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Use of the Emergency Department for Severe Headache. A population-based study

Benjamin W. Friedman, MD MS, **Daniel Serrano, MA**, **Michael Reed, PhD**, **Merle Diamond, MD**, and **Richard B. Lipton, MD**
Departments of Emergency Medicine (BWF), Neurology (RBL), Epidemiology and Population Health (RBL), Albert Einstein College of Medicine, Bronx, NY

Montefiore Headache Center, Bronx, NY (BWF, RBL)

Vedanta Research, Chapel Hill, NC (DS, MR)

Diamond Headache Clinic, Chicago, IL (MD)

Abstract

Background—Although headache is a common emergency department (ED) chief complaint, the role of the ED in the management of primary headache disorders has rarely been assessed from a population perspective. We determined frequency of ED use and risk factors for use among patients suffering severe headache.

Methods—As part of the American Migraine Prevalence and Prevention study, a validated self-administered questionnaire was mailed to 24,000 severe headache sufferers, who were randomly drawn from a larger sample constructed to be socio-demographically representative of the US population. Participants were asked a series of questions on headache management, healthcare system use, socio-demographic features, and number of ED visits for management of headache in the previous 12 months. In keeping with the work of others, “frequent” ED use was defined as a particpants report of four or more visits to the ED for treatment of a headache in the previous 12 months. Headaches were categorized into specific diagnoses using a validated methodology.

Results—Of 24,000 surveys, 18,514 were returned, and 13,451 (56%) provided complete data on ED use. Socio-demographic characteristics did not differ substantially between responders and non-responders. Among the 13,451 responders, over the course of the previous year, 12,592 (94%) did not visit the ED at all, 415 (3%) visited the ED once, and 444 (3%) visited the ED more than once. Patients with severe episodic tension-type headache were less likely to use the ED than patients with severe episodic migraine (OR 0.4 [95%CI 0.3, 0.6]). Frequent ED use was reported by 1% of the total sample or 19% (95%CI: 17, 22%) of subjects who used the ED in the previous year, though frequent users accounted for 51% (95%CI: 49, 53) of all ED visits. Predictors of ED use included markers of disease severity, elevated depression scores, low socio-economic status, and a predilection for ED use for conditions other than headache.

Conclusions—Most individuals suffering severe headaches do not use the ED over the course of a single year. The majority of ED visits for severe headache are accounted for by a small subset of all ED users. Increasing disease severity and depression are the most readily addressable factors associated with ED use.

Corresponding author and address for reprints: Benjamin W. Friedman, MD, Department of Emergency Medicine, Albert Einstein College of Medicine, Montefiore Medical Center, 111 East 210th Street, Bronx, New York 10467, Email: befriedm@montefiore.org, Phone: (718) 920-6626, Fax: (718)798-0730.

The primary headache disorders are highly prevalent in the US population; migraine affects 9-15% of Americans1, tension-type headache 38%2, and chronic headache 4%3. Under-diagnosis and under-treatment of the headache disorders are common4, particularly in lower socio-economic groups5, leaving many patients without adequate resources to treat their acute headaches. Even well-treated primary headache patients are susceptible to severe acute headaches that do not respond to usual treatment.

Although it is predictable that primary headache disorder patients will have severe acute attacks, it is not clear where they are to get treatment for these exacerbations. The US healthcare system is a piecemeal system, in which many do not have healthcare insurance or a usual source of care6 7. Uninsured patients often cannot access neurology specialty care8. Timely primary care appointments can be difficult to obtain for patients with government insurance9. Even well insured patients have difficulty obtaining an urgent appointment with their primary care physician, especially during off-hours10.

Against this backdrop, it may be expected that emergency departments (ED) play an important role within the US healthcare system for headache management. To date, the role of the ED has not been well-described. Some population-based data suggest that the ED is used uncommonly for management of primary headache disorders11¯13, though hospital derived data indicate headache is the fifth most common chief complaint in US EDs, accounting for five million individual visits annually14 15.

The ED may be a suboptimal place to treat patients with primary headache disorders. Lengthy wait times for analgesia16 17, environmental conditions non-conducive to treatment of headache, and lack of continuity of care diminish its appeal. The current epidemic of ED overcrowding, though multifactorial in origin18, would likely benefit from appropriate diversion of care to an outpatient setting. On the other hand, few other healthcare locations can offer expedited care 24 hours a day19.

