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Assessing Evidence-Based Medicine and Opioid/Barbiturate as First-Line Acute Treatment of Pediatric Migraine and Primary Headache: a Retrospective Observational Study of Health Systems Data

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Abstract

Objectives: Evaluate providers' use, and predictors, of evidence-based medicine (EBM) or opioid/barbiturate as first-line acute treatment for children's initial presentation of acute migraine or primary headache.

Methods: This retrospective, observational study utilized patient (children ages 6-17) and provider/encounter characteristics extracted from the patient's Electronic Health Record from 2008-2014 during an initial encounter for migraine or primary headache. The primary outcome was provider EBM utilization; overall prescriptions and opioid/barbiturate prescriptions were also evaluated. Hierarchical linear modeling examined whether Level 1 (patient: demographic, insurance type) and Level 2 (provider/encounter: treatment setting/location, encounter diagnoses) characteristics influenced outcomes.

Results: 38,926 patients (56.7% female, mean age=12.1) and 1,617 providers were evaluated. Only 17.7% of patients were diagnosed with migraine; 16.1% received EBM. Older children (OR = 1.07, P <0.001), females (OR = 1.14, P <0.001), and those diagnosed with migraine (OR = 4.71, P<0.001) were more likely to receive EBM. Among prescriptions, 15.8% were opioids/barbiturates. Older children (OR = 1.14, P <0.001) and those cared for in Emergency Department/Urgent Care (OR = 2.02, P <0.001) were at increased risk.

Conclusions: Demographics and migraine diagnosis are associated with EBM and opioid/barbiturates. Primary care provides an opportunity to target provider interventions to enhance effective pediatric headache treatment.

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Keywords

Initial treatment; primary care; emergency department; triptan; adherence to best practice; children and adolescents

Introduction

Migraine and other primary headache affects children of all ages, with prevalence rates increasing to as high as 28% among adolescents age 15-17.(1,2) These can severely affect a child's school, home, and social functioning.(3–5) Treatment with evidence-based acute medicine (EBM) can reduce pain and disability from migraine and other headaches. Randomized placebo-controlled trials support the efficacy of NSAIDs, acetaminophen, and triptans (four of which are now FDA-labeled for acute migraine treatment in adolescents, with rizatriptan being labeled down to age six) in treating acute migraine in children and adolescents and were considered EBM for the current study.(6–11) Research in adults has shown that providers demonstrate low adherence to EBM when treating acute migraine (12,13); however, it is unknown whether this pattern extends to treating children and adolescents.

Suboptimal acute migraine and primary headache treatment in children can lead to unnecessary pain, increased disability, decreased quality of life and possible medication misuse. (14) It may also lead to unnecessary visits to the emergency department or urgent care (ED/UC) when children are not given the treatment tools needed to manage their condition successfully at home. Of special concern is that, in lieu of EBM, providers may prescribe opioids or barbiturates; this is especially concerning given the American Headache Society and American Academy of Neurology's recommendation against using opioids and barbiturates as a first-line treatment for migraine. (15,16)Suboptimal acute medication use increases patients' risk of high frequency and chronic migraine, medication overuse headaches, treatment related adverse events, excessive healthcare utilization, and safety issues including medication abuse or accidental medication overdose.(17–19) In addition, opioid use may decrease triptan efficacy(20), which, if causally related, would imply that opioids impair the efficacy of using EBM in the future.

EBM guideline adherence may vary across treatment settings (Primary Care, Specialty Care, ED/UC). Prescribing patterns for managing painful conditions across the US have shown geographic variation wherein people living in rural areas, especially in the Midwest, are at higher risk of being prescribed opioids. (21,22)

Information regarding adherence to EBM for treating acute pediatric migraine is needed. A seminal guideline and subsequent expert reviews of efficacious medications for treating acute migraine in children and adolescents are published (6–11) yet no large-scale studies have assessed EBM guideline adherence across settings in the US. The current paper is a retrospective, observational study utilizing electronic health record (EHR) data among children and adolescents who presented with migraine or primary headache to evaluate the following aims:

1. Describe patterns for treating acute migraine and primary headache in children and adolescents.
2. Describe patient-level and provider-level predictors of EBM adherence in treating acute migraine and primary headache among children and adolescents.
3. Describe patient-level and provider-level predictors of opioid and barbiturate prescriptions.

Methods

Patients

This retrospective, observational study utilized EHR-derived (Epic) data to identify children and adolescents' initial presentation at a large health system in the Midwest for migraine or primary headache across Missouri, Kansas, Oklahoma and Arkansas in metropolitan and non-metropolitan areas to either Primary care, Specialty care, or Emergency Department/ Urgent Care (ED/UC) from January 2008- June 2014.

