Pediatric Headache: Clinical Algorithm Project

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Problem Description and Population

The pediatric population is defined within health care as the group of individuals whose age spans the time from birth to age 18; under some chronic care circumstances, the age of a pediatric patient may stretch to age 20 or 21 (Bhawra, Toulany, Cohen, Hepburn, & Guttmann, 2016). Within this population, headache is a frequent and disabling health concern that can result in diminished quality of life and have negative impact on the course of normal development (Colombo et al., 2011). There are a variety of primary headache types and etiologies that occur in children as young as 4 years of age and may expand into adulthood (Bonthius, Lee & Hershey, 2015). The primary headaches consist of: migraine, tension-type headaches, and trigeminal autonomic cephalgias; of these, migraines are the most common (Shah & Kalra, 2009).

Accurately assessing and managing headaches in the pediatric population can be difficult for specialists, and even more so for time-pressed primary care providers (Colombo et al., 2011). The presentation of head pain varies greatly between patients and may not always fit classic diagnostic descriptions such as those outlined in International Classification of Headache Disorders II (ICHD II) (Colombo et al., 2011). Presentation of pediatric head pain also significantly differs from adult head pain presentation, and in a pre-verbal child headaches can be particularly challenging to localize, assess and diagnose (Shah & Kalra, 2009). Recurring headaches tend to progress into adolescence and adulthood making early diagnosis and effective management key in decreasing on-going headache burden and its sequelae (Colombo et al., 2011).

The Headache Algorithm “toolkit” has been created to support prompt treatment of the pediatric population with recurring head pain, however, it also serves to empower primary care

providers in diagnosing and managing the primary headache syndromes. Bale, Currey, Firth & Larson (2009) conducted a survey study of primary care pediatricians in the United States. In their report, respondents indicated a persistent shortage of pediatric neurologists in their area, leading to lengthy delays for specialty appointments and greater difficulties seeking treatment for patients living in more rural settings. Three of the most common reasons for the neurology referrals were new-onset seizures, tics, and migraines. The study also showed the perceived shortage of pediatric neurologists is complicated by an aging workforce that will further deplete this specialized population of providers within the coming decade (Bale, Currey, Firth, & Larson, 2009).

At last report, the national average wait time to see a pediatric neurologist was close to 9 weeks; at some medical centers the wait time may extend upward of 16 weeks (Children's Hospital Association, 2012). The shortfall of U.S. child neurologists - which was 20% in 2012 - is expected to worsen by 2020 and persist through 2025 (Dall et al., 2013). Given these elements, the development of a comprehensive, time-efficient clinical algorithm developed to facilitate diagnosis and management of pediatric headaches at the primary level of care may increase provider access and reduce treatment delays.

Epidemiology

From an epidemiological perspective, headache is one of the most common pediatric medical complaints, with prevalence increasing as children move toward adolescence (Knupp et al., 2012; Bonthius, et al., 2015). Data collected from 64 cross sectional studies, in 32 countries, over the past 25 years shows that headaches affect 54.4% of children and adolescents. By the age of 18, approximately 90% of young people experience headache (Robertson et al., 2016). Recurrent headaches occur in approximately 11% of children and 28% of adolescents (Knupp et

al., 2012). Headache prevalence shows no gender bias until the age of 12, after which it skews towards females (Bonthius, et al., 2015).

Project Purpose

Reflective of the national trend in the Bale et al., study (2009), our local Pediatric Neurology Department at Doernbecher Children's Hospital also has a wait-list of four to six months for an appointment with a neurologist. Some of these specialty visits are for headache referrals that could be resolved and/or treated during a primary care visit. The goal of the current project was to create useful algorithms for primary care providers addressing pediatric head(ache) pain. The purpose of the algorithms will be to empower primary care providers in accurately assessing and managing pediatric headache, simultaneously, refining the referrals to Doernbecher's pediatric neurology.

Review of the Literature

The initial literature search was conducted utilizing the online during the months of May/June, 2016. Databases used include, PubMed, Cochrane Library, Medline, Google Scholar, and Up-To-Date®. Parameters for the search were set to look for full-text, English language or translated to English articles published between the years 2000 and June of 2016. Search terms included, "pediatric headaches," "pediatric tension-type headache," "pediatric tension-type headache versus migraine," "headache evaluation, pediatric," "distinguishing pediatric headaches," "pediatric migraines," "pediatric migraine treatment," "pediatric migraine prophylaxis," "pediatric migraine treatment guidelines," "pediatric migraine diet," and "pediatric migraine complementary alternative treatment."

