# Variables Associated With Administration of Nurse-initiated Analgesia in Pediatric Triage

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**Objectives:** Triage nurse-initiated analgesia (TNIA) has been shown to be associated with decreased time to the provision of analgesia and improved patient satisfaction. We examined variables that influence the provision of analgesia in a pediatric emergency department that uses TNIA.

**Methods:** A 4-year retrospective cohort study of all children with triage pain scores ≥1 was conducted. Data on demographics and patients' and nurses' characteristics were collected. Logistic regression analyses were used to examine the effect of multiple variables on the provision of any analgesia and opioid analgesia.

**Results:** Overall, 28,746 children had triage pain scores ≥1; 14,443 (50.2%) patients received analgesia of any type and 1888 (6.6%) received opioid analgesia. Mean time to any analgesia was 8.0 ± 3.7 minutes. Of the 9415 patients with severe pain, 1857 (19.7%) received opioid analgesia. Age, sex, hourly number of patients waiting to be triaged, and nurse experience were not associated with the provision of any analgesia or opioid analgesia. Severe pain had the highest odds ratios (ORs) for the provision of any analgesia and opioid analgesia (7.7; 95% confidence interval [CI]: 7.1-8.2 and 22.8; 95% CI: 18.1-28.8, respectively). Traumatic injury and time-to-triage <8 minutes were associated with the provision of opioid analgesia (OR: 4.7; 95% CI: 4.2-5.2 and OR: 1.6; 95% CI: 1.5-1.8, respectively).

**Discussion:** TNIA yielded a short time to analgesia, but rates of any analgesia and opioid analgesia were low. Several variables associated with the provision of any analgesia and opioid analgesia were identified. Our findings provide evidence to guide future educational programs in this area.

**Key Words:** analgesia, pain, triage, nurse

Appropriate pediatric pain assessment and management in the emergency department (ED) is an important aspect of care, and triage pain protocols have been established to improve the frequency of analgesic administration.[1–4] Undertreatment of pain in the ED has been reported in many studies as a persistent problem, and there are still large gaps in our knowledge, depriving children of adequate analgesia.[5–9] Studies that have examined analgesic administration in the ED found that multiple factors were independently associated with inadequate ED pain management: age and sex, presenting symptom, pain severity, triage score, time of arrival, ethnicity and race, crowding, and type of insurance.[7,10–17] It is believed that one way to overcome the problem of inadequate analgesia is to establish a triage nurse-initiated analgesia (TNIA) protocol that empowers nurses to administer analgesics early and without physician authorization.[18–23]

TNIA has been shown to be associated with decreased time to provision of analgesia and improved patient satisfaction.[18–23] In children, prior studies have reported conflicted results with regard to reducing time to analgesia.[18–20] There are currently no studies that have investigated the influence of various factors on the provision of analgesia using TNIA, in children. Understanding these variables may help nurses and medical staff to develop effective strategies to increase the rate of analgesia provision using TNIA. We sought to examine variables that influence the provision of analgesia in a pediatric ED that uses TNIA.

## METHODS

### Setting and Study Design

Rambam Health Care Campus (RHCC) is a tertiary care hospital as well as a referral center for 12 district hospitals. The hospital serves a population of >2 million residents. The Pediatric ED has an annual volume of ~27,000 patients.

We conducted a retrospective analysis of routinely collected hospital data of all ED children (ages 3-18) who had pain scores of at least 1 on a 10-point scale in triage.[9] The study period was from January 1, 2015, to December 31, 2018. The study was approved by the institutional review board.

### Data Collection and Selection of Participants

RHCC patient data management system ("Prometheus," integrated electronic medical records system,

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I.S.: conceived the idea for the study, designed the study, analyzed the data, performed the statistical analysis, and drafted the manuscript. L.H.-S., R.A., and D.S.: assisted in data extraction, carried out the initial analyses, reviewed the manuscript, and approved the final manuscript as submitted. R.L.: carried out the statistical analysis, reviewed the manuscript, and approved the final manuscript as submitted. E.B. and N.P.: critically reviewed the manuscript, and approved the final manuscript as submitted. O.F.: coordinated and supervised data collection, analyzed the data, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.
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Haifa, Israel) is a computerized mandatory working tool for all physicians, nursing staff and any ED health care personnel. All patients seen in RHCC have their episode of care recorded in the Prometheus. The Prometheus contains any data collected in real-time by physicians and nurses including vital signs, pain scores, and triage category level, and records the time and date of medication administration, along with the dose, route, and frequency. On the basis of Prometheus, the Information Technology Department of the hospital developed a business intelligence information system (BIINS) that provides reporting and analytical functions across multiple datasets. The BIINS enables automatic extraction of patient data from the electronic medical records according to criteria set by researchers.[24,25]

