 (11.4%) |
| Alcohol abuse | 1142 (2.8%) | 660 (2.0%) | 482 (6.7%) |
| Migraine | 968 (2.4%) | 825 (2.5%) | 143 (2.0%) |
| Chronic heart failure | 770 (1.9%) | 405 (1.2%) | 365 (5.1%) |
| Liver disease | 715 (1.8%) | 476 (1.4%) | 239 (3.3%) |
| Renal diseases | 708 (1.8%) | 407 (1.2%) | 301 (4.2%) |
| Cerebrovascular disease | 681 (1.7%) | 354 (1.1%) | 327 (4.6%) |
| Rheumatoid arthritis/collagen vascular diseases | 676 (1.7%) | 464 (1.4%) | 212 (3.0%) |
| Schizophrenia | 450 (1.1%) | 271 (0.8%) | 179 (2.5%) |

ED emergency department, *SD* standard deviation

that were administered 90-min after arrival [3]. Woolner et al. (2020) reported that only 42% of adults who presented with musculoskeletal pain at a Toronto ED received analgesics, which occurred an average of 129 min after arrival; these measures improved after process enhancements [20]. Considering that the initiation of analgesia occurred a median of 133 min after first contact in the ED in the current study, a potential area for improvement may include strategies to reduce this time; prehospital analgesic administration by paramedics was not available for the 19% of visits where individuals arrived by ambulance.

Acute pain management in individuals with opioid dependence can be challenging and limited research exists to inform evidence-based guidelines [7, 21]. General guidelines indicate that pharmacological approaches for the management of acute pain among those with opioid dependence should incorporate the use of opioids and non-opioids with the goals of effective analgesia, strategies that can assist to reduce the effects of opioid tolerance or opioid-induced

hyperalgesia, and the prevention of opioid withdrawal reactions and complications [7, 21, 22]. In alignment with this, adults who met chronic opioid use criteria before the ED visit were more likely to receive opioids during and upon discharge from the ED.

Guidelines recommend use of NSAIDs for acute pain management in the outpatient setting for most patients [23]; when managing patients with acute pain for whom opioids are considered appropriate, the lowest effective dose (up to a maximum daily dose of 50 MME) of the least potent immediate-release opioid for short-term use is recommended by the Health Quality Council of Ontario and the Centres for Disease Control and Prevention (more than 7 days is rarely indicated) [22, 24]. Findings from this study indicate areas of concordance with these recommendations along with potential areas for improvement. While NSAIDs were the most commonly dispensed non-opioid analgesic during the first 7 days after being discharged home directly from the ED, more opioid (15.2%) prescriptions were dispensed than

Table 4 Outpatient analgesic medication dispensation during the first 7 days after the index trauma-related emergency department visit; presented among those discharged home directly from the emergency department

