Development of a Visualization Tool for Tracking Modifiable Risk Factors for Progression from Episodic to Chronic Migraine

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Background

Migraine is a common neurologic condition affecting more than 900 million individuals worldwide.[1] The clinical course of migraine is defined as either episodic (occurring < 15 days per month) or chronic (≥ 15 headache days per month, with ≥8 migraine days, for > 3 months). Up to 2.5% of individuals with episodic migraine progress to chronic migraine each year.[2] Several modifiable risk factors for migraine progression and burden have been identified[3,4,5,6] (Table 1). **We propose that these risk factors, in combination with the patient's self-reported level of headache-related disability, may be considered a Comprehensive Clinical Assessment in Migraine (CCAM).**

Several scales have been developed to assess factors relevant in a CCAM history, such as the Patient Health Questionnaire (PHQ-9) Depression Assessment[7] and the Migraine Treatment Optimization Questionnaire (M-TOQ).[8] The Migraine Disability Assessment Scale (MIDAS)[9] has been validated for evaluation of perceived functional disability in migraine. However, **there is no single comprehensive scale that captures both the range of risk factors for migraine progression and self-reported migraine-related disability.**

At the same time, visualization tools that incorporate color-coded displays and graphs to reflect several attributes of a single patient have been shown to efficiently communicate a range of clinical information in other patient populations.[10,11,12] Visualization tools also may enhance patient-provider communication,[13] thus promoting doctor-patient communication,[14] which is associated with improved patient satisfaction in chronic pain,[15] increased patient adherence with treatment recommendations,[16] lower pain intensity, and higher well-being scores.[17]

With the trend toward shorter clinical visits in modern medicine,[18] the proposed study seeks to **develop the first-ever self-report visualization tool for patients with episodic migraine, to: 1) improve efficiency of communication about relevant CCAM history, 2) help providers focus open-ended questions on pertinent domains of CCAM, 3) facilitate doctor-patient communication without lengthening visit time, and 4) allow physicians and patients to track progress in CCAM over time.**

Functional Status	Modifiable risk factors
Self-reported headache disability	Depression
Headache frequency	Anxiety
	Abortive Medication Overuse
	Intractable Nausea
	Insomnia
	Diet
	Exercise

Table 1. Aspects of Comprehensive Clinical Assessment in Migraine

Aims

Aim 1: Perform literature review of gold standard questionnaires and scales that address risk factors reflected in CCAM.
Approach: PubMed search using key terms (e.g., "functional disability," "headache frequency," "depression," "anxiety," "medication overuse," "nausea," "insomnia," "diet," and "exercise," and cross-reference these with "episodic migraine," "chronic migraine," and "progression") to identify relevant, English-language studies. We will consult national experts in headache to seek out additional scales used in clinical practice. From this, we will determine the exact CCAM domains to be included in the tool.

Aim 2: Formulate visualization tool questions for each CCAM domain.
Approach: Prospective questions will be compiled, then reviewed by expert panels of physicians and migraine patients to determine if questions are capturing the intended content of each CCAM domain. The online tool QUAID (Question Understanding Aid) will be used to detect common problems with questionnaire items. Sensibility, readability, and face and content validity will be assessed by the panels.

Aim 3: Develop visualization tool software platform.
Approach: Collaborate with software engineers at University of Washington to develop the visualization tool software platform. Once completed, perform focus groups of patients and providers regarding usability and projected feasibility; modify as appropriate.

Proposed Visualization Tool

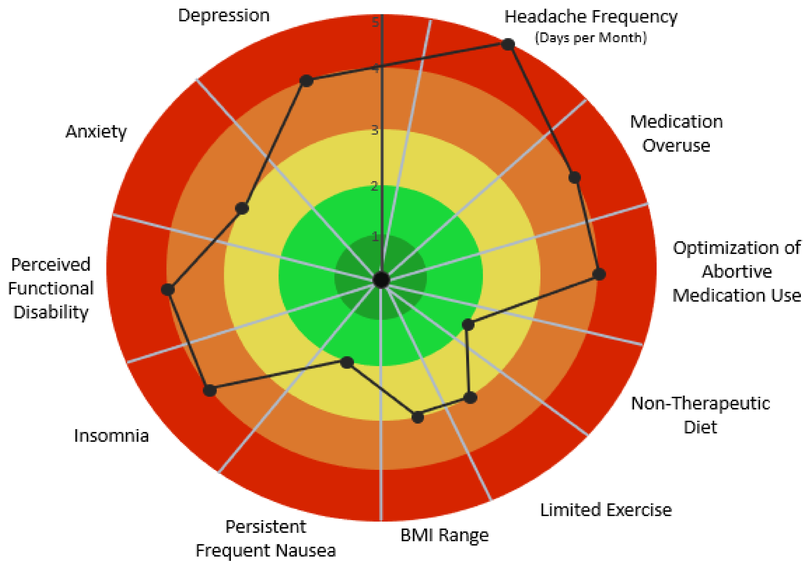

Figure 1. A preliminary example of the proposed visualization tool. Each pie slice, or potential CCAM domain, represents self-reported functional disability or a relevant risk factor in progression from episodic to chronic migraine. Patient responses (dots) are reported on a scale of 1-5 (with variable units based on specific domain (e.g., 1 = less severe or less frequent, increasing to 5 = most severe or most frequent)).