For each patient who had a pain score of least 1 in triage, the following data were extracted from the BIINS: demographics (age, weight, sex), diagnosis (medical or trauma), triage acuity level (1 to 5), pain score (1 to 3, 4 to 6, 7 to 10), time of arrival (07:00 to 15:00, 15:01 to 23:00, 23:01 to 07:00), day of the week (weekday, weekend), time to triage (TTT), hourly number of new patients to be triaged (NPTT), and triage nurse experience (1 to 5 y, 6 to 10 y, $\geq$11 y).[18]

## TNIA Protocol

The pediatric ED nursing staff uses the Pediatric Canadian Triage Acuity Scale (PedCTAS) to triage patients, a system that has been used widely in Canada and other countries since 2001. Using this method, patients are divided into 5 categories according to their medical or traumatic problem; level 1—patient requires immediate evaluation and care, level 2—patient requires evaluation and care within 15 minutes, level 3—patient requires evaluation and care within 30 minutes, level 4—patient requires evaluation and care within 60 minutes, and level 5—patient requires evaluation and care within 120 minutes.[26]

TNIA has been used routinely in the triage of our ED since 2011. On the basis of department protocol, the triage nurse is responsible for pain assessment and treatment of any child admitted to the ED. Triage nurses are allowed to administer 1 dose of analgesic medication, including an opioid, for a wide range of presenting complaints, without consultation with a physician. The nurse independently provides analgesia to any patient older than 3 years of age, using a single analgesic agent from a previously developed list of possible analgesics (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CJP/A639). Parental refusal to be treated with an analgesic is documented.

If a child was treated with an analgesic before ED arrival, he/she will be treated with a different analgesic in triage (eg, a child in pain who was treated with paracetamol 2 hours before arrival will be treated with ibuprofen or dipyrone at triage). TNIA pathway is not used in patients younger than 3 years, and in children with special health care needs (eg, pervasive neurodevelopment disorders, autism spectrum disorder, developmental disorders, and behaviorally complex children).

A nurse obtains a credential to perform TNIA after receiving education on pain assessment and management. This education includes courses that involve human patient simulation, in-hospital workshops and refresher courses throughout the year. Nurses also constantly receive advanced education in the form of "one-on-one coaching," and "audit with structured feedback," strategies designed to improve protocol adherence.[24,27,28]

Pain is assessed using the self-report verbal Numeric Rating Scale (0 to 10) for children aged 16 to 18 years.[29] Two instruments are used to assess pain in the 3 to 15-year-old group; the Wong-Baker FACES Pain Rating Scale, and the Visual Analog Scale.[30,31] The Wong-Baker FACES Pain Rating Scale is a self-report scoring scale mainly designed for use by children aged 3 to 7 years. The child is presented with a selection of 6 faces expressing different degrees of distress. After providing an explanation of the scale, the examiner used specific instructions for use. The child then points to the face that best represents his/her level of pain (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CJP/A639).[30] The Visual Analog Scale is a self-report scoring scale mainly designed for use by children aged 8 to 15 years. It consists of a horizontal line, 10 cm in length, anchored by word descriptors such as none, annoying, uncomfortable and worst imaginable pain (translated into Hebrew and Arabic). After providing an explanation of the scale, the examiner asks the child to mark the level of pain that represents his or her current state of pain (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CJP/A639).[31]

Mild, moderate, and severe pain are defined as scores of 1 to 3, 4 to 6, and 7 to 10, respectively.[9] Patients who have severe pain receive either oral oxycodone, oral morphine or intranasal fentanyl at the nurse's discretion (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CJP/A639).