| | Discharged home directly from the index ED visit | | |
|--|--|---------------------------------------|---------------------------------|
| | All subjects (<i>N</i> = 35,109) | Mode of arrival to the index ED visit | |
| | | Walk-in (<i>N</i> = 30,616) | Ambulance (<i>N</i> = 4493) |
| Received ≥ 1 dispensation, <i>n</i> (%) | 7717 (22.0%) | 6061 (19.8%) | 1656 (36.9%) |
| <i>Non-opioids</i> | | | |
| Received ≥ 1 dispensation, <i>n</i> (%) | 4028 (11.5%) | 3096 (10.1%) | 932 (20.7%) |
| Route of administration | | | |
| Oral | 4008 (99.5%) | 3082 (99.5%) | 926 (99.4%) |
| Transmucosal | 12 (0.3%) | 11 (0.4%) | < 10 (N/A) |
| Parenteral | 14 (0.3%) | < 10 (N/A) | < 10 (N/A) |
| Other (topical, dental, infiltration) | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |
| Drug class | | | |
| NSAIDs | 3634 (90.2%) | 2803 (90.5%) | 831 (89.2%) |
| Gabapentinoids | 561 (13.9%) | 381 (12.3%) | 180 (19.3%) |
| Local anesthetics | 12 (0.3%) | < 10 (N/A) | < 10 (N/A) |
| <i>Opioids</i> | | | |
| Overall | | | |
| Received ≥ 1 dispensation, <i>n</i> (%) | 5344 (15.2%) | 4281 (14.0%) | 1063 (23.7%) |
| Daily MME dose | | | |
| Median (IQR) | 36 (20) | 36 (20) | 35 (23) |
| ≥ 50 MME, <i>n</i> (%) | 990 (18.5%) | 776 (18.1%) | 214 (20.1%) |
| Number of days of supply | | | |
| Median (IQR) | 5 (7) | 5 (6) | 6 (7) |
| > 7 days, <i>n</i> (%) | 1613 (30.2%) | 1245 (29.1%) | 368 (34.6%) |
| Met chronic opioid use criteria during the 1-year pre-index period, <i>n</i> (%) | 984 (2.8%) | 716 (2.3%) | 268 (6.0%) |
| Received ≥ 1 dispensation | 467 (47.5%) | 333 (46.5%) | 134 (50.0%) |
| ≥ 50 MME daily dose | 173 (37.0%) | 129 (38.7%) | 44 (32.8%) |
| > 7 days of supply | 302 (64.7%) | 233 (70.0%) | 69 (51.5%) |
| Did not meet chronic opioid use criteria during the 1-year pre-index period, <i>n</i> (%) | 34,125 (97.0%) | 29,900 (97.7%) | 4225 (94.0%) |
| Received ≥ 1 dispensation | 4877 (14.3%) | 3948 (13.2%) | 929 (22.0%) |
| ≥ 50 MME daily dose | 817 (16.8%) | 647 (16.4%) | 170 (18.3%) |
| > 7 days of supply | 1311 (26.9%) | 1012 (25.6%) | 299 (32.2%) |
| Did not meet chronic opioid use criteria during the 1-year post-index period, <i>n</i> (%) | 33,808 (99.1%) | 29,668 (99.2%) | 4140 (98.0%) |
| Received ≥ 1 dispensation | 4739 (14.0%) | 3850 (13.0%) | 889 (21.5%) |

Table 4 continued

| | Discharged home directly from the index ED visit | | |
|--|--|---------------------------------------|---------------------------------|
| | All subjects (<i>N</i> = 35,109) | Mode of arrival to the index ED visit | |
| | | Walk-in (<i>N</i> = 30,616) | Ambulance (<i>N</i> = 4493) |
| ≥ 50 MME daily dose | 780 (16.5%) | 623 (16.2%) | 157 (17.7%) |
| > 7 days of supply | 1220 (25.7%) | 946 (24.6%) | 274 (30.8%) |
| Met chronic opioid use criteria during the 1-year post-index period, <i>n</i> (%) | 317 (0.9%) | 232 (0.8%) | 85 (2.0%) |
| Received ≥ 1 dispensation | 138 (43.5%) | 98 (42.2%) | 40 (47.1%) |
| ≥ 50 MME daily dose | 37 (26.8%) | 24 (24.5%) | 13 (32.5%) |
| > 7 days of supply | 91 (65.9%) | 66 (67.3%) | 25 (62.5%) |
| Overall | | | |
| Formulation, <i>n</i> (%) | | | |
| Immediate release | 5240 (98.1%) | 4206 (98.2%) | 1034 (97.3%) |
| Controlled release | 191 (3.6%) | 146 (3.4%) | 45 (4.2%) |
| Route of administration, <i>n</i> (%) | | | |
| Oral | 5291 (99.0%) | 4237 (99.0%) | 1054 (99.2%) |
| Transmucosal | 43 (0.8%) | 35 (0.8%) | < 10 (N/A) |
| Transdermal | 24 (0.4%) | 23 (0.5%) | < 10 (N/A) |
| Parenteral | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |
| Drug name, <i>n</i> (%) | | | |
| Codeine | 3565 (66.7%) | 2887 (67.4%) | 678 (63.8%) |
| Tramadol | 1159 (21.7%) | 953 (22.3%) | 206 (19.4%) |
| Oxycodone | 621 (11.6%) | 446 (10.4%) | 175 (16.5%) |
| Hydromorphone | 278 (5.2%) | 200 (4.7%) | 78 (7.3%) |
| Morphine | 87 (1.6%) | 67 (1.6%) | 20 (1.9%) |
| Methadone | 52 (1.0%) | 43 (1.0%) | < 10 (N/A) |
| Buprenorphine | 60 (1.1%) | 52 (1.2%) | < 10 (N/A) |
| Fentanyl | < 10 (N/A) | < 10 (N/A) | 0 (0%) |
| Other | < 10 (N/A) | < 10 (N/A) | < 10 (N/A) |