See Figure 1 for the inclusion/exclusion patient population flow. The multi-input inclusion and exclusion algorithms involved information extracted from the patients' EHR, including; visit reason (chief complaint) and International Statistical Classification of Diseases and Related Health Problems, Ninth Revision (ICD-9)(23) encounter diagnoses, and problem lists associated with the encounter.

Inclusion Criteria: Inclusion criteria were: (1) ages 6-17 years old; (2) initial presentation for care at a large health system in the Midwestern region of the United States (US); and (3) migraine or headache was identified as a reason for the encounter and/or was an ICD-9 encounter diagnosis. After qualifying patients were identified, patients were classified as 'Migraine', 'Headache', or 'No Diagnosis'. If the encounter diagnosis included the word migraine, the patient was classified as 'Migraine'. This is consistent with findings that a physician diagnosis of migraine has a high positive predictive value for a confirmed migraine diagnosis based on prospective headache diary keeping (24). If the encounter diagnosis contained the word headache, or cephalagia, but not migraine, the patient was classified as 'Headache'. If the patient indicated migraine and/or headache as a primary visit reason and there was no migraine or headache encounter diagnosis, the patient was classified as "No Diagnosis".

Exclusion Criteria: Exclusion criteria were: (1) encounter diagnosis indicated headache secondary to another condition (medical or environmental/drug related); (2) encounter occurred subsequent to trauma to the brain; (3) pregnancy at time of the encounter; (4) patient's oral temperature during the encounter was above 99.5 F; (5) encounter diagnosis identified an infectious condition whereby headache could be secondary (e.g., influenza, upper respiratory infection, meningitis, sinusitis, allergic rhinitis); (6) lab values obtained during that encounter indicated a condition for which headache could be secondary (influenza, group A/B streptococcus, mononucleosis, abnormal blood cell counts), (7) encounter involved worker's compensation; or (8) history of neoplasms.

Procedures

During or immediately following a patient encounter, the health care provider team entered information regarding the patient's presentation (visit reason/chief complaint, ICD-9 diagnoses, recommended medications, prescriptions) into the EHR. Epic also stores extractable patient, provider, and encounter characteristics. Eligible patients who presented for care from January 2008 – June 2014 were identified, data were extracted and then transferred into Clarity, a database that organizes query-relevant information from the Epic record into discrete data elements. A patient's visit history was examined and only the patient's initial visit for migraine or primary headache was utilized in this study. Clinicians and data scientists then concurrently reviewed the extracted patient population parameters to verify that the patients in the dataset matched the eligibility criteria and the data elements articulated by the clinicians. After the dataset was verified, all data elements were certified for quality, reliability, and validity. The data were then converted to a certified discrete manipulatable data file ("flat file") that contained discrete patient information, encounter information, and medication recommendations/prescriptions.

The study protocol was approved by the Mercy Health Institutional Review Board.

Measures

Patient Characteristics.—Patient characteristics extracted from the patients' EHR included: age, sex, race/ethnicity, insurance status, year of visit, and co-morbid medical conditions assessed via ICD-9 codes at time of visit. Race/ethnicity and insurance status were grouped as follows due to sampling distribution: for race/ethnicity—Caucasian, Non-Hispanic vs. Other, and for insurance status—Private/Commercial, Government [e.g., Medicaid], vs. Self-Pay/Charity/Other. Regardless of the number of visits the patient had where they presented for migraine or headache during the study period, only their first visit was included for the current analysis.

Provider Characteristics.—The encounter setting type and the address/zip code of the encounter were extracted from the Epic record.

Specialty.: The encounter setting was extracted from the patient's EHR and was condensed into three categories: Primary Care, Specialty Care (i.e., not Primary Care), or Emergency Department/Urgent Care (ED/UC).

Location.: To determine the encounter county, the encounter location zip code was extracted from the EHR and then matched to county via a national database (25) that utilizes information from multiple sources, including the US Postal Service and the US Census Bureau to determine zip code county location. The metropolitan/non-metropolitan status of the county was determined using the US Department of Agriculture Rural-Urban Continuum Codes (26), which provides a nine-level county categorization (three metropolitan, six non-metropolitan). For the current study, the three metropolitan categories were classified as 'Metropolitan' and the six non-metropolitan categories were classified as 'Non-Metropolitan'.

Medication Classification.—Medications were classified by combining information available from First DataBank (via EHR) and clinical domain knowledge. Data-driven expert guidelines and trials for acute medication suggest that NSAIDs (specifically ibuprofen and naproxen) and acetaminophen are appropriate for treating acute migraine and primary headache in children and adolescents. (6,27–29) For migraine specifically, there are several FDA-approved triptans: rizatriptan is approved among children ages 6-17(11), almotriptan, zolmitriptan nasal spray, and sumatriptan/naproxen are approved among adolescents ages 12-17. (10,27,30,31) Sumatriptan nasal spray has been recommended as being effective for children ages 12-17 based on multiple positive randomized placebo-controlled trials. (32,33) For this study, if the provider documented a recommendation in the electronic health record at the encounter that the child or adolescent take any NSAID, acetaminophen, or any triptan, EBM was rated as “yes”. Regardless of all other prescriptions/recommendations, if the child was prescribed an opioid or barbiturate at that encounter, “Opioid/Barbiturate” was rated “yes” and “EBM” was rated “no”.