## Variables Associated With Triage Load

We included 2 variables that we surmised would influence triage load. The variable "TTT" was defined as the period of time from registration at the ED desk until the beginning of triage.[32] The variable "NPTT" was defined as the hourly number of patients waiting to be triaged at any given time.[33]

## Study Outcome Measures

The primary outcome was the proportion of children receiving any analgesia at triage. The secondary outcome was the proportion of children receiving opioid analgesia at triage. Any analgesia was defined as the provision of analgesia of any type (an opioid or a nonopioid). Opioid analgesia was defined as the provision of an opioid analgesic.[34,35]

## Primary Data Analysis

Data were analyzed with SPSS 21 version (SPSS-IBM, Chicago, IL). Multivariable logistic regressions were performed to identify covariates that influence the administration of any analgesia and opioid analgesia. All variables with a $P$-value <0.10 on univariate analysis as well as variables with a biologically plausible relationship were considered for inclusion in a regression model. Only variables with an overall $P$-value <0.05 were retained in the final model. The variables introduced in the regression model were based on clinical relevance and available data from the Israel Ministry of Health and included age, sex, medical or trauma diagnosis, pain score (0 to 3, 4 to 6, 7 to 10), time of arrival (07:00 to 15:00, 15:01 to 23:00, 23:01 to 07:00), day of the week (weekday, weekend), TTT ($\geq$8 min, <8 min), hourly number of NPTT (>4, $\leq$4), and triage nurse experience (<5 y, 6 to 10 y, >11 y). Missing data were minimal (<1%).

# RESULTS

During the 4-year study period, 28,746 patients with a mean (SD) age of 10.9 (4.9) years and a male/female ratio of

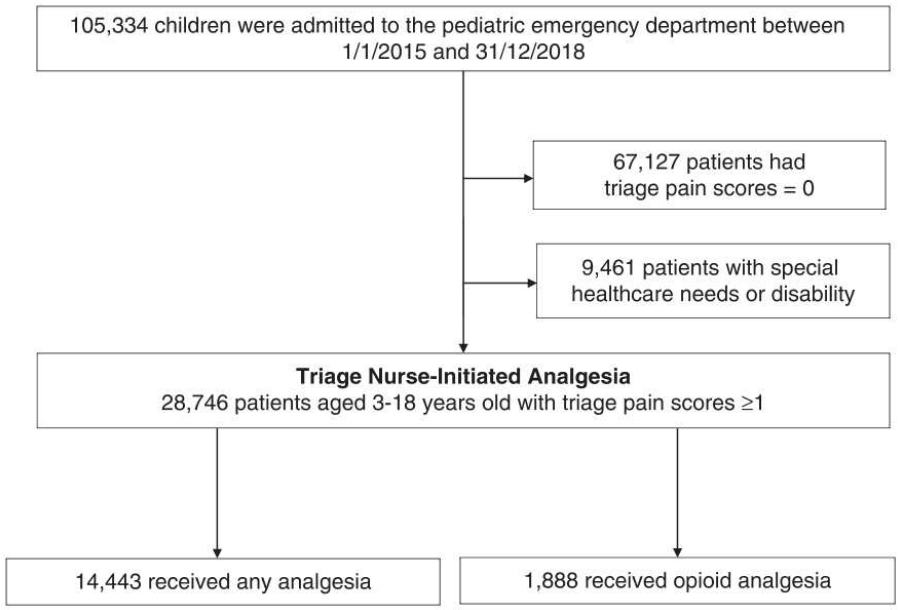


**FIGURE 1.** Study flow chart.

16,622/12,124 had a pain score of at least 1 in triage (Fig. 1, Table 1). The distribution of patients according to PedCTAS levels were 74 (0.3%), 2736 (9.6%), 13,346 (46.4%), 11,630 (40.5%), and 932 (3.2%) for PedCTAS levels 1, 2, 3, 4, and 5, respectively. All 74 patients who had PedCTAS level 1 received opioid analgesia for severe trauma (mainly fall from height and motor vehicle collision) or burns. These patients were treated with intranasal fentanyl in the resuscitation room by the triage nurse. Patients' and demographic characteristics are presented in Table 1.