ED emergency department, IQR interquartile range, MME morphine milligram equivalent, N/A not applicable

non-opioid (11.5%) analgesics; it is possible that a number of individuals received over-the-counter non-opioid analgesics, as these are not captured in administrative data. Among the opioids dispensed, prescribing practices were largely in alignment with recommendations, however potential gaps in optimal prescribing

were noted. Adults who received a daily dose ≥ 50 MME and for more than 7 days was common; while causality cannot be established, 138 adult patients with trauma who received an opioid dispensation immediately after being discharged home directly from the ED newly met criteria for chronic opioid use in the

following year, among whom 26.8% received a daily dose ≥ 50 MME and 65.9% received > 7 days of supply. Also, codeine and tramadol were the most commonly dispensed opioid types, both of which have come under scrutiny. Although codeine use in the outpatient setting is widespread and has been found to be the most commonly prescribed opioid in many countries, including Canada, its analgesic effect is highly variable and associated with risk of adverse effects that can be severe [9, 25, 26]. Health Canada has recently classified tramadol as a Schedule I drug because of its potential for problematic use, risk for tolerance and dependence, and harmful adverse effects [27].

This study has several important strengths, including the large size and population-based design. However, this study is also subject to limitations that should be taken into consideration when interpreting results. Prehospital analgesic administration was not available for the 19% of trauma-related ED visits where patients arrived by ambulance. Severity of acute pain associated with trauma could not be determined as there were no measures of pain assessment within the administrative data. PIN only provides information on prescription medication dispensations, and therefore may not represent actual medication uptake by individuals. Whether individuals were counselled on the appropriate use of analgesics is also not included in administrative data. Use of over-the-counter or illicit analgesics and other non-pharmacotherapy pain management therapies are not captured within provincial administrative data and therefore were not reported.

CONCLUSIONS

Results of this study provide insight into current adult trauma-related analgesic practices within the ED and upon discharge that can be used to inform optimization of analgesic pharmacotherapy practices for the treatment of acute pain. Findings indicate that areas for improvement may include strategies to reduce time to initiation of analgesics in the ED, as well as consideration of recommendations for acute

pain management upon discharge to provide ideal patient-centered, evidence-informed, and guideline concordant care. Further research into the continued development of non-opioid analgesics, as well as providing access to currently approved opioid alternatives, will offer healthcare providers additional options for improved treatment of acute pain.

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Compliance with Ethics Guidelines. Ethics approval for this study was received from the University of Alberta Institutional Review Board (Pro00096969). No participants were placed at risk as a result of the study, and informed consent was not required.

Data Availability. The datasets analyzed during the current study are not publicly available because the data custodians, Alberta Health Services and Alberta Health, do not allow users of the data to publish the data. Please contact the corresponding author for requests related to the data used in this study.