An attempt was made to utilize resources from 2010 and forward, however, reliable information on pediatric headaches that properly covered the scope of the topic dated back to

2004. Therefore, most articles referenced were written between 2004 and 2016. The search produced a plethora of articles, reviews and guidelines that applied to pediatric headache, pediatric migraine, migraine treatments, tension-type headaches, and differing features between headache types. For the Doctorate of Nursing Practice (DNP) beginning benchmarks (Scholarly Inquiry Paper, Case Study Report) at Oregon Health & Science University, 39 resources were chosen for their relevance and scientific rigor. Within these 39 resources, were 25 articles, 9 practice parameters or guidelines, 2 reviews, 1 assessment/measurement tool, and 2 international diagnostic criteria documents.

As this project progressed, the literature search was expanded with additional search terms including, "cephalgias," "atypical pediatric headache presentation," "pediatric headache diagnostic clinical pathway," "pediatric headache algorithm," "clinical headache guidelines in primary care," "barriers to guideline implementation," "headache lifestyle recommendations," "complementary alternative headache approaches," "nutraceuticals used in pediatric headache" and "secondary causes of pediatric headache." The expanded search took place in the fall of 2016 and winter of 2017, and yielded an additional eight articles and three guidelines relevant to the project.

The project additionally benefitted from conversations with pediatric headache experts from Colorado Children's Hospital, Children's Health in Dallas, and Oregon Health & Science University. These conversations, and the supplemental clinical information generously shared by these individuals, informed the project, refined details, and filled holes left by gaps in the literature. Finally, the headache and/or neurological sections of the following pediatric text books were utilized: *Pediatric Physical Examination* (2014), *Current Diagnosis & Treatment: Pediatrics* (2012), and *Pediatric Acute Care: A Guide for Interprofessional Practice* (2015).

Several of the pediatric headache centers that dot the nation have developed their own sets of practice guidelines. These guidelines have been built with input from pediatric neurologists, nurse practitioners, physicians, pharmacists, psychologists, and naturopathic providers. The pediatric headache guidelines reviewed for this project, though few, proved to be thorough and offer comprehensive, evidence-based guidance. However, there were no headache guidelines specific to pediatrics that were created in a primarily visual format. A key goal of the algorithm project was to accommodate the frequently over-burdened schedules and 15 minute visits that characterize the practice of primary care providers. As such, an attempt was made to encapsulate current practice surrounding diagnosing and managing pediatric headache using visual cues that would be safe and comprehensive, yet also time-efficient.

As with many pediatric diseases and treatments, there are gaps in the literature. Data on effective treatment specific to *pediatric* headache is limited, with much of the research performed on and reflective of adult models. Thus, several of the pharmacological therapies used to treat pediatric migraines are prescribed off-label (Brenner & Lewis, 2008). Clinical algorithm development encompassed the evaluation of secondary causes of headache, headache assessment, effective first and second-line pharmacological interventions, nutraceutical, and lifestyle recommendations, in hopes of illuminating the most current evidence-based practices for pediatric primary care providers.

Approach to the Conduct of the Project

It was unclear at the outset of the project how many algorithms would be required to adequately cover the components of headache diagnosis and first-line pharmacological/lifestyle management. Initially, the project was aimed toward creating one comprehensive algorithm. However, it quickly became obvious that a single algorithm would provide insufficient space to

cover topics thoroughly, and would overwhelm rather than inform the viewer. Therefore, the final product consists of four algorithms: 1) *Initial Headache Evaluation*, 2) *Causes of Secondary Headache in a Child Without a Shunt*, 3) *Evaluation of Primary Headaches*, and 4) *Medication Management for Pediatric Headache*. There are also supplemental guides in the toolkit, which include an *Additional Information* sheet – with several provider resources – and a *Triptan Dosing Schedule* (see Appendices A, B, C, D, E, and F respectively). It may be prudent in the future to add an algorithm for menstrual migraines, and a more complete dosing schedule that includes second-line pharmacological treatments.

Project Participants

Prior to beginning algorithm design, a clinical expert panel of eight members was chosen to evaluate the algorithms upon completion. The panel members consist of: two primary care pediatric nurse practitioners, two pediatric pain specialists (one of whom specializes in headache), two pediatric neurologists, a primary care pediatrician, and a newly licensed family nurse practitioner. On completion of the algorithm development phase of the project, an email that included the algorithms was sent to members of the panel for review. Within the email, eight questions were posed to guide feedback and offer a basis for comparison among respondents. A request was made to return feedback within a two-week window, either by email, phone, or scheduled interview.

Outcome Evaluation

Of the eight clinical expert panel members, seven (88%) returned feedback on the project. Out of the seven respondents, six returned feedback via email, one chose an in-person interview. Responses revealed a wide array of perspectives unique to the individual, their specialty, working environment, and number of years in practice. The eight questions used to

guide response were as follows: 1) Does the flow of the algorithms make sense? 2) Are they easy to follow? 3) Are they efficient enough? 4) Are they comprehensive enough? 5) Do they provide adequate information for a primary care provider to feel safe in diagnosing a primary headache syndrome and offering first-line headache management? 6) Would they work best in the field, if accompanied by a short teaching session? 7) Is there information you feel is missing? and 8) Any other feedback?