Analyses

Descriptive statistics characterized the sample in terms of patient characteristics (level 1 predictors), provider characteristics (level 2 predictors), and medication classification (outcomes). Medication classifications evaluated in the entire sample include: 1) EBM (received a medication that was either FDA-approved or recommended by guidelines vs. received other medication/received no medication) and 2) received any medication (received a medication vs. did not receive a medication). Medication classifications evaluated in only the subset of the sample which received medication (n = 21,015) were Opioid/Barbiturate (received an opioid or barbiturate medication vs. received other medication types).

Hierarchical linear modeling (HLM) examined whether Level 1 (patient) characteristics and Level 2 (provider) characteristics influenced medication classification in three separate models evaluating EBM, received any medication, and Opioid/Barbiturate as outcome variables. All Level 1 and Level 2 variables were entered into a single logistic HLM for each outcome variable. HLM allows for examining the effect of multiple levels of nested independent variables on the outcome variable. (34) HLM is robust in the face of correlated error terms, which are inherent in nested data. All tests were two-tailed with *alpha* set at 0.05. Analyses were performed using SPSS v21 and HLM v7.

Results

Description of Patient and Provider Characteristics

In total, 73,196 unique encounters were extracted from the EHR (Figure 1). Among these, 34,032 were not eligible; 17,703 were ineligible due to patient inclusion criteria, 3,687 were ineligible due to provider inclusion criteria, 312 were ineligible due to both patient and provider inclusion criteria, and 12,330 were excluded because of missing information about inclusion criteria. Thus, 39,164 unique patient encounters were eligible for analysis. Among these, 54 were missing outcome (medication prescription) data, and 184 were missing predictor (patient-level demographic) data. The final sample consisted of encounters between 38,926 patients and 1,617 providers.

Patient and provider-level descriptive statistics are found in Table 1. Only 17.7% were diagnosed with migraine; 36.6% received a headache diagnosis, and 45.7% reported migraine or headache as a primary visit reason but received no ICD-9 diagnostic code for migraine or headache. The majority of patients (57.0%) had private insurance. Most encounters occurred in metropolitan-area practices (78.2%). Most encounters occurred in primary care settings (64.6%).

Compared to participants included in the analysis (n = 38,926), ineligible participants (n = 34,032) were, on average, younger [Excluded M = 11.29, SD = 3.53; Included M = 12.09, SD = 3.46; t(73,064) = 30.86, $p < .001$] and had a higher proportion of boys (46.2% vs. 43.2%; $\chi^2 = 67.61$, $p < .001$) compared to participants included in the analysis. There was no difference in race between participants excluded and included in the analysis ($p = .372$).

Medication Classification

Evidence-Based Medicine (EBM)—Patients received a prescription consistent with EBM in less than one in five encounters (16.1%; Table 2). Table 3 shows that children and adolescents who were older (OR = 1.07 per year of age, 95% CI 1.06 to 1.08, *P*<.001) or female (OR = 1.14, 95% CI 1.07 to 1.21, *P*<.001) had higher odds of receiving EBM, whereas Caucasians had lower odds of receiving EBM compared to Non-Caucasians (OR = 0.89, 95% CI 0.82 to 0.96, *P*=.002); Figure 2. Patients who received a migraine (OR = 4.71, 95% CI 4.17 to 5.33, *P*<.001) or headache (OR = 1.71, 95% CI 1.55 to1.88, *P*<.001) diagnosis had higher odds of receiving EBM compared to patients who did not receive a headache or migraine diagnosis. Patients who had only a headache diagnosis had lower odds of receiving EBM relative to patient who received a migraine diagnosis (OR = 0.36, 95% CI 0.32 to 0.41, *P*<.001). Having government insurance increased the odds of receiving EBM relative to those with private insurance (OR = 1.22, 95% CI 1.12 to 1.32, *P*<.001) or with no insurance (OR = 2.09, 95% CI 1.80 to 2.43, *P*<.001). Having no insurance lowered the odds of receiving EBM compared to private insurance (OR = 0.58, 95% CI 0.52 to 0.67, *P*<.001).

Providers located in a metropolitan area had lower odds of prescribing EBM than providers located in a non-metropolitan area (OR = 0.65, 95% CI 0.58 to 0.74, *P*<.001) (Table 3). Specialty care providers had lower odds of prescribing EBM than either primary care providers (OR = 0.71, 95% CI 0.53 to 0.95, *P*=.021) or ED/UC providers (OR = 0.73, 95% CI 0.53 to 0.99, *P*=.045).