The question of why certain patients use an ED for headache management remains unanswered. ED use among headache patients may be a marker of insufficient primary care —a severe headache had not been anticipated and the patient had not been provided any resources with which to treat the acute attack. Another possibility is that adequately treated headache patients have nowhere else to go when suffering an acute attack not responsive to usual treatment. Barriers to healthcare access within the US healthcare system are likely to be particularly problematic when a rapid appointment is needed for an acute painful headache attack9. Finally, opioid seeking behavior has been associated with ED use20 21, though not well examined within the headache literature. It may be that patients use the ED because they prefer the medications administered there.

As a first step towards optimizing use of the ED, we sought to understand the role of the ED in the management of severe headache in the US. The American Migraine Prevalence and Prevention (AMPP) study, which has identified and assessed a large representative sample of severe headache sufferers in the US, provides an opportunity to begin this process. The specific goals of this sub-study were 1) to determine the frequency of ED use for management of headache among Americans suffering from severe headache attacks, 2) to determine the rate of frequent ED use (≥4 visits/ year) for management of headache, 3) to identify the headache sufferer's stated reason for the ED visit and 4) to identify modifiable predictors of ED use and frequent ED use within a sample representative of the US population.

Methods

Overview

This research was performed as part of the American Migraine Prevalence and Prevention Study, an ongoing, longitudinal population-based survey that identified Americans with severe headache and follows them with serial questionnaires over the course of several years. This study was reviewed and approved by the Committee on Clinical Investigation, the ethical review board of the Albert Einstein College of Medicine.

Study population

In 2004, a validated self-administered headache questionnaire was mailed to a stratified random sample of 120,000 US households, drawn from a 600,000 household nationwide panel maintained by National Family Opinion, Inc. The nationwide panel is constructed to be representative of the entire US population with regard to socio-demographic features. An initial survey, containing 21 questions about headache descriptors, patterns of diagnosis and treatment, and headache related disability was completed by all household members with self-defined severe headaches. Of 162,576 individual respondents, 30,721 reported severe headaches. In 2005, a follow-up survey was mailed to a random sub-sample of 24,000 of these severe headache sufferers. The majority of the analyses presented in this paper were based on the 2005 sample. Another questionnaire, mailed to the same 24,000 severe headache sufferers in 2006, asked respondents who used the ED to list reasons why they did so. The 2006 questionnaire was used only to determine the headache sufferer's reasons for using the ED.

Study instrument

The survey instrument contained 60 questions, divided into relevant sections, about an individual's headache, medical, and psychiatric history, use of healthcare resources, and socio-demographic features. It also contained the MIDAS headache-related disability instrument, and the Patient Health Questionnaire depression screening instrument (PHQ-9).

Outcome of interest

The primary outcome of interest was self-reported frequency of ED or Urgent Care use for treatment of headache within the previous 12 months. ED and urgent care are joined together in this analysis because of their comparable role in the US healthcare system: a place designed for unscheduled visits for acute medical conditions by patients previously unknown to the healthcare provider. ED use is defined as subject report of at least one visit to the ED or urgent care for treatment of a headache in the previous 12 months. Similar to others, we defined frequent ED use as self-report of at least four visits to the ED or urgent care for treatment of a headache in the previous 12 months[22–24].

Predictor variables of interest

Predictor variables were drawn from the following arenas: socio-demographic characteristics, headache-specific variables, and general descriptors of healthcare needs. The following socio-demographic variables were assessed: gender, age, insurance status, and income level. The following headache-specific variables were assessed: headache-related disability, prescription medication use for acute attack, preventative prescription medication use, healthcare professional seen most often for management of headache. The following general healthcare variables were assessed: presence of depression, use of ED or urgent care for non-headache reasons.

Data-based categorizations

Patients could be assigned one of the following headache diagnoses: migraine, probable migraine, tension-type headache, transformed migraine, and chronic daily headache. Categorization of the episodic primary headache disorders was based on the 2nd edition of the International Classification of Headache Disorders. Categorization of transformed migraine and other chronic daily headaches followed definitions used in other epidemiologic studies25.

