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Resolution of Acute Pain Following Discharge From the Emergency Department: The Acute Pain Trajectory

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Abstract: **We demonstrate and evaluate a method for modeling acute pain resolution in individual patients over 6 days following an emergency department visit for an acutely painful condition. Five hundred and thirteen patients presenting with acutely painful conditions provided 11-point numerical ratings of pain intensity at discharge from an emergency department and daily thereafter for a total of 6 days. Latent growth curve modeling with a linear fit yielded measures of initial pain intensity (intercept) and rate of pain resolution (slope) for each individual patient. The linear fits provided good approximations of individual pain trajectories. The average patient had intercept of 6.57 with a slope of −.61. On Day 4, 54.6% of patients reported a pain level equal to or greater than 4. Classification of individual patients by slope revealed that 79% of the sample had the expected negative slope for acute pain resolution while 21% had flat or positive slopes, indicating lack of pain resolution or worsening of pain over time following discharge. The standard errors of measurement for the acute pain trajectories were markedly smaller than those for conventional pain ratings, indicating that the trajectory approach to pain measurement improves measurement precision.**

Perspective: ***The acute pain trajectory provides more information than conventional pain measurement and increases measurement precision. It provides a means of determining the efficacy of acute pain management in the emergency department. The rate of pain resolution is a potentially valuable outcome measure for controlled clinical trials.***

Key words: *Acute pain, emergency medicine, growth curve, oligoanalgesia, pain trajectory.*

Pain management is a persisting challenge in the care of Emergency Department (ED) patients with acute conditions. Although about three-quarters of ED patients present with pain, oligoanalgesia is common.[3,6,7] ED patients presenting with painful conditions ordinarily have moderate pain at discharge, and they typically receive medication for 3 or 4 days.[4,5] The pain associated with most acute conditions diminishes over time with the resolution of the inflammatory response, but it some cases it persists for an extended period or indefinitely. Johnston et al[3] found that more than one-third of patients still have significant pain more than 1 week after discharge.

The rate at which ED patients resolve their acute pain after discharge is clinically significant and it is a potentially important outcome measure in clinical trials of ED pain interventions. Repeated measures of acute pain over time, when modeled, can yield a growth curve. A linear fit of the measures provides a good approximation for a 6-day acute postoperative pain time window,[1] The fit estimates both pain intensity and rate of pain resolution, thus increasing the information that pain assessment provides. In addition, these estimates have a lower standard error of measurement than conventional pain assessment methods.

The primary purpose of this paper is to demonstrate and evaluate a method for modeling the acute pain trajectories of individual patients over 6 days following an ED visit for an acutely painful condition. The ED acute pain trajectory is a linear fit of pain report scores over 6 days beginning with and following an ED visit. It quantifies both initial pain intensity and rate of pain resolution. In addition, the trajectory approach to acute pain measurement permits retrospective classification of

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patients as: 1) resolving pain over time; 2) maintaining a constant level of pain over time; or 3) increasing pain intensity over time. The secondary purposes of this paper are to: 1) demonstrate that the measurement precision of the pain trajectory is superior to that of conventional pain measurement with conventional pain rating scales; 2) demonstrate application of the acute pain trajectory to individual cases; and 3) examine differences in the acute pain trajectory across age, sex, diagnosis, education level, and ethnic group.

Methods

Theoretical Model

The pain trajectory is a longitudinal estimate of acute pain as a latent growth curve,[2] normally resolving in intensity over days. The psychometric goal of pain growth curve modeling is to estimate the true, dynamic course of acute pain resolution in each individual. The fundamental assumption of this approach is that acute pain is an attribute of the individual patient that follows a dynamic trajectory, with individuals differing in the specific features of their unique pain trajectories. The most parsimonious characterization of an individual trajectory across 6 measures is a linear fit, and simple linear plots of pain intensity over days provide reasonable approximations of the true, underlying pain trajectories.

Design

We employed a repeated measures design for descriptive purposes.

Setting and Informed Consent

The study took place at an academic emergency department with an annual volume of 36,000 patients. The Institutional Review Board approved the study. All subjects gave written, informed consent to participate in a study of larger scope that included daily reports of acute pain intensity.

Population

A convenience sample of 899 ED patients in the University of Utah Healthcare System consented to participate. Inclusion criteria for study participation were age equal to or greater than 18 years and presenting with a painful condition at the ED. Exclusion criteria were inability to speak English, physical or psychiatric comorbidities that could compromise the ability of the patient to comply with study requirements, and ongoing treatment for a pre-existing chronic pain condition. We also excluded patients who would be unavailable for postdischarge follow-up. Of the 899 consented patients, 513 were discharged and provided complete pain rating data over 6 days following their visit to the ED. For the purpose of this report, we excluded patients who did not provide complete data over 6 days.

The included patients ranged in age from 18 to 85 years with a median age of 35 years, and 57% were female. All received standard of care pain management during the ED visit and at discharge. Table 1 provides a breakdown by pain diagnosis and gender. Table 2 breaks down the sample by ethnicity and education level.

Table 1. Frequency Count and Percent of Total Sample for Pain Diagnosis by Gender

Gender	Female		Male	
Diagnosis	N	Percent of Total	N	Percent of Total
Abdomen	40	7.80	33	6.43
Back	44	8.58	26	5.07
Chest	13	2.53	11	2.14
Head/neck	61	11.89	32	6.24
Hip	10	1.95	5	.97
Limb	113	22.03	101	19.69
Shoulder	13	2.53	11	2.14

Methods of Measurement

Patients provided a pain report daily using an 11-point numerical rating scale (NRS) ranging from zero to 10 with the anchors "no pain" at zero and "worst possible pain" at 10. Participants agreed to complete the first NRS at interview while at the ED and to provide subsequent pain NRSs on a daily basis after discharge until they had completed the full 6-day record. Participants who completed the full 6 days of data recording received a coupon worth $30 at a local store. Fifty-seven percent of consented subjects provided a complete data record.

Data Collection

Data collectors performed initial screening on medical records, contacted potential volunteers at the ED, and obtained informed consent. They instructed consented subjects in the use of the booklet to report their pain levels on a daily basis. Using postage-paid return envelopes, they mailed their completed data forms to the study coordinator who entered the ratings into the database and deidentified the records.

Outcome Measures

Comparisons of the Bayesian Information Criteria for multiple polynomial fits revealed that a linear fit provides the most reasonable approximation of acute pain resolution across 6 days. We therefore modeled each patient's set of 6 daily reports of acute pain with a linear fit to obtain individual pain trajectories. To achieve this, we analyzed each patient's data independently using ordinary regression with time as the only predictor for each patient. This yielded 2 acute pain trajectory measures for each patient: 1) the intercept, or initial pain level; and 2) the slope, or rate of pain resolution. The intercept and slope comprised the primary outcomes. To gauge measurement precision, we used regression standard errors for the 2 parameters. Patients with the same scores at each assessment time were assigned intercepts at the constant value and slopes of zero with standard error of measurement for both equal to zero.