Any Medication—Approximately half of patients received a prescription of any kind (54.0%; Table 2). Children and adolescents who were older (OR = 1.02 per year of age, 95% CI 1.01 to 1.02, *P*<.001) or Caucasian (vs Non-Caucasian; OR = 1.09, 95% CI 1.03 to 1.15, *P*=.004) had higher odds of receiving any medication. Patients who received a headache diagnosis had lower odds of receiving any medication compared patients who received a migraine diagnosis (OR = 0.61, 95% CI 0.57 to 0.65, *P*<.001). Patients who received a migraine diagnosis had higher odds of receiving any medication compared to patients who received no headache diagnosis (OR = 1.40, 95% CI 1.31 to 1.51, *P*<.001). Patients who received no diagnosis had lower odds of receiving medication than patients who received a headache diagnosis (OR = 0.85, 95% CI 0.81 to 0.89, *P*<.001). Having government

insurance increased the odds of receiving medication than having either private insurance (OR = 1.22, 95% CI 1.13 to 1.31, *P*<.001) or no insurance (OR = 2.29, 95% CI 2.11 to 2.48, *P*<.001). Having no insurance lowered the odds of receiving medication compared to private insurance (OR = 0.53, 95% CI 0.50 to 0.57, *P*<.001).

Providers located in a metropolitan area had lower odds of prescribing medication compared to providers in a non-metropolitan area (OR = 0.52, 95% CI 0.46 to 0.61, *P*<.001). ED/UC providers had lower odds of prescribing medication compared to primary care providers (OR = 0.78, 95% CI 0.67 to 0.91, *P*=.001).

Opioid or Barbiturate—Among those receiving a prescription, 15.8% received an opioid or barbiturate (Table 2). Among encounters at which medication was prescribed, being older (OR = 1.14, 95% CI 1.12 to 1.16 per year of age, *P*<.001), female (OR = 1.16, 95% CI 1.08 to 1.31, *P*<.001), or Caucasian (OR = 1.18, 95% CI 1.08 to 1.31, *P*<.001) increased the odds of receiving an opioid or barbiturate (Table 5). Receiving a migraine (OR = 1.63, 95% CI 1.34 to 1.89, *P*<.001) or headache (OR = 1.60, 95% CI 1.42 to 1.80, *P*<.001) diagnosis also increased the odds of receiving an opioid or barbiturate compared to receiving no diagnosis. Similarly, having government insurance (OR = 1.12, 95% CI 1.01 to 1.24, *P*=.036) or no insurance (OR = 1.22, 95% CI 1.07 to 1.39, *P*=.003) increased the odds of receiving an opioid or barbiturate compared to private insurance.

There were no significant differences in the odds of prescribing an opioid or barbiturate between providers in metropolitan and non-metropolitan areas. Providers in specialty care (OR = 1.91, 95% CI 1.30 to 2.82, *P*=.001) and the ED/UC (OR = 2.02, 95% CI 1.70 to 2.39, *P*<.001) had higher odds of prescribing an opioid or barbiturate compared to primary care providers.

Discussion

In this retrospective, observational study utilizing EHR-derived data, fewer than one in six children and adolescents presenting with headache in a US health system over a six-year period received EBM for acute migraine or primary headache, and nearly half received no treatment at all. Younger children, boys, the uninsured, and Caucasians were less likely to receive EBM; however, Caucasians were more likely to receive a medication recommendation or prescription than non-Caucasians. The strongest predictor of received EBM was receiving a migraine diagnosis (OR 4.71, 95% CI 4.17 to 5.33, *P*<.001). This underscores the importance of making a clear diagnosis in children presenting with primary headaches and the consequences of underdiagnosing or misdiagnosing migraine. Given our thorough exclusion of secondary headache, it is disappointing that nearly half (45.7%) the children and adolescents in this population did not receive a migraine or primary headache diagnosis.

Primary care was the setting where children and adolescents were most likely to receive EBM treatment for migraine and primary headache. Perhaps clinicians are more comfortable initiating medication treatment and are more invested in selecting treatments with long-term viability within an established patient-provider relationship. In the current study, ED/UC

providers were least likely to provide any medication and were twice as likely to prescribe opioids relative to primary care providers. ED/UC providers may be focused on ruling out secondary headache, potentially at the expense of diagnosing primary headache disorders. Also, ED/UC providers may hesitate to prescribe new outpatient medications for headaches since they will not be able to follow the child in the outpatient setting to ensure treatments are being used correctly. These findings underscore the need for pediatric headache management to be housed within the primary care setting whenever possible.

Clinicians practicing in a metropolitan area were less likely to prescribe EBM or any medication for children and adolescents with migraine and primary headache. This was a relatively surprising finding. It is possible that in non-metropolitan areas there are fewer treatment setting options and thus the primary care provider may be required to take on more comprehensive care relative to providers in a metropolitan area. This may have the unintended benefit of a more established relationship that leads to more engaged visits and providers feeling more comfortable prescribing EBM during the initial visit for migraine and primary headache.