Analysis

Frequency of ED use is presented by headache type. Reasons for ED use are presented as proportion with 95%CI. Relative odds of use of the ED and frequent use of the ED by headache type are presented with 95%CI. All univariate analyses were performed twice: first for the severe headache patients who used the ED at least once in the previous 12 months and then for the severe headache patients who used the ED at least four times in the previous 12 months. For each of the variables discussed above, a univariate analysis is presented in which rates are reported in tabular form. Odds ratios, with 95% CI are computed for the population of subjects with at least one ED visit versus no ED visits and with frequent ED use versus no ED use.

A multivariate logistic regression model was used to determine predictors of ED use, with a multiple imputation technique to account for missing data. In multiple imputation a value is determined for each variable for each individual based on the level of all other variables. We included in this analysis only those variables that were felt to have a clinically relevant or theoretical association with the primary outcome, all of which are presented in Table 3. Markov chain Monte Carlo (MCMC) imputation was used to generate 30 imputed data sets. Though it is common to see many fewer imputations in applications, we generated 30 imputed data sets in order to maximize the efficiency of the estimates. The EM (expectation/maximization) algorithm for the Maximum Likelihood Estimate converged in 67 interactions, while the posterior mode converged in 11 iterations. MCMC chains were well mixed and stable at convergence, indicating good convergence of the MCMC imputations. Several of the variables we generated imputations for were discrete or categorical. There currently does not exist a good method for the imputation of discrete or categorical variables that are binary or ordinal. Therefore, post imputation, variables whose original metric was discrete were rounded to the original categorizations. Though there are known problems with rounding, including parameter bias, no sensible alternative exists. Rounded variables included MIDAS, PHQ, gender, current preventive use, insurance status, having at least one ED visit, visiting a primary MD, and visiting a specialist MD. All values are presented as OR with 95%CI. Analysis was performed using SAS v. 9.1(SAS, Cary, NC).

Results

During the year 2005, 24,000 surveys were mailed, 18,514 were returned (77%), and 13,451 (56%) provided complete data on ED use. Participants who provided data on ED use did not differ substantially with regard to socio-demographic characteristics or headache related disability from those who did not.

Of 13,451 patients, 12,592 (93.6%) did not visit the ED at all, 415 (3.1%) visited the ED once in the previous year, and 444 (3.3%) visited the ED more than once in the previous year (Table 1). Any use of the ED was most common in the transformed migraine group (15.5%), followed by the episodic migraine group (7.3%) and least common in the ETTH (3%) and probable migraine (2.6%) groups. Among severe headache sufferers, migraineurs (migraine, probable migraine and transformed migraine) accounted for 95.1% of all ED

visits. Respondents with episodic tension-type headache were less likely to use the ED than those with episodic migraine (OR 0.4 [0.3, 0.6]). Respondents with chronic daily headache were more likely than those with episodic migraine to use (OR 2.3 [1.8, 3.0]) and to make frequent use of the ED (OR 13.4 [8.4, 21.5]).

Of 859 respondents who used the ED at least once, 48% (95%CI: 45, 51%) used the ED once, 32% (95%CI: 29, 35%) used the ED two or three times, and 19% (95%CI: 17, 22%) used the ED four or more times. Of the 2011 ED visits reported by these 859 respondents, those who used the ED once accounted for 21% (95%CI: 19, 23%) of all ED visits, those who used the ED two or three times accounted for 28% (95%CI: 26, 30%) of all ED visits, and those who used the ED four or more times accounted for 51% (95%CI: 49, 53%) of all ED visits. Thus, 19% of ED users account for the majority of visits.

Respondents who used the ED were asked why they did so (Table 2). Unbearable pain was the reason endorsed most commonly, followed by unavailable or inaccessible primary care provider, and the desire for better or different medications. Although financial and insurance barriers were mentioned by few respondents, these barriers may be reflected in the second most commonly cited reason for ED use, unavailable or inaccessible primary care provider.