Future Directions

Following development of the visualization tool, further studies will include:

1) A validation study to test content validity, construct validity, and reliability
2) A feasibility study performed in the clinical setting.

The proposed visualization tool has both **research and clinical applications in assessing and tracking patient modifiable risk factors for progression from episodic to chronic migraine**, as well as assessing headache outcomes, visit efficiency, and patient and provider visit satisfaction. The tool could **be implemented in a range of clinics,** from primary care, to specialties (general neurology, pain medicine), and subspecialties (headache).

Further technologic advances are also possible, such as **conversion of the visualization tool into a cellular device application for personal patient tracking of CCAM.**

References

1. Feigin, Valery L., et al. "Global, regional, and national burden of neurological disorders during 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015." The Lancet Neurology 16.11 (2017): 877-897.
2. Lipton, Richard B. "Tracing transformation: chronic migraine classification, progression, and epidemiology." Neurology 72.5 Supplement 1 (2009): S3-S7.
3. Buse, Dawn C., et al. "Migraine progression: a systematic review." Headache: The Journal of Head and Face Pain 59.3 (2019): 306-338.
4. Martin, Vincent T., and Brinder Vij. "Diet and headache: part 1." Headache: The Journal of Head and Face Pain 56.9 (2016): 1543-1552.
5. Martin, Vincent T., and Brinder Vij. "Diet and headache: part 2." Headache: The Journal of Head and Face Pain 56.9 (2016): 1553-1562.
6. Irby, Megan B., et al. "Aerobic exercise for reducing migraine burden: mechanisms, markers, and models of change processes." Headache: The Journal of Head and Face Pain 56.2 (2016): 357-369.
7. Ashina S, Serrano D, Lipton RB, et al. Depression and risk of transformation of episodic to chronic migraine. J Headache Pain. 2012;13:615-624.
8. Lipton RB, Kolodner K, Bigal ME, et al. Validity and reliability of the migraine-treatment optimization questionnaire. Cephalalgia. 2009;29:751-759.
9. Bigal ME, Rapoport AM, Lipton RB, Tepper SJ, Sheftell FD. Assessment of migraine disability using the migraine disability assessment (MIDAS) questionnaire: A comparison of chronic migraine with episodic migraine. Headache. 2003;43:336-342.
10. Wanderer, Jonathan P., et al. "Clinical data visualization: the current state and future needs." Journal of medical systems 40.12 (2016): 275.
11. Loorak, Mona Hosseinkhani, et al. "Timespan: Using visualization to explore temporal multi-dimensional data of stroke patients." IEEE transactions on visualization and computer graphics 22.1 (2015): 409-418.
12. Harle, Christopher A., Daniel B. Neill, and Rema Padman. "Information visualization for chronic disease risk assessment." IEEE intelligent systems 27.6 (2012): 81-85.
13. Foraker, Randi E., et al. "EHR-based visualization tool: adoption rates, satisfaction, and patient outcomes." eGEMs 3.2 (2015).
14. Gotz, David, and David Borland. "Data-driven healthcare: Challenges and opportunities for interactive visualization." IEEE computer graphics and applications 36.3 (2016): 90-96.
15. Hirsh AT, Atchison JW, Berger JJ, et al. Patient satisfaction with treatment for chronic pain: Predictors and relationship to compliance. Clin J Pain 2005;21 (4):302–10
16. Hirsh AT, Atchison JW, Berger JJ, et al. Patient satisfaction with treatment for chronic pain: Predictors and relationship to compliance. Clin J Pain 2005;21 (4):302–10
17. Cepeda, M. Soledad, et al. "Emotional disclosure through patient narrative may improve pain and well-being: results of a randomized controlled trial in patients with cancer pain." Journal of pain and symptom management 35.6 (2008): 623-631.
18. Fiscella, Kevin, and Ronald M. Epstein. "So much to do, so little time: care for the socially disadvantaged and the 15-minute visit." Archives of internal medicine 168.17 (2008): 1843-1852.