Three respondents (43%) answered all eight of the feedback questions; the remaining four (57%) did not answer the questions, but instead addressed many of the questions by offering comments directly on the individual algorithms. The feedback on the overall quality of the algorithm packet was positive among all respondents. There were no other patterns or themes that emerged in the feedback review. Of note, however, was those panel members with more practice experience found the algorithms easy to negotiate and comprehensive, but expressed this may have been due to a familiarity with headache syndromes. Beyond these points, remarks were quite diverse, with the highest number of refining details received from a pediatric neurologist on the panel. The panel member for whom the packet was most helpful, was the newly licensed family nurse practitioner.

A cross-section of remarks from the panel were, “these would be best if accompanied by a short teaching session on pediatric headache,” “you could think about including ‘hormone’ related headaches,” “you may want to emphasize the lifestyle changes more prominently,” “include evaluation for anemia,” “consider adding a brief comment for what to do with shunts/head trauma,” “add more detail…under history…neuro exam.” Other comments addressed adding or adjusting visual cues for heightened usability.

A lesson learned from the process of attempting to distill themes from data was the importance not only of providing structure to capture, compare and synthesize feedback from respondents, but to be specific in the instructions. While this information is not new, the project served to demonstrate and underscore its importance to the progression of a project. The next steps include integrating suggestions and constructive feedback. Once they have been integrated, the algorithms will be pilot tested across different types of primary care providers with different experience. It is hypothesized that the algorithms may prove most useful for new providers, those less familiar with pediatric practice, and/or providers with limited clinical headache experience. Based on initial feedback, a brief teaching session, where there is room for direct questions and answers, may also be beneficial for the more inexperienced provider.

Practice Related Implications

Originally, the project was meant to include both the development of algorithms (project goal) and a test of the algorithm packet's effectiveness (project purpose) among a selected group of local primary care providers. However, achieving both goals would have expanded the project's commitment beyond allowable time boundaries. Therefore, the focus of the project became the phase I development of the algorithm toolkit, and evaluation of the toolkit by a clinical expert panel.

The next step will involve a retrospective chart review of referrals to Doernbecher's pediatric neurology clinic to discover sources and reasons for, what eventually were labeled, inappropriate specialist referrals. Insight from this review will help inform further refinement of the algorithms, as well as, identify foci for initial pilot testing. Phase II of the study involves distributing the algorithm to a select group of primary care providers for testing at the point-of-care and evaluating feedback via survey or interview. This data will be collected and synthesized

regarding the toolkit's effectiveness in supporting diagnosis and management of pediatric headache. The long-term impact on referral patterns will be monitored by implementing a downstream chart review of patients treated and/or referred using the algorithm.

Given the lengthy delays for neurology appointments, primary care offices have shown interest in tools that facilitate care within their setting. Other facilitators going forward include: the ability to provide more specialized care for patients who would otherwise need to travel, expansion of clinical expertise, patient retention, and expanded revenue opportunities.

Future project barriers might include insufficient number of primary care offices and/or providers willing to participate in the project, low number of pediatric patients who have headache as a chief complaint, algorithms that are either not refined enough or too complicated to be user friendly, lack of necessary documentation regarding process and outcome, patient dissatisfaction with treatment or perception of restricted access to specialty care.

Summary

Headaches occur in nearly 60% of children over a period of time ranging from one month to the extent of their age, and headache prevalence has been increasing in school age children (Bonthius et al., 2015). The focus of this study was to develop a pediatric headache decision making toolkit for point-of-care primary care providers. With understanding, primary care providers can effectively, efficiently diagnose and treat recurring headache syndromes, and differentiate between primary headaches by noting key characteristics of the distinguishing features. The algorithms assist primary care providers in the identification of specific headache types, which in turn, will help facilitate treatment pathways, as well as, help patients avoid lengthy wait-times for neurology referrals that may not have been necessary (Bale, et al., 2009). Additionally, the toolkit also calls attention to the fact that headaches may mask other significant

but easily treatable conditions, such as vision impairment. Finally, identifying headaches early on, providing life-style, medication, and stress management techniques may help stop headache escalation. Early intervention is central as head pain has strong impact on quality of life and pediatric patients with recurring headaches frequently evolve into adult patients with recurring headaches. This paper reports phase I process and proposed phase II.