**TABLE 1.** Demographic Characteristics, Pain Scores, and Study Variables (N = 28,746)

| | Not Treated With Analgesia (N = 14,303) | Treated With any Analgesia (N = 14,443) | Treated With Opioid Analgesia (N = 1888) |
|---|---|---|---|
| Age, mean ± SD (y) | 10.6 ± 4.9 | 11.2 ± 4.9 | 11.4 ± 4.7 |
| Sex, n (%) | | | |
| Male | 8344 (58.3) | 8278 (57.3) | 1272 (67.4) |
| Female | 5959 (41.7) | 6165 (42.7) | 616 (32.6) |
| Diagnosis, n (%) | | | |
| Trauma | 8212 (57.4) | 6178 (42.8) | 1411 (74.7) |
| Medical | 6091 (42.6) | 8265 (57.2) | 477 (25.3) |
| Pain score, n (%) | | | |
| 1-3 | 5514 (38.6) | 1771 (12.3) | 8 (0.4) |
| 4-6 | 5913 (41.3) | 6133 (42.5) | 23 (1.2) |
| 7-10 | 2876 (20.1) | 6539 (45.3) | 1857 (98.4) |
| 24 h time of arrival, n (%) | | | |
| 07:00-15:00 | 5529 (38.7) | 5238 (36.3) | 585 (31.0) |
| 15:01-23:00 | 6968 (48.7) | 6945 (48.1) | 1080 (57.2) |
| 23:01-07:00 | 1806 (12.6) | 2260 (15.6) | 223 (11.8) |
| Day of the week, n (%) | | | |
| Weekday | 10,872 (76.0) | 10,702 (74.1) | 1310 (69.4) |
| Weekend | 3431 (24.0) | 3741 (25.9) | 578 (30.6) |
| Nurse experience, n (%) (y) | | | |
| < 5 | 2877 (20.1) | 3130 (21.7) | 296 (15.7) |
| 5-10 | 6117 (42.8) | 6408 (44.3) | 973 (51.5) |
| > 10 | 5309 (37.1) | 4905 (34.0) | 619 (32.8) |
| Time to triage, mean ± SD (min) | | | |
| Length of time | 12.5 ± 10.9 | 11.1 ± 9.4 | 9.9 ± 8.2 |
| No. patients waiting to be triaged, median (IQR) | | | |
| Patients/h | 5 (3-7) | 5 (3-7) | 5 (3-7) |

IQR indicates interquartile range.

The mean (SD) pain score was 5.4 (2.4). The mean (SD) period of time from ED registration to analgesic administration was 8.0 (3.7) minutes. Overall, 14,443/28,746 (50.2%) patients were treated with analgesia of any type, and 1888/28,746 (6.6%) were treated with opioid analgesia; 1236 patients were treated with oxycodone, 546 patients received oral morphine, and 106 received intranasal fentanyl. Of the 21,461 (74.7%) patients who had pain scores > 3, 12,672/21,461 (59.0%) received any analgesia. Of the 9415 (32.8%) who had pain scores > 6, 1857/9415 (19.7%) received opioid analgesia (Table 1). Caregiver refusal to be treated with an opioid was found in 431 children, 218/14,390 (1.5%) trauma cases and 233/14,356 (1.6%) medical cases. All were treated with another analgesic. Refusal to non-opioid analgesia was not recorded.

## Independent Factors Associated With Administration of any Analgesia

Multivariate regression analysis showed that odds ratios (ORs) for the provision of any analgesia were 7.7 (95% confidence interval [CI]: 7.1-8.2) for severe pain, 3.3 (95% CI: 3.1-3.6) for moderate pain, 1.2 (95% CI: 1.1-1.3) for arrival at night shift, and 1.1 (95% CR: 1.0-1.1) for arrival at weekend (Table 2).

## Independent Factors Associated With Administration of Opioid Analgesia

Multivariate regression analysis showed that ORs for the provision of opioid analgesia were 22.8 (95% CI: 18.1-28.8) for severe pain, 4.7 (95% CI: 4.2-5.2) for traumatic injury, 1.9 (95% CI: 1.5-2.5) for moderate pain, 1.6 (95% CI: 1.5-1.8) for TTT <8 minutes, 1.4 (95% CI: 1.2-1.5) for male sex, 1.2 (95% CI: 1.1-1.4) for arrival at weekend, and 1.2 (95% CI: 1.0-1.3) for arrival at evening shift (Table 3).

**TABLE 2.** Multivariable Regression Analysis

| | OR | 95% CI |
|---|---|---|
| Younger age | 1.1 | 1.0-1.2 |
| Female | Ref | — |
| Male | 1.0 | 1.0-1.1 |
| Pain score* | | |
| 1-3 | Ref | — |
| 4-6 | 3.3 | 3.1-3.6 |
| 7-10 | 7.7 | 7.1-8.2 |
| 24 h time of arrival | | |
| 07:00-15:00 | Ref | — |
| 15:00-23:00 | 1.0 | 1.0-1.1 |
| 23:00-07:00 | 1.2 | 1.1-1.3 |
| Medical | Ref | — |
| Trauma | 1.1 | 1.0-1.1 |
| Nurse experience (y) | | |
| < 5 | Ref | — |
| 5-10 | 1.1 | 1.0-1.2 |
| > 10 | 1.1 | 1.0-1.2 |
| Arrival at weekday | Ref | — |
| Arrival at weekend | 1.1 | 1.0-1.1 |
| Time to triage (min) | | |
| ≥ 8 | Ref | — |
| < 8 | 1.0 | 1.0-1.1 |
| Hourly number of patients to be triaged | | |
| > 4 | Ref | — |
| ≤ 4 | 1.0 | 1.0-1.1 |

Variables associated with the provision of analgesia of any type.
*On the basis of triage nurse-initiated analgesia protocol.
CI indicates confidence interval; OR, odds ratio; Ref, reference.