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REFERENCES

1. Tanabe P, Buschmann M. A prospective study of ED pain management practices and the patient's perspective. *J Emerg Nurs.* 1999;25(3):171–7.
2. Cordell WH, Keene KK, Giles BK, Jones JB, Jones JH, Brizendine EJ. The high prevalence of pain in emergency medical care. *Am J Emerg Med.* 2002;20(3):165–9.
3. Todd KH, Ducharme J, Choiniere M, Crandall CS, Fosnocht DE, Homel P, et al. Pain in the emergency department: results of the Pain and Emergency Medicine Initiative (PEMI) Multicenter Study. *J Pain.* 2007;8(6):460–6.
4. Ahmadi A, Bazargan-Hejazi S, Heidari Zadi Z, Euasobhon P, Ketumarn P, Karbasfrushan A, et al. Pain management in trauma: a review study. *J Injury Violence Res.* 2016;8(2):89–98.
5. Anekar AA, Cascella M. WHO Analgesic Ladder. StatPearls. Treasure Island (FL): StatPearls Publishing. Copyright © 2022, StatPearls Publishing LLC.; 2022.
6. Preuss CV, Kalava A, King KC. Prescription of controlled substances: benefits and risks. StatPearls. Treasure Island (FL): StatPearls Publishing. Copyright © 2022, StatPearls Publishing LLC.; 2022.
7. Raub JN, Vettese TE. Acute pain management in hospitalized adult patients with opioid dependence: a narrative review and guide for clinicians. *J Hosp Med.* 2017;12(5):375–9.
8. von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet.* 2007;370(9596):1453–7.
9. Canadian Institute for Health Information. Opioid prescribing in Canada: how are practices changing? Ottawa, Ontario: CIHI; 2019.
10. Sullivan MD, Edlund MJ, Zhang L, Unützer J, Wells KB. Association between mental health disorders, problem drug use, and regular prescription opioid use. *Arch Intern Med.* 2006;166(19):2087–93.
11. Baborik AL, Satre DD, Kline-Simon AH, Weisner CM, Campbell CI. Alcohol, cannabis, and opioid use disorders, and disease burden in an integrated health care system. *J Addict Med.* 2017;11(1):3–9.
12. Rice JB, White AG, Birnbaum HG, Schiller M, Brown DA, Roland CL. A model to identify patients

- at risk for prescription opioid abuse, dependence, and misuse. *Pain Med.* 2012;13(9):1162–73.
13. National Institutes on Drug Abuse (US). Common comorbidities with substance use disorders research report. Bethesda, MD; 2020.
 14. Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care.* 2005;43(11):1130–9.
 15. Tian TY, Zlateva I, Anderson DR. Using electronic health records data to identify patients with chronic pain in a primary care setting. *J Am Med Inform Assoc.* 2013;20(E2):E275–80.
 16. Tonelli M, Wiebe N, Fortin M, Guthrie B, Hemmelgarn BR, James MT, et al. Methods for identifying 30 chronic conditions: application to administrative data. *BMC Med Inform Decis Mak.* 2015;15:31.
 17. Lurie N, Popkin M, Dysken M, Moscovice I, Finch M. Accuracy of diagnoses of schizophrenia in Medicaid claims. *Hosp Commun Psychiatry.* 1992;43(1):69–71.
 18. Kolodner K, Lipton RB, Lafata JE, Leotta C, Liberman JN, Chee E, et al. Pharmacy and medical claims data identified migraine sufferers with high specificity but modest sensitivity. *J Clin Epidemiol.* 2004;57(9):962–72.
 19. The Royal College of Emergency Medicine Best Practice Guideline. Management of pain in adults. London, England; 2021.
 20. Woolner V, Ahluwalia R, Lum H, Beane K, Avelino J, Chartier LB. Improving timely analgesia administration for musculoskeletal pain in the emergency department. *BMJ Open Quality.* 2020;9(1).
 21. Mehta V, Langford R. Acute pain management in opioid dependent patients. *Rev Pain.* 2009;3(2):10–4.
 22. Health Quality Ontario. Opioid prescribing for acute pain: care for people 15 years of age and older. Toronto: Ontario; 2018.
 23. Qaseem A, McLean RM, O’Gurek D, Batur P, Lin K, Kansagara DL, et al. Nonpharmacologic and pharmacologic management of acute pain from non-low back, musculoskeletal injuries in adults: a clinical guideline from the American College of Physicians and American Academy of Family Physicians. *Ann Intern Med.* 2020;173(9):739–48.
 24. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain—United States, 2016. *J Am Med Assoc.* 2016;315(15):1624–45.
 25. Tobias JD, Green TP, Coté CJ. Codeine: time to say “no”. *Pediatrics.* 2016;138(4).
 26. “Weak” opioid analgesics. Codeine, dihydrocodeine and tramadol: no less risky than morphine. *Prescrip Int.* 2016;25(168):45–50.
 27. Government of Canada. Regulations amending the narcotic control regulations (tramadol): SOR/2021–43. In: Canada Gazette, editor. 2021.