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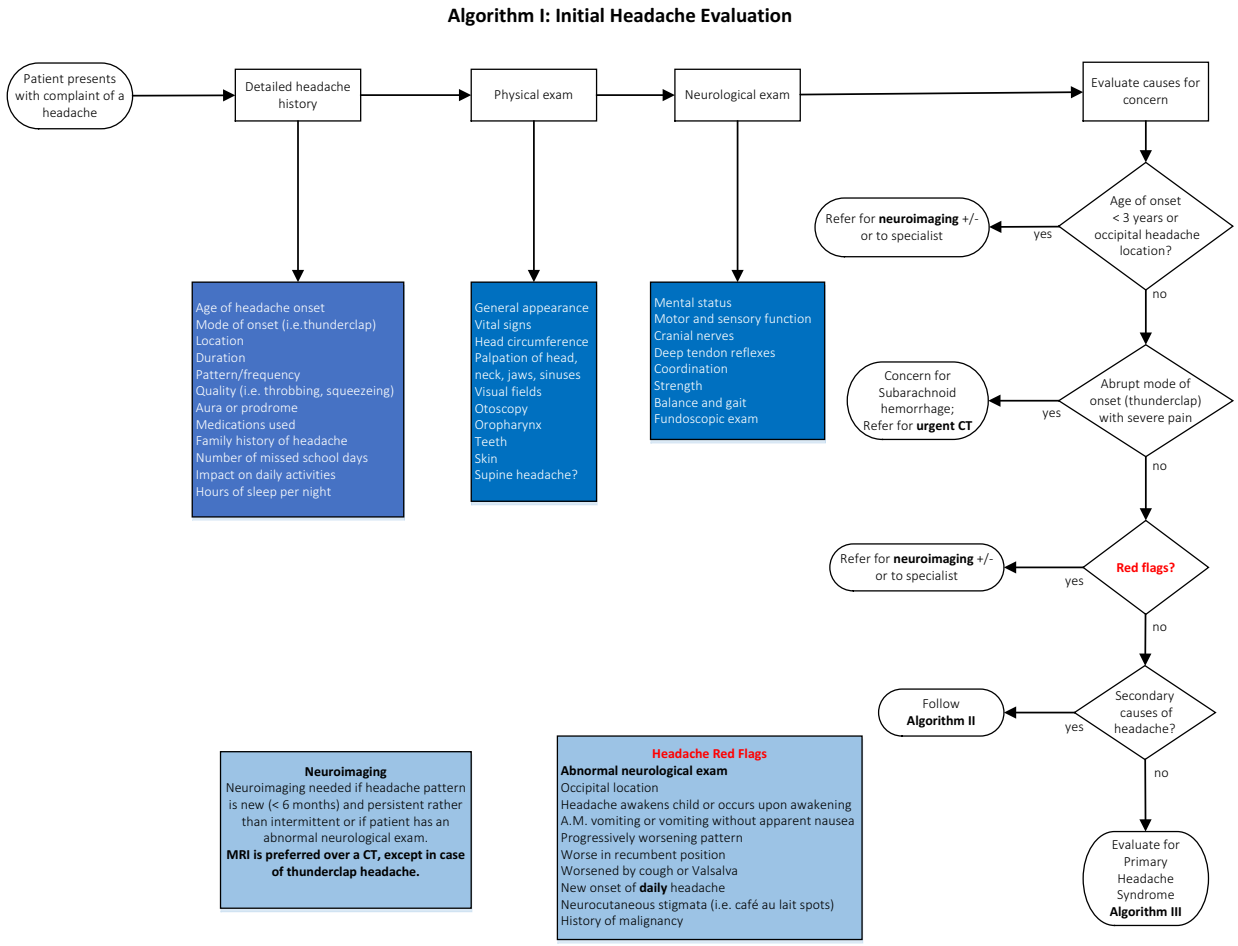
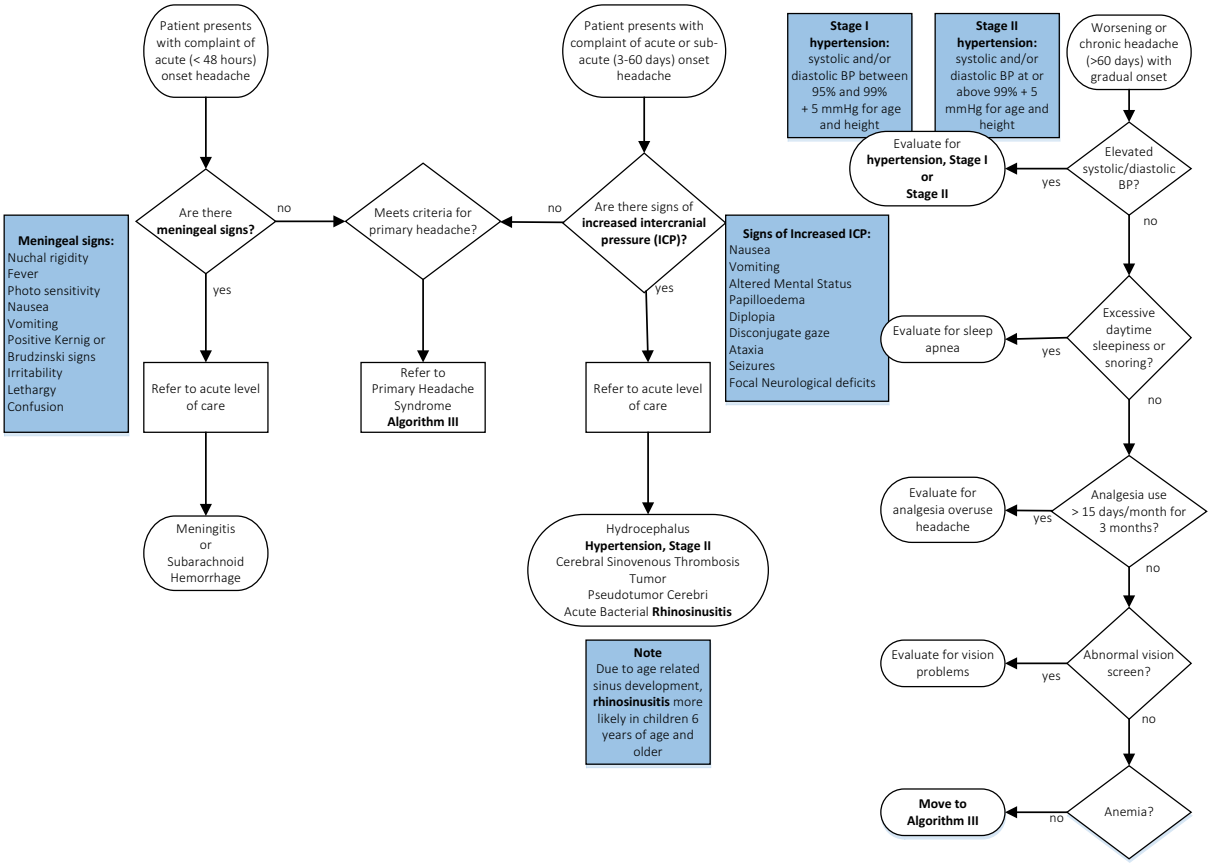
A.