Univariate predictors of ED use and frequent ED use are presented in Table 3. In univariate analyses, ED use was more likely in females, in younger age groups and in those with low household incomes. High disability scores, use of prescription acute treatments and preventive treatments, depression and use of the ED for reasons other than headache were also associated with ED visits for headache. Multivariate predictors of ED use and frequent ED use are presented in Tables 4 & 5. Multiple markers of severe underlying primary headache disorder, such as elevated MIDAS scores, prescription medication use, and headache specialty consultation, predict ED use and frequent ED use. However, the variables most strongly associated with ED use for management of headache are ED use for management of non-headache conditions and lower socio-economic status. Although female gender is associated with ED use in univariate modeling, it did not remain significant in the multivariate model.

Discussion

This population-based study demonstrated that the vast majority of Americans with severe headache do not use the ED for management of their headache over the course of one year. This is consistent with data from other sources, in which the annual incidence of ED use for headache management was 3.5%13 and the lifetime prevalence was 19.5% among female migraineurs and 13.4% among male migraineurs11. Initial headache care was provided by an emergency physician for 3.4% of female migraineurs and 1.9% of male migraineurs12. Although ED use is uncommon from a population perspective, headache is the fifth most common ED chief complaint14. These ostensibly discrepant results are explained by the high population prevalence of severe headache.

Most patients who use the ED for management of severe headache do so infrequently. As has been demonstrated elsewhere, frequent ED use is uncommon among individual patients. Because of the large number of visits made by some individuals, the frequent use population accounts for the majority of ED headache visits26. Herein, we found that the top fifth of users accounted for the majority of ED visits. This pattern of very high use in a minority of patients is not unique to headache patients, having been reported in other chronic disorders with episodic attacks, such as asthma27.

In this study, 79% of patients cited unbearable pain as the reason for using the ED. This is compatible with prior work from the EMPATH study, which suggested that perceived

medical necessity is the most frequent patient reported reason for ED use. The EMPATH study conceptualized the reasons behind ED use in five categories: medical necessity (as perceived by the patient), convenience, preference for treatment in the ED, and issues of insurance, and affordability28. Apropos of these data, because the ED can provide expedited care during all hours of the week, with a large repertoire of available parenteral treatments, the ED may be, by default, the optimal location for acute primary headache management in many healthcare environments that cannot provide these services in a clinic or office setting. Healthcare systems interested in unloading headache patients from the ED may benefit by providing an alternate location for expedited headache care.

Independent risk factors for ED use and frequent ED use among patients with severe headache include markers of increasing disease severity—elevated MIDAS scores, prescription medication use for acute attacks, headache specialty consultation, and preventative medication—as well as depression, lower socio-economic status, and a predilection for ED use for non-headache reasons. Medical insurance is protective against ED use after adjusting for disease severity. These findings are consistent with data from multiple other sources including headache clinical trials29, population-based studies30¯32, and ED-based studies24. From the individual practitioner's perspective, disease severity and depression are modifiable risk factors, which if addressed, may decrease the probability of an ED visit. Practitioners can identify patients at high risk of an ED visit and develop contingency plans with these individuals. From the perspective of the healthcare administrator, frequent ED use for headache can be addressed by identifying barriers to expedited treatment for all medical conditions. Targeting effective interventions at high-use individuals may contribute to a substantial decrease in total number of ED visits. We identified three non-randomized clinical studies, all of which used a before and after design to demonstrate a decrease in the frequency of ED use for chronic headache patients who participated in comprehensive headache management programs, which offered headache education and interdisciplinary care33¯35. These programs were effective in decreasing the burden of illness and healthcare costs in select, motivated patients.

Elevated MIDAS scores, prescription medication use for acute attacks, headache specialty consultation and preventative medication use were associated with ED use and frequent ED use. This suggests that increasing disease severity is associated with ED use and frequent ED use. A less likely explanation supported by these cross-sectional data is effective ED discharge planning. In this explanatory model, patients with high MIDAS scores who present to an ED receive appropriate prescriptions for acute attack medication from the emergency physician and are then referred onward to specialty headache care, where the patient receives an appropriate prescription for a preventative medication. If this were so, we would expect ED users to vary from year to year, a hypothesis that can be tested in future work. A second alternate explanation is that patients with more severe headache disorders are enthusiastic healthcare consumers, who use the ED, but also make frequent use of headache specialty care and primary care. These patients would then be more likely to receive prescriptions for acute and preventative medications. This latter hypothesis is supported by an independent observation that a segment of severe headache sufferers are frequent healthcare consumers36.