**TABLE 3.** Multivariable Regression Analysis

| | OR | 95% CI |
|---|---|---|
| Older age | 1.1 | 1.0-1.2 |
| Female | Ref | — |
| Male | 1.4 | 1.2-1.5 |
| Pain score* | | |
| 1-3 | Ref | — |
| 4-6 | 1.9 | 1.5-2.5 |
| 7-10 | 22.8 | 18.1-28.8 |
| 24 h time of arrival | | |
| 07:00-15:00 | Ref | — |
| 15:00-23:00 | 1.2 | 1.0-1.3 |
| 23:00-07:00 | 0.9 | 0.8-1.1 |
| Medical | Ref | — |
| Trauma | 4.7 | 4.2-5.2 |
| Nurse experience (y) | | |
| < 5 | Ref | — |
| 5-10 | 1.1 | 1.0-1.2 |
| > 10 | 1.1 | 1.0-1.2 |
| Arrival at weekday | Ref | — |
| Arrival at weekend | 1.2 | 1.1-1.4 |
| Time to triage (min) | | |
| ≥ 8 | Ref | — |
| < 8 | 1.6 | 1.5-1.8 |
| Hourly number of patients to be triaged | | |
| > 4 | Ref | — |
| ≤ 4 | 1.0 | 1.0-1.1 |

Variables associated with the provision of opioid analgesia.
*On the basis of triage nurse-initiated analgesia protocol.
CI indicates confidence interval; OR, odds ratio; Ref, reference.

### Analysis of Patient Load in Triage

A cyclical distribution of NPTT was found along the 24 hours (Fig. 2).

## DISCUSSION

The present study evaluated variables that influence the administration of analgesia in a pediatric ED with TNIA. A strength of this study is the relatively high number of patients who were treated with TNIA. The main finding of our study is that the TNIA allowed for a short time to analgesia (8 min) for those patients who received it. The overall rate of any analgesia was 50.2%, and only 59.0% of the patients with moderate and severe pain (pain score 4 to 10) were treated with some form of analgesia. These concerning results suggest that TNIA reduces the time to receiving analgesics, a finding that is consistent with literature reports[18–23]; however, TNIA may not necessarily improve the analgesia administration rate. Previous studies in adult EDs reported that TNIA yielded a rate of 56.0%[18] and 32.5%[20] for any analgesia administration. These findings corroborate our results of a 50% analgesia rate in a pediatric ED. The low rate of analgesia clearly suggests that, despite the fact that triage nurses in our department are highly trained professionals, they did not fully adhere to the department pain management protocol (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CJP/A639).

The finding of 59.0% analgesia to children with pain scores > 3 is particularly worrisome because it is incongruent with the American Academy of Pediatrics policy that analgesia is recommended for children with pain scores of 4/10 or greater.[1]

Another important finding of our study is that only 19.7% of the patients with severe pain (pain score 7 to 10) were treated with an opioid. Regression analysis showed that severe pain and traumatic injury were strongly associated with the provision of opioids. These results suggest that TNIA was more appropriately applied for trauma diagnoses. Two previous studies conducted in our department provide support for this assumption. One study revealed that 99% of the patients with fractures and a pain score of 7 or more received opioids,[24] while the other study showed that only 56.8% of the patients who had an acute abdominal pain score of 7 or more received opioids.[25] This phenomenon of treating differently 2 individuals who present with the same level of pain has been previously described. Friedland et al[36] reported that, while 100% of children with vasoocclusive crisis received pain medications, only about 30% of children with other causes of pain were treated with analgesics.

Another possible contributing factor might be parental refusal of analgesia. Parental fear of opioids is a well-known entity.[37] It was theoretically possible that more parents of patients who had pain related to a medical disorder refused to be treated with opioids compared with parents of patients who had pain related to an injury. Our findings, however, do not support this hypothesis; we found a similar rate of refusal of opioids between caregivers of patients who had traumatic injuries and caregivers of patients who had medical diagnoses (~1.5%). Another possible explanation is that, as opposed to pain scores related to an injury (eg, fracture pain), nurses found it difficult to take pain scores related to a medical disorder (eg, abdominal pain) at face value. This phenomenon was reported in a Canadian survey study.[38]

Study findings do not point to a specific gap in knowledge that must be addressed. However, there is clearly a need for adequate education on the management of children with pain score ≥ 4, and on opioid analgesia for children with severe, nontraumatic pain.