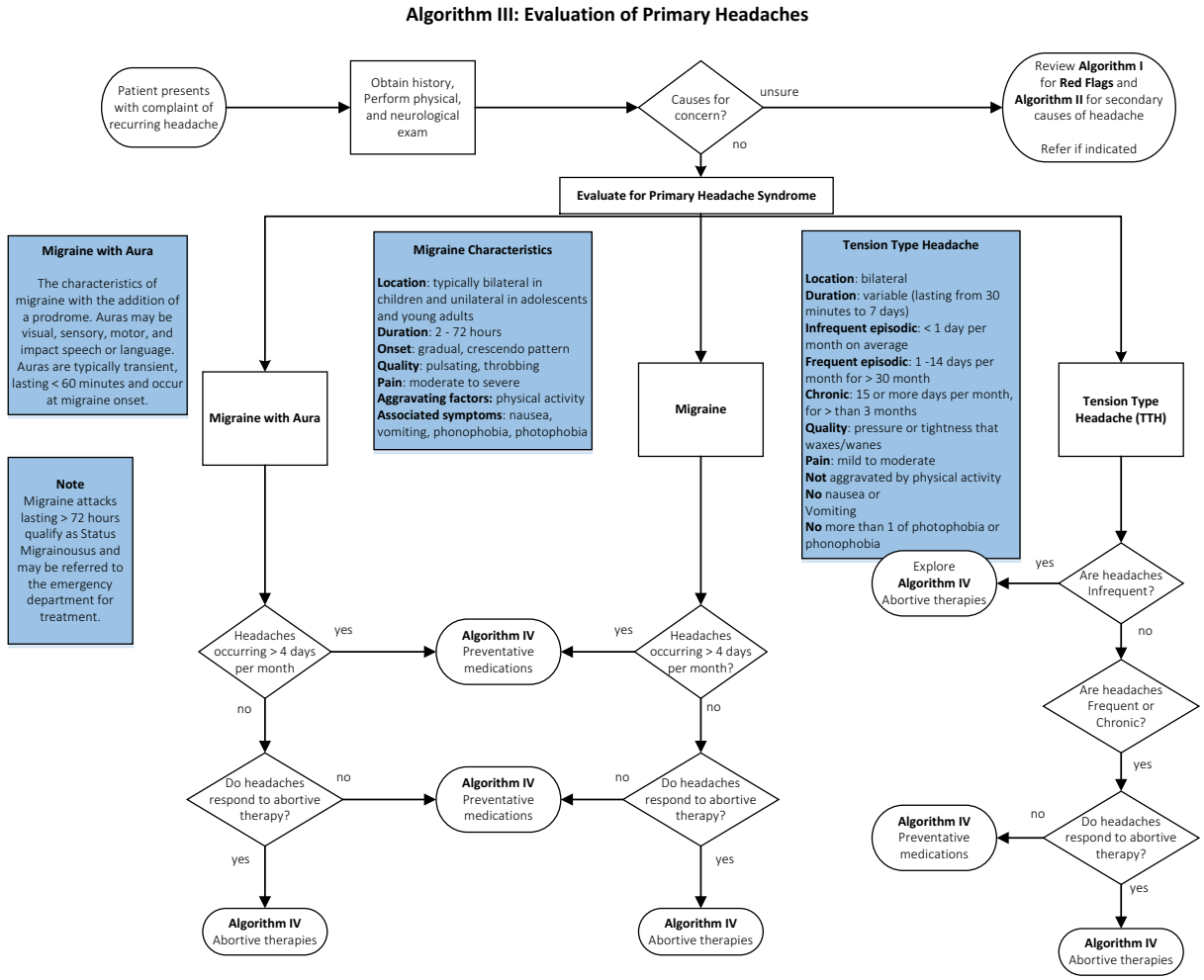

Algorithm I: Initial Headache Evaluation
Patient presents with complaint of a headache
Detailed headache history
Physical exam
Neurological exam
Evaluate causes for concern
Age of headache onset
Mode of onset (i.e.thunderclap)
Location
Duration
Pattern/frequency
Quality (i.e. throbbing, squeezeing)
Aura or prodrome
Medications used
Family history of headache
Number of missed school days
Impact on daily activities
Hours of sleep per night
General appearance
Vital signs
Head circumference
Palpation of head, neck, jaws, sinuses
Visual fields
Otoscopy
Oropharynx
Teeth
Skin
Supine headache?
Mental status
Motor and sensory function
Cranial nerves
Deep tendon reflexes
Coordination
Strength
Balance and gait
Fundoscopic exam
Age of onset < 3 years or occipital headache location?
yes
Refer for neuroimaging +/- or to specialist
no
Abrupt mode of onset (thunderclap) with severe pain
yes
Concern for Subarachnoid hemorrhage; Refer for urgent CT
no
Red flags?
yes
Refer for neuroimaging +/- or to specialist
no
Secondary causes of headache?
yes
Follow Algorithm II
no
Evaluate for Primary Headache Syndrome Algorithm III
Neuroimaging
Neuroimaging needed if headache pattern is new (< 6 months) and persistent rather than intermittent or if patient has an abnormal neurological exam.
MRI is preferred over a CT, except in case of thunderclap headache.
Headache Red Flags
Abnormal neurological exam
Occipital location
Headache awakens child or occurs upon awakening
A.M. vomiting or vomiting without apparent nausea
Progressively worsening pattern
Worse in recumbent position
Worsened by cough or Valsalva
New onset of daily headache
Neurocutaneous stigmata (i.e. café au lait spots)
History of malignancy

B.

Algorithm II: Causes of Secondary Headache in a Child Without a Shunt or Recent History of Trauma