In this study, both age and sex were associated with receiving EBM. Younger children and boys were less likely to receive EBM. Migraine and primary headache are identified by patient report rather than by laboratory testing or neuroimaging. Headache history taking can be challenging across all age groups, but especially so for younger children, whose limited vocabulary may impede their ability to describe their symptoms in terms commonly used to denote pain. This could lead to clinicians underestimating the need to treat younger children's' pain. In adults, migraine effects more women than men, however in pre-pubertal children migraine prevalence is roughly equal between the sexes (35). It is crucial that boys who present with migraine or primary headache be diagnosed and treated appropriately. Results related to age and sex should be treated with some caution: in this study, younger patients and boys were more likely to be excluded due to missing data. It is possible the excluded patients differed systematically from those included in the study in a way that influenced these results. Future studies should continue to evaluate the role of age in sex when evaluating EBM recommendations for pediatric headache.

Unfortunately, one of every six children and adolescents who received a medication were prescribed an opioid or barbiturate for their headaches. Opioids and barbiturates were more likely to be prescribed to adolescents, girls and Caucasians. Children with government insurance or no insurance were also more likely to receive these problematic medications. Perhaps surprisingly, those with a diagnosis of migraine were more likely than those with no diagnosis to receive opioids and barbiturates. Regardless of the reason for prescribing an opioid or barbiturate, their frequent use in children and adolescents with migraine and primary headache is problematic. Regularly using opioids or barbiturates among those with migraine is associated with an increased risk of developing medication overuse headache, decreased likelihood of responding to a migraine preventive like topiramate, and decreased likelihood of responding to a triptan acutely(14,18,20,36). Moreover, as few as four days a month of barbiturate exposure raises the patient's risk of experiencing chronic migraine (≥15 days of headache per month). (37) There is also serious potential for central nervous system side effects, tolerance, addiction, and withdrawal. (17,38,39). It is thus important that

pediatric providers be made aware of the potential deleterious impact of these medications when deciding how to best treat migraine and primary headache.

Strengths of this study include the large numbers and our ability to sample from multiple different clinical settings across four different states in the US. Another strength was the ability to extract information from patient records that identified not only those diagnosed with migraine or primary headache but also those who presented with migraine or primary headache (as those with indications of the most common causes of secondary headache in this population were excluded) but did not receive a migraine or headache diagnosis; this group is crucial to understand given that these patients made up nearly half the population and yet often are not considered in population level findings.

One limitation of the study was that only the patient's initial visit to a single large health system in the Midwest was studied. By selecting only initial visits we minimized sources of bias related to repeated visits. There is a wealth of information that could be gleaned from longitudinally tracking presentation and treatment patterns. However, we chose to focus on initial visits for this study to determine how children and adolescents are treated when they first present for migraine or primary headache. Further, it is possible that patients initially sought care outside of this health system, which could not be captured in this study. Generally, for a patient of any age to present to a provider for migraine or primary headache, the pain is significant enough to prompt them to seek medical care. This typically means that the patient's attempts to manage headaches on their own have been unsuccessful. As such, knowing how they are treated from the first time they present is useful.

Another limitation is that migraine diagnosis was made based upon ICD-9 code rather than direct history taking to determine whether patients met international diagnostic criteria for migraine. However, a physician diagnosis of migraine is most often correct (24). Further, there is a risk of heterogeneity in the sample, which is common to all electronic health record data collection. It is possible that some pediatric patients with primary tension-type headache or a trigeminal autonomic cephalalgia were included in the sample, in addition to missed migraine diagnoses. It is also possible that a small number of secondary headaches either due to causes not excluded in the current study, or where the cause was not documented, were also included in the sample. A final limitation common to electronic health record data is lack of documentation. In this study, over-the-counter medication recommendations were captured through in-note documentation, which could be incomplete. It is possible that NSAID and acetaminophen recommendations were underestimated in patients for whom these medications would likely be recommended over-the-counter (private insurance or no insurance) compared to patients whose insurance might cover these agents with a prescription (government insurance). Finally, excluded patients had higher proportions of younger ages and boys (compared to girls); it is possible our final sample had some selection bias that could have influenced results, due to a combination of our inclusion/exclusion criteria and bias in documentation in administrative data.

Future research should focus on interventions intended to improve education regarding EBM for pediatric migraine to pediatric providers and assessing the impact of that education. In addition, research is needed to determine why many children and adolescents are not

receiving an appropriate headache diagnosis and treatment within the primary care setting. Lastly, longitudinal analysis of patients over time to assess care utilization and provider prescribing patterns over time would provide further insight.

