

# An international study of emergency physicians' practice for acute headache management and the need for a clinical decision rule

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## ABSTRACT

**Objective:** Patients with acute headache often undergo computed tomography (CT) followed by a lumbar puncture to rule out subarachnoid hemorrhage. Our international study examined current practice, the perceived need for a clinical decision rule for acute headache and the required sensitivity for such a rule.

**Methods:** We approached 2100 emergency physicians from 4 countries (Australia, Canada, the United Kingdom and the United States) to participate in our survey by sampling the membership of their emergency associations. We used a modified Dillman technique with 3–5 notifications and a prenotification letter employing a combination of electronic mail and postal mail. Physicians were questioned about neurologically intact patients who presented with headache. Analysis included both descriptive statistics for the entire sample and stratification by country.

**Results:** The total response rate was 54.7% (1149/2100). Respondents were primarily male (75.5%), with a mean age of 42.5 years and a mean 12.3 years of emergency department (ED) experience. Of the physicians who responded, 49.5% thought all acute headache patients should be investigated with CT and 57.4% felt CT should always be followed by lumbar puncture. Of the respondents, 95.7% reported they would consider using a clinical decision rule for patients with acute headache to rule out subarachnoid hemorrhage. Respondents deemed the median sensitivity required by such a rule to be 99% (interquartile range 98%–99%). Approximately 1 in 5 physicians suggested that 100% sensitivity was required.

**Conclusion:** Emergency physicians report that they would welcome a clinical decision rule for headache that would determine which patients require costly or invasive tests to

rule out subarachnoid hemorrhage. The required sensitivity of such a rule was realistic. These results will inform and inspire the development of clinical decision rules for acute headache in the ED.

**Keywords:** clinical decision rules, subarachnoid hemorrhage, headache, emergency department, lumbar puncture, computed tomography

## RÉSUMÉ

**Objectif :** Les patients présentant une céphalée aiguë subissent souvent un examen par tomodensitométrie (TDM) suivi d'une ponction lombaire pour exclure une hémorragie sous-arachnoïdienne. Dans notre étude internationale, nous avons examiné la pratique actuelle, le besoin perçu d'une règle de décision clinique en cas de céphalée aiguë et la sensibilité requise pour une telle règle.

**Méthodes :** Nous avons effectué une enquête auprès d'un échantillon composé de 2100 médecins d'urgence membres d'associations de médecine d'urgence de 4 pays (Australie, Canada, Royaume-Uni et États-Unis). Nous avons utilisé une version modifiée de la méthode Dillman et une combinaison de courrier électronique et de courrier postal pour communiquer avec les participants, soit 3 à 5 correspondances et une lettre de préavis. Nous avons interrogé les médecins au sujet de patients ne présentant aucun trouble neurologique, mais présentant une céphalée. L'analyse comprenait des statistiques descriptives pour l'ensemble de l'échantillon ainsi qu'une stratification par pays.

**Résultats :** Le taux de réponse totale était de 54,7 % (1149 sur 2100). Les répondants étaient principalement des hommes (75,5 %), dont l'âge moyen était de 42,5 ans et le nombre

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moyen d'années d'expérience en médecine d'urgence était de 12,3. Parmi les répondants, 49,5 % étaient d'avis que tous les patients présentant une céphalée aiguë devraient faire l'objet d'un examen par TDM, et 57,4 % estimaient que la TDM devrait toujours être suivie d'une ponction lombaire. Quelque 95,7 % des répondants ont indiqué qu'ils songeraient à utiliser une règle de décision clinique pour les patients présentant une céphalée aiguë afin d'exclure une hémorragie sous-arachnoïdienne. Les répondants ont jugé que la sensibilité médiane nécessaire par une telle règle devrait être de 99 % (intervalle interquartile de 98 à 99 %).

Environ 1 médecin sur 5 a proposé que la sensibilité devrait être égale à 100 %.

**Conclusion :** Les médecins d'urgence ont signifié qu'ils aimeraient avoir recours à une règle de décision clinique en cas de céphalée aiguë qui permettrait de