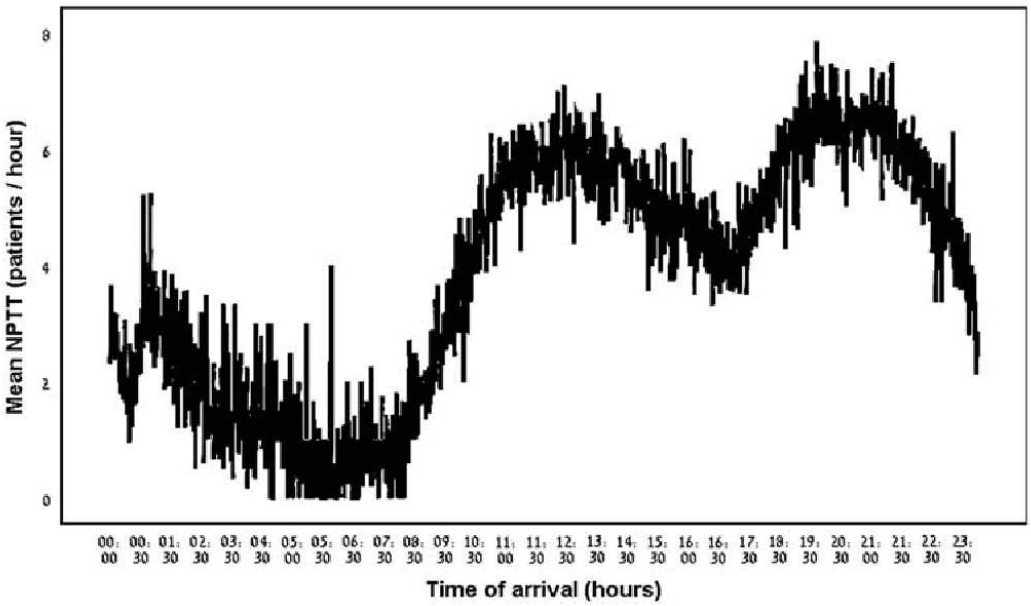


**FIGURE 2.** Distribution of new patients to be triaged (NPTT) along 24 hours.

Since external barriers, such as workload and staffing shortages, may have an impact on nurse's adherence to the TNIA protocol,[39] we performed further analysis on the NPTT and TTT. NPTT, the hourly number of new patients waiting to be triaged, and TTT, the time elapsed from ED registration to the beginning of triage, reflect patient load in triage.[32,33] Study findings revealed that NPTT was not associated with the provision of any analgesia or opioid analgesia. Our findings also suggest that the NPTT did not influence pain score and that it seems to follow a predictable pattern throughout the day (Fig. 2). This pattern that represents the cyclical pattern of ED census can help the planning of staffing requirements for TNIA.[40]

Interestingly enough, we found that TTT < 8 minutes was associated with the provision of opioid analgesia. It is reasonable to believe that since the administration of an opioid analgesic requires double-checking of the calculation of the dose and takes more time, nurses may sometimes prefer an alternative nonopioid agent.

This study has several limitations. First, there are the inherent limitations of a retrospective study design, including dependence on the quality of documentation recording. The information was extracted using a business intelligence information system; therefore, misinterpretation or abstractor bias had no impact. Second, our cohort came from a single center where nurses are skilled in practicing analgesia and continuously trained. Therefore, our results may not apply to other institutions. Third, we did not have data on prehospital analgesic medication administration. We do not think that this limitation would have affected our results, given the fact that, according to TNIA protocol, a child who was treated with an analgesic before arrival is expected to be treated in triage if still painful (using a different analgesic). Fourth, we did not include ethnicity in our analysis because of the poor recording of this variable. It is important to note that previous studies conducted in our department that investigated analgesia administration to fracture-related pain and appendicitis-related pain found no ethnic differences between the 2 major ethnic groups in Israel; Jews and Arabs.[24,25]

In summary, the analysis of TNIA in a pediatric ED shows that time to drug administration was short, but the rates of any analgesia and opioid analgesia were relatively low. We identified several variables that were associated with the provision of any analgesia and opioid analgesia. Our findings provide evidence to guide future educational programs to improve pain management in the pediatric ED.

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