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Public Health Relevance

- Less than one in six children and adolescents received EBM for acute migraine or primary headache, and nearly half received no treatment at all. Younger children, boys, the uninsured, and Caucasians were less likely to receive EBM.
- The strongest predictor of receiving EBM was receiving a migraine diagnosis; this underscores the importance of making a clear diagnosis in children presenting with primary headaches and the consequences of underdiagnosing or misdiagnosing migraine.
- Primary care was the setting where children and adolescents were most likely to receive EBM treatment for migraine and primary headache.
- One of every six children and adolescents who received a medication were prescribed an opioid or barbiturate for their headaches. Opioids and barbiturates were more likely to be prescribed to adolescents, girls and Caucasians.
- Children who received care in an Emergency Department/Urgent Care were less likely to receive a medication relative to primary care and when they did, they were twice as likely to be prescribed an opioid or barbiturate relative to primary care.

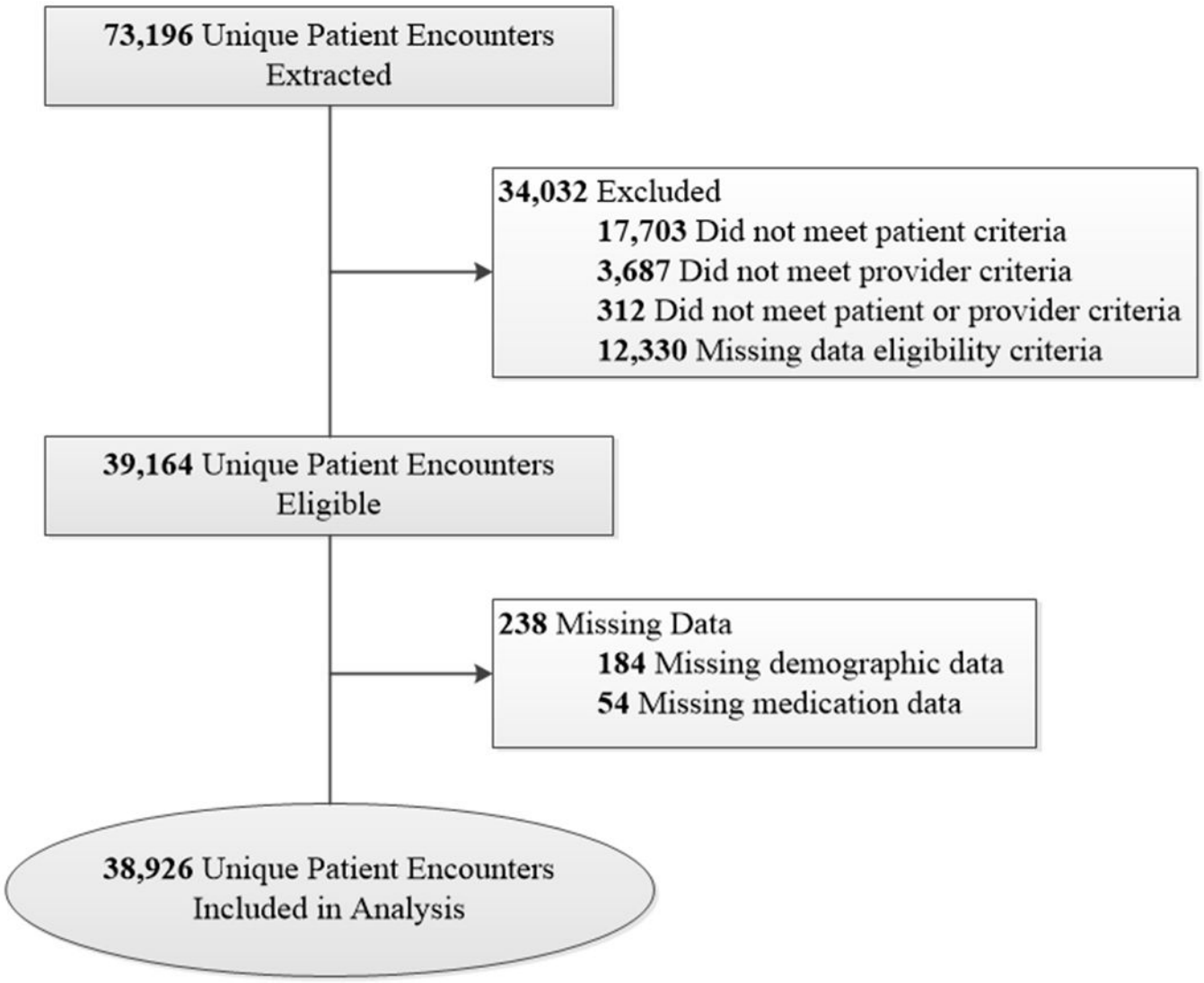

Figure 1.
Patient flow diagram.