Prescription medication for management of an acute attack is associated with ED use and frequent ED use, when compared to use of over-the-counter medications alone. It seems most plausible that this is a marker of underlying disease severity, although the association remains even after adjusting for disease severity. A causal relationship between these medications, particularly opioids, and ED use is possible, and has been suggested by data from other sources37 38. This association should not be used to deny opioids to patients who

need them, particularly because recommended alternatives, such as the triptans or dihydroergtoamine, were also associated with an increased risk of ED visit.

Strengths of this work include a large, population based sample and ICHD based classification of headaches. Limitations of this work include the cross-sectional design, which limits our conclusions to association rather than causality, participation bias, which potentially biases the accuracy of these results in an unmeasurable manner, and relying on an individual's self-report of ED use, which is subject to both recall bias and the possible social undesirability of ED use. Individuals may be unable or unwilling to recall correctly if, when, and why they used the ED. In addition, we combined ED and urgent care visits. From this study, we cannot distinguish factors associated with these two sites for emergency treatment. Finally, we used imputation methods to address missing data. We feel confident in these methods because this is a standard manner to provide accurate estimates in the face of missing data and because similar results were obtained using a model without imputed data.

In conclusion, ED use for management of severe headache is uncommon. The majority of ED visits are accounted for by a small subset of all ED users. Increasing disease severity is associated with ED use and is the most readily addressable factor associated with ED use.

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Table 1

Number of individuals (%) using the Emergency Department (ED) or Urgent Care (UC) in the previous year by type of headache disorder: Results from the American Migraine Prevalence and Prevention 2005 survey.

	Number of Emergency Department or Urgent Care visits n (%)							
	0	**1**	**2**	**3**	**4-6**	**7-10**	**>10**	**Total**
Migraine	8602 (92.7)	324 (3.5)	158 (1.7)	65 (0.7)	80 (0.8)	28 (0.3)	23 (0.2)	9280 (100)
Probable migraine	2321 (97.4)	36 (1.5)	13 (0.5)	2 (0.1)	8 (0.3)	1 (0.0)	2 (0.1)	2383 (100)
ETTH	1125 (97.0)	23 (2.0)	7 (0.6)	3 (0.3)	0 (0.0)	2 (0.2)	0 (0.0)	1160 (100)
Transformed migraine	419 (84.5)	30 (6.0)	14 (2.8)	18 (3.6)	10 (2.0)	3 (0.6)	2 (0.4)	496 (100)
CDH	125 (94.7)	2 (1.5)	2 (1.5)	0 (0.0)	3 (2.4)	0 (0.0)	0 (0.0)	132 (100)
Total	12592 (93.6)	415 (3)	194 (1.4)	88 (0.7)	101 (0.8)	34 (0.3)	27 (.2)	13451 (100)

Notes: ETTH=episodic tension-type headache, CDH=chronic daily headache

Migraine, probable migraine, and ETTH are defined by ICHD-2 criteria. Transformed migraine and CDH are defined according to Silberstein/Lipton criteria25.

Table 2

Headache patients' stated reasons for ED use over the past year: Results from the American Migraine Prevalence and Prevention 2006 survey

Reason for visit*	**n (% [95%CI]) N= 766**
Unbearable pain	605 (79% [76, 82%])
PCP unreachable/ inaccessible	479 (63% [60, 66%])
Better/ different medications	195 (26% [23, 29%])
Concern about significance of pain	173 (23% [20, 26%])
ED is primary source of care	46 (6% [5, 8%])
Insurance/ financial barriers	38 (5% [4, 7%])
Referred	8 (1% [1, 2%])
Associated symptoms	7 (1% [1, 2%])
Other	25 (3% [2, 4%])

Notes: PCP-primary care physician

* Numbers sum to more than the total (N) because individuals were ask to endorse all reasons that contributed to ED visit.