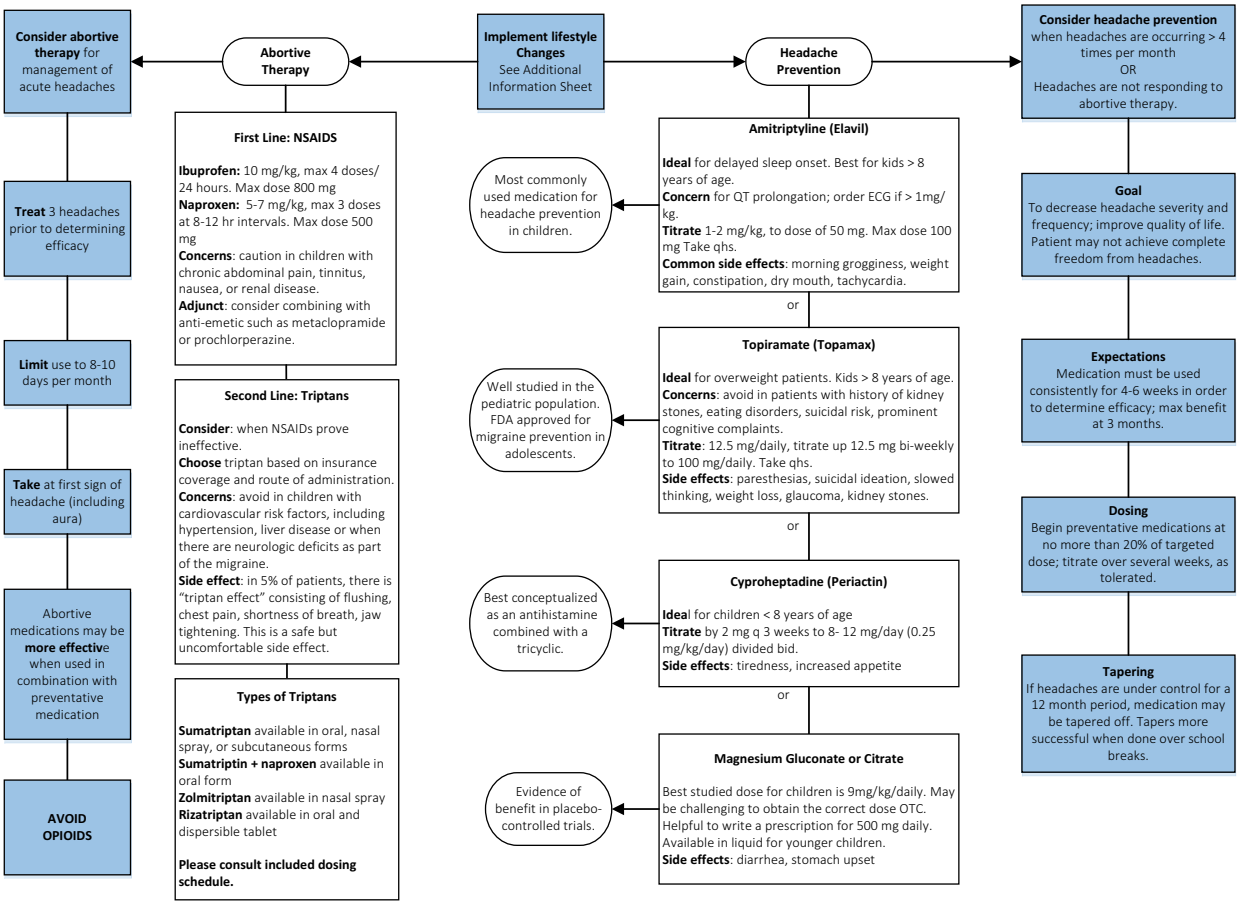


C.


Algorithm III: Evaluation of Primary Headaches
Patient presents with complaint of recurring headache
Obtain history, Perform physical, and neurological exam
Causes for concern?
unsure
Review Algorithm I for Red Flags and Algorithm II for secondary causes of headache
Refer if indicated
no
Evaluate for Primary Headache Syndrome
Migraine with Aura
The characteristics of migraine with the addition of a prodrome. Auras may be visual, sensory, motor, and impact speech or language. Auras are typically transient, lasting < 60 minutes and occur at migraine onset.
Migraine Characteristics
Location: typically bilateral in children and unilateral in adolescents and young adults
Duration: 2 - 72 hours
Onset: gradual, crescendo pattern
Quality: pulsating, throbbing
Pain: moderate to severe
Aggravating factors: physical activity
Associated symptoms: nausea, vomiting, phonophobia, photophobia
Tension Type Headache
Location: bilateral
Duration: variable (lasting from 30 minutes to 7 days)
Infrequent episodic: < 1 day per month on average
Frequent episodic: 1 -14 days per month for > 30 month
Chronic: 15 or more days per month, for > than 3 months
Quality: pressure or tightness that waxes/wanes
Pain: mild to moderate
Not aggravated by physical activity
No nausea or Vomiting
No more than 1 of photophobia or phonophobia
Note
Migraine attacks lasting > 72 hours qualify as Status Migrainousus and may be referred to the emergency department for treatment.
Migraine with Aura
Migraine
Tension Type Headache (TTH)
Headaches occurring > 4 days per month
yes
Algorithm IV Preventative medications
Headaches occurring > 4 days per month?
Explore Algorithm IV Abortive therapies
Are headaches Infrequent?
Are headaches Frequent or Chronic?
Do headaches respond to abortive therapy?
Algorithm IV Abortive therapies

D.

Algorithm IV: Medication Management for Pediatric Headaches



E.

Additional Information

Lifestyle Recommendations: aim for patient to take-on 2 - 3 of the most appropriate recommendations. These interventions alone may reduce headache recurrence.

- Attempt to drink 8 cups of water a day and limit caffeine to no more than 2 days per week. **Adequate hydration is essential** and should be a first-step in headache management and prevention.
- Aim for 9 – 11 hours of sleep each night.
- Learn progressive relaxation techniques or meditation.
- Get 60 minutes of physical activity per day.
- Eat a healthy breakfast daily, and eat every 4 hours.
- When experiencing a migraine, stay away from computer and television screens.
- There is data showing cognitive behavioral therapy may be a beneficial treatment for pediatric migraine, and augment efficacy of medications such as amitriptyline (Ng, Venkatanarayanan, & Kumar, 2016).

Tools and Resources

- PedMIDAS migraine is a validated tool for assessment of headache burden. Cincinnati Children's, Headache Center provides a free downloadable PDF of the tool: https://www.cincinnatichildrens.org/service/h/headache-center/pedmidas. Scoring for the PedMIDAS tool may be located near the bottom of the web page.
- Encourage your patient to keep a headache diary. A headache diary may provide significant information regarding where to encourage lifestyle interventions. Boston Children's Hospital offers a great example: http://www.childrenshospital.org/~/media/healthtopics-kidsmd/conditions/headaches/hadiary.ashx?la=en.
- Create school and home action plans. Headache Relief Guide has a provider section that will walk you through the creation of an action plan. The site was created by doctors from Children's Mercy Hospital in Kansas City. It is an excellent resource for both patients and providers: headachereliefguide.com.