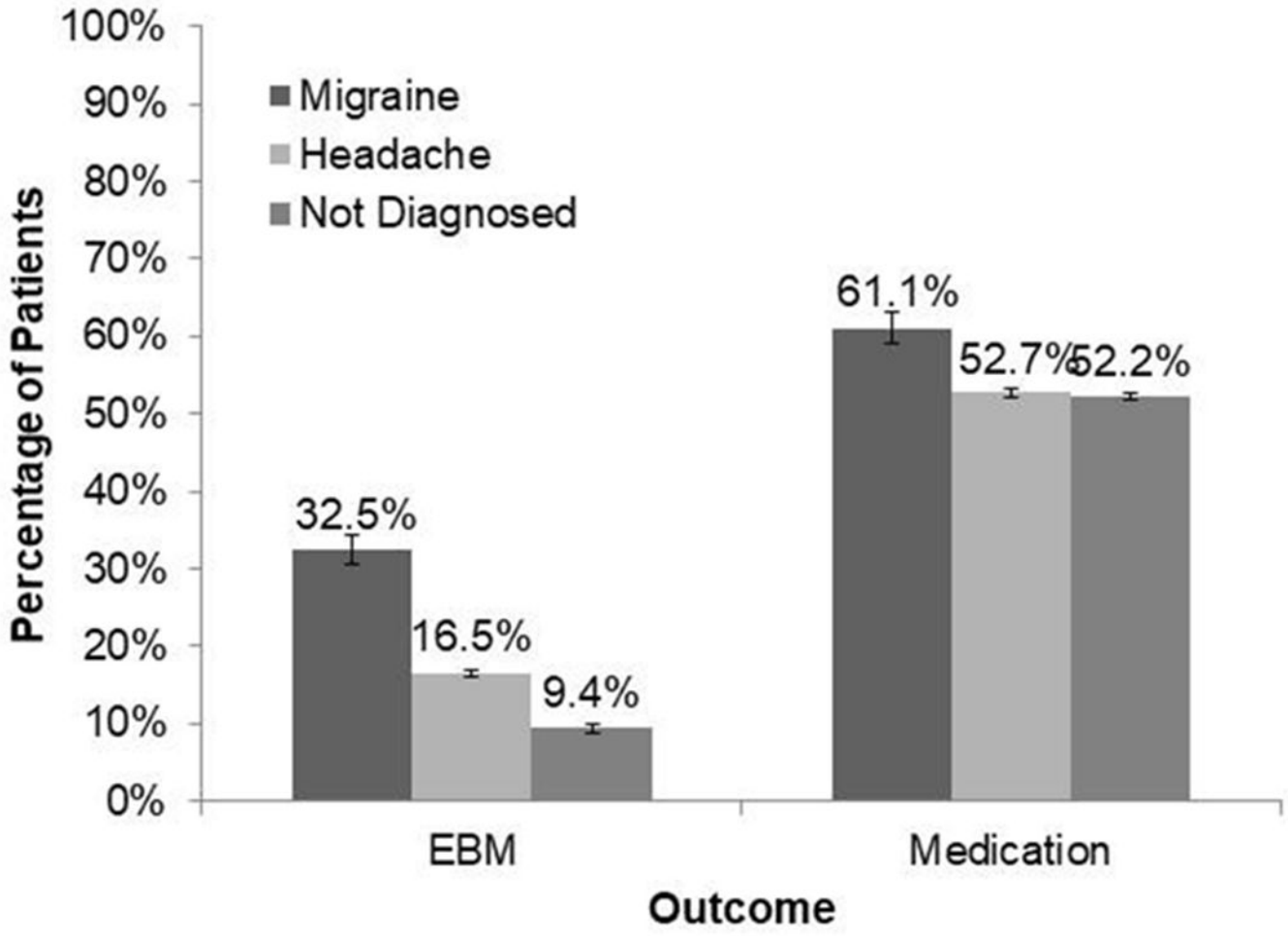

Figure 2.

Percentage of patients who received Evidence-Basd Medicine and any Medication prescription or recommendation by diagnostic category: migraine, headache, or not diagnosed.

Table 1.

Demographics by Level 1 (Patient) and Level 2 (Provider)

Variable	Frequency	%
Level 1 (Patient)		
Age [Mean (SD)]	12.1 (3.5)	
Sex		
Male	16,842	43.3%
Female	22,084	56.7%
Race		
Caucasian	30,403	78.1%
Not Caucasian	8,523	21.9%
Diagnosis		
Headache Diagnosed	14,252	36.6%
Migraine	6,901	17.7%
Headache Not Diagnosed	17,773	45.7%
Insurance		
Private Insurance	22,198	57.0%
Medicare/Medicaid/Government Insurance	8,332	21.4%
Self-Pay/Charity/No Insurance	8,396	21.6%
Level 2 (Provider)		
Location		
Metro	1,264	78.2%
Non-Metro	353	21.8%
Specialty		
Primary Care	1,044	64.6%
Specialty Care	145	9.0%
Emergency Room/Urgent Care/Crisis	428	26.5%
Center		

Level 1 (Patient) N = 38,926; Level 2 (Provider) N = 1,617

Table 2.