Table 3

Univariate associations with emergency department (ED) use and frequent use over the past year

	No ED visit N (%)	At least 1 visit N (%)	OR (95%CI) visit versus no visit	≥4 visits N (%)	OR (95% CI) ≥4 visits versus no visits
Socio-demographic variables					
Gender					
-male	3270(25.6)	144(16.8)	OR Reference	31(15.5)	OR Reference
-female	9509(74.4)	715(83.2)	1.9 (1.6, 2.3)	169(84.5)	2.0 (1.4, 3.0)
Age					
<19	17(0.1)	2(0.2)	OR Reference	1(0.5)	OR Reference
19 – 30	1670(13.1)	132(15.4)	0.9 (0.2, 3.7)	35(17.5)	0.5 (0.1, 3.5)
31-40	2641(20.7)	198(23.1)	0.9 (0.2, 3.6)	44(22.0)	0.4 (0.1, 2.8)
41-50	3475(27.2)	270(31.4)	0.8 (0.2, 3.5)	57(28.5)	0.4 (0.1, 2.6)
51-65	3678(28.8)	221(25.7)	0.6 (0.1, 2.5)	53(26.5)	0.3 (0.0, 2.1)
>65	1298(10.2)	36(4.2)	0.2 (0.1, 0.9)	10(5.0)	0.1 (0.0, 1.0)
Health insurance					
- No	1871(15.4)	144(17.3)	OR Reference	37(19.2)	OR Reference
-Yes	10280(84.6)	686(82.7)	0.9 (0.8, 1.1)	156(80.8)	0.8 (0.6, 1.2)
Income					
<$22,500	2798(22.1)	178(46.4)	5.0(3.4, 7.4)	69(54.8)	12.1(4.9,29.9)
$22,500-39,999	2547(20.1)	82(21.4)	2.5(1.7, 3.9)	26(20.6)	5.0(1.9,13.0)
$40,000-59,999	2457(19.4)	43(11.2)	1.4(0.9, 2.2)	12(9.5)	2.4(0.8, 6.8)
$60,000-89,999	2422(19.1)	50(13.0)	1.6(1.0, 2.6)	14(11.1)	2.8(1.0, 7.9)
$90,000+	2445(19.3)	31(8.1)	OR Reference	5(4.0)	OR Reference
Headache specific variables					
MIDAS headache disability score					
0-5	7150(58.5)	254(31.2)	OR Reference	34(18.5)	OR Reference
6-10	2022(16.5)	143(17.6)	1.9 (1.6, 2.4)	32(17.4)	3.2 (2.0, 5.2)
11-20	1603(13.1)	161(19.8)	2.8 (2.3, 3.4)	39(21.2)	4.8 (3.0, 7.7)
>20	1447(11.8)	256(31.4)	4.5 (3.8, 5.4)	79(42.9)	9.8 (6.5, 14.6)

	No ED visit N (%)	At least 1 visit N (%)	OR (95%CI) visit versus no visit	≥4 visits N (%)	OR (95% CI) ≥4 visits versus no visits
Acute medication use					
-OTC only	7763(65.6)	222(27.0)	OR Reference	38(20.1)	OR Reference
-Opiate, prescription NSAID	1413(11.9)	181(22.0)	5.6 (4.4, 7.1)	43(22.8)	9.24(5.8,14.7)
-Triptan or DHE	2015(17.0)	303(36.9)	4.1 (3.3, 5.0)	73(38.6)	5.4 (3.5, 8.4)
-Prescription other	635(5.4)	115(14.0)	4.6 (3.8, 5.4)	35(18.5)	6.0 (4.1, 8.9)
Preventative medication					
-None	6084(90.8)	344(74.6)	OR Reference	75(67.0)	OR Reference
-Any	617(9.2)	117(25.4)	2.8 (2.2, 3.5)	37(33.0)	3.9 (2.6, 5.8)
Health professional seen most often for headache					
-None	167(2.2)	11(1.4)	OR Reference	3(1.6)	OR Reference
-Primary care	4115(55.2)	264(33.6)	1.0(0.6, 1.9)	35(18.9)	0.5 (0.2, 1.6)
- Headache specialist	600(8.1)	85(10.8)	2.0 (1.0, 3.7)	21(11.4)	1.7 (0.5, 5.8)
Other healthcare variables					
Depression screener (PHQ9)					
Normal	6168(48.3)	214(24.9)	OR Reference	41(20.5)	OR Reference
Elevated	6611(51.7)	645(75.1)	2.8 (2.4, 3.3)	159(79.5)	3.5 (2.5, 5.0)
# of ED/UC visits for non- headache reasons					
0	8749(80.7)	283(41.4)	OR Reference	48(33.8)	OR Reference
At least 1	2091(19.3)	400(58.6)	5.8 (4.9, 6.8)	94(66.2)	7.2 (5.1,10.2)
>3	381(3.5)	175(25.6)	12.97(10.5, 16.0)	58(40.8)	20.4 (13.8, 30.3)