Additional Abortive Medication

- Tylenol may be the most appropriate abortive medication for children with gastrointestinal issues, kidney disease, or other conditions contraindicating NSAIDS.

Additional Preventative Medications

- Verapamil: 2 mg/kg/day PO divided two to three times daily, increase 4-8 mg/kg/day divided TID; maintenance dose is 240 mg/day. Side effects: hypotension, nausea, AV block, weight gain. Obtain ECG if on or over 240 mg/daily.
- Propranolol: 10 mg PO TID, maintenance dose 20-40 mg PO TID. Side effects: hypotension, vivid dreams, depression.

Additional Nutraceuticals

- Riboflavin: 200 mg daily for younger children; 400 mg daily for older children and young adults.

Follow-up Guidelines

These guidelines come from Angelina Koehler, a nurse practitioner specializing in pediatric headache out of Children's Hospital Colorado:

- For new onset headache, follow-up in 2 – 4 weeks.
- Children with more than 8 headaches monthly or changes to their treatment plan, follow- up in 4 – 6 weeks.
- Children with less than 8 headaches monthly and new changes to their treatment plan, follow-up in 8 – 12 weeks.
- Children with no changes and stable, follow-up in 10 – 12 weeks up to yearly.

F.

Triptan Dosing Schedule

Medication	Form	Dosage	Maximum dose	Frequency	Formulations	Cost (these reflect Colorado prices)	Side effects
Rizatriptan (Maxalt®)	PO	< 40 kg: 5 mg > 40 kg: 10 mg	< 40 kg: 10 mg/24 hours > 40 kg: 20 mg/24 hours	Can repeat in 2 hrs	ODT: 5, 10 mg Tab: 5, 10 mg	$25-39/tab Generic $10/tab	Nausea, dizziness, weakness, flushing
Almotriptan (Axert®)	PO	6.25 to 12.5 mg	25 mg/day	Can repeat in 2 hrs	Tab: 6.25, 12.5mg	$9-27/tab	Nausea, somnolence, dizziness
SUMAtriptan (Imitrex®)	PO **	Less than 50 kg: 25 mg Greater than 50 kg: 50 mg	100 mg/24 hours PO	Can repeat in 2 hrs	Tab: 25, 50, 100 mg	25 mg: $17/9 tab 50 mg: $50/9 tab 100 mg: $70/9 tab	Nausea, dizziness, weakness, flushing
	Intranasal	Less than 50 kg: 5-10 mg Greater than 50 kg: 20 mg	40 mg/hours intranasal		Intranasal: 5, 20mg	5mg: $137-265/6 doses 20mg: $145-158/ 6 doses	
	SC	0.06 to 1 mg/kg	12 mg/hours SC		SC: 4 mg/0.5 mL , 6 mg/0.5 mL	2 syringes: $130-175	
ZOLMitriptan (Zomig®)	PO	Greater than 50 kg: 2.5 to 5 mg/dose	10 mg/24 hours	Can repeat in 2 hrs	Tab: 2.5,5mg ODT: 2.5,5mg	$29-65/3 tab dose pack (generic)	Nausea, dizziness, chest pain and tightness, weakness, paresthesia
	IN	5 mg/dose			Intranasal: 5mg	6 doses: $350-380	
Eletriptan (Relpax®)	PO	Greater than 50 kg: 20 to 40 mg/dose	80 mg/24 hours	Can repeat in 2 hrs	Tab: 20,40 mg	$36-48/tab	Nausea, weakness dizziness, paresthesia
Naratriptan (Amerge®)	PO	1 to 2.5 mg/dose	5 mg/24 hours	Can repeat in 4 hrs		$35-36/tab	Nausea, dizziness, pain (CNS)
Frovatriptan (Frova®)	PO	2.5 mg/dose	5 mg/24 hours	Can repeat in 2 to 4 hrs		$15-54/tab	Flushing, dizziness, fatigue, xerostoma, paresthesia
Treximet (Sumatriptan and Naproxen)	PO	10 mg sumatriptan/60 mg naproxen	85 mg sumatriptan/500 mg naproxen	1 dose every 24 hours	Tab	$26-30/tab w/coupon	Nausea, dizziness, chest pain and tightness, weakness, paresthesia, xerostoma

(Koehler, A., Turner, S, Jorgensen, J. Birlea, M., & Foss, A. 2016)

Note:
Triptans should not be used more than 2 times per week, with a maximum of 6 times per month.

Do not administer dihydroergotamine (nasal or IV) within 24 hours of last triptan dose.

FDA approved: Treximet, Almotriptan, and Zomig ≥ 12 years of age, Riztriptan ≥ 6 years of age. Other triptans are prescribed and may be effective, however, FDA approval has not been established for the pediatric population.