Prescription Descriptive Statistics

Variable	Frequency	%
Received EBM		
Yes	6,267	16.1%
No	32,659	83.9%
Received Any Medication		
Yes	21,015	54.0%
No	17,911	46.0%
Received Opioid or Barbiturate *		
Yes	3,317	15.8%
No	17,698	84.2%

N = 38,926;

* N = 21,015 (Only those who received a medication)

Table 3.

Patient and Provider-Level Predictors of Receiving EBM

Effect	Odds Ratio	95% Confidence Interval	p-value
Level 1 (Patient)			
Age (per year increase)	1.07*	1.06 to 1.08	<0.001
Sex (Female vs. Male)	1.14*	1.07 to 1.21	<0.001
Race (Caucasian vs. Non-Caucasian)	0.89*	0.82 to 0.96	0.002
Diagnosis			
Headache vs. No Diagnosis	1.71*	1.55 to 1.88	<0.001
Migraine vs. No Diagnosis	4.71*	4.17 to 5.33	<0.001
Headache vs. Migraine	0.36*	0.32 to 0.41	<0.001
Insurance			
Government vs. Private	1.22*	1.12 to 1.32	<0.001
None vs. Private	0.58*	0.52 to 0.67	<0.001
Government vs. None	2.09*	1.80 to 2.43	<0.001
Level 2 (Provider)			
Location (Metro vs. Non-Metro)	0.65*	0.58 to 0.74	<0.001
Specialty			
Specialty Care vs. Primary Care	0.71*	0.53 to 0.95	0.021
ED/UC vs. Primary Care	0.98	0.84 to 1.13	0.71
Specialty Care vs. ED/UC	0.73*	0.53 to 0.99	0.045

Level 1(Patient) N = 38,926; Level 2 (Provider) N = 1,617

Table 4.

Patient and Provider-Level Predictors of Receiving any Medication

Effect	Odds Ratio	95% Confidence Interval	p-value
Level 1 (Patient)			
Age (per year increase)	1.02*	1.01 to 1.02	<0.001
Sex (Female vs. Male)	1.02	0.98 to 1.07	0.30
Race (Caucasian vs. Non-Caucasian)	1.09*	1.03 to 1.15	0.004
Diagnosis			
Headache vs. No Diagnosis	0.85*	0.81 to 0.89	<0.001
Migraine vs. No Diagnosis	1.40*	1.31 to 1.51	<0.001
Headache vs. Migraine	0.61*	0.57 to 0.65	<.0001
Insurance			
Government vs. Private	1.22*	1.14 to 1.31	<0.001
None vs. Private	0.53*	0.50 to 0.57	<0.001
Government vs. None	2.29*	2.11 to 2.48	<0.001
Level 2 (Provider)			
Location (Metro vs. Non-Metro)	0.52*	0.46 to 0.61	<0.001
Specialty			
Specialty Care vs. Primary Care	0.82	0.64 to 1.07	0.15
ED/UC vs. Primary Care	0.78*	0.67 to 0.91	0.001
Specialty Care vs. ED/UC	1.06	0.80 to 1.40	0.68

Level 1 (Patient) N = 38,926; Level 2 (Provider) N = 1,617

Table 5.

Patient and Provider-Level Predictors of Receiving an Opioid if Prescribed Medication

Effect	Odds Ratio	95% Confidence Interval	p-value
Level 1 (Patient)			
Age (per year increase)	1.14*	1.12 to 1.16	<0.001
Sex (Female vs. Male)	1.16*	1.08 to 1.31	<0.001
Race (Caucasian vs. Non-Caucasian)	1.18*	1.08 to 1.31	<0.001
Diagnosis			
Headache vs. No Diagnosis	1.60*	1.42 to 1.80	<0.001
Migraine vs. No Diagnosis	1.63*	1.34 to 1.89	<0.001
Headache vs. Migraine	0.98	0.87 to 1.11	0.78
Insurance			
Government vs. Private	1.12*	1.01 to 1.24	0.036
None vs. Private	1.22*	1.07 to 1.39	0.003
Government vs. None	0.92	0.78 to 1.07	0.28
Level 2 (Provider)			
Location (Metro vs. Non-Metro)	0.87	0.73 to 1.03	0.10
Specialty			
Specialty Care vs. Primary Care	1.91*	1.30 to 2.82	0.001
ED/UC vs. Primary Care	2.02*	1.70 to 2.39	<0.001
Specialty Care vs. ED/UC	0.95	0.63 to 1.43	0.80

Level 1 (Patient) N = 21,015; Level 2 (Provider) N = 1,284.