Notes: OTC=over the counter medication, NSAID=non-steroidal anti-inflammatory drug, DHE=dihydroergotamine, PHQ=patient health questionnaire, PHQ>=4 was considered elevated

Table 4

Multivariate model of factors associate with emergency department(ED) use

Variable	OR (95%CI)
Socio demographic variables	
Health insurance	
No (Reference)	1.0
Yes	0.8 (0.6, 1.0)
Income	
<$22,500	2.4 (1.8, 3.3)
$22,500-39,999	1.6 (1.2, 2.2)
$40,000-59,999	1.4 (1.0, 2.0)
$60,000-89,999	1.4 (1.0, 1.9)
$90,000+ (Reference)	1.0
Age	
≤30 (Reference)	1.0
31-40	0.9 (0.7, 1.3)
41-50	1.1 (0.8, 1.5)
51-65	1.2 (0.9, 1.6)
>65	1.3 (0.9, 1.9)
Headache specific variables	
MIDAS headache disability score	
0-5 (Reference)	1.0
6-10	1.4 (1.1, 1.7)
11-20	1.5 (1.2, 2.0)
>20	1.9 (1.5, 2.5)
Acute medication use	
-OTC only (Reference)	1.0
-Opiate, prescription NSAID	1.5(1.2, 1.8)
-Triptan or DHE	1.7(1.4, 2.1)
Preventative medication	
-None (Reference)	1.0
-Any	1.1(1.0, 1.4)
Health professional seen most often for HA	
-None (Reference)	1.0
-Primary care	0.8 (0.6, 1.0)
- Headache specialist	2.0 (1.5, 2.7)
Other healthcare variables	
Use of ED or urgent care (UC) for non-headache reasons	

Variable	**OR (95%CI)**
0 (Reference)	1.0
≥1	11.9 (9.8, 14.5)
Depression screener (PHQ9)	
Normal (Reference)	1.0
Elevated	1.3(1.0, 1.6)

PHQ>=4 was considered elevated

Table 5

Multivariate model of factors associate with frequent (≥4 visits) emergency department use

Variable	OR (95%CI)
Socio demographic variables	
Health insurance	
No (Reference)	1.0
Yes	0.6 (0.3, 1.2)
Income	
<$22,500	11.5 (2.9, 45.3)
$22,500-39,999	5.3 (1.3, 21.5)
$40,000-59,999	2.8 (0.6, 13.0)
$60,000-89,999	3.7 (0.9, 16.4)
$90,000+ (Reference)	1.0
Age	
≤30 (Reference)	1.0
31-40	0.8 (0.3, 1.9)
41-50	0.7 (0.3, 1.6)
51-65	0.7 (0.3, 1.6)
>65	0.5 (0.1, 1.7)
Headache specific variables	
MIDAS headache disability score	
0-5 (Reference)	1.0
6-10	1.6 (0.7, 3.9)
11-20	3.1 (1.3, 7.3)
>20	3.7 (1.7, 8.3)
Acute medication use	
-OTC only (Reference)	1.0
-Opiate, prescription NSAID	1.4 (0.7, 2.6)
-Triptan or DHE	1.8 (1.0, 3.2)
Preventative medication	
-None	1.0
-Any	1.5 (0.9, 2.7)
Health professional seen most often for HA	
-None (Reference)	1.0
-Primary care	1.0(0.5, 1.9)
- Headache specialist	2.7(1.2, 6.1)
Other healthcare variables	
Frequent use of ED or urgent care (UC) for non-headache reasons	

Variable	OR (95%CI)
0 (Reference)	1.0
≥4	42.0 (23.6, 74.9)
Depression screener (PHQ9)	
Normal (Reference)	1.0
Elevated	1.2 (0.6, 2.5)

PHQ>=4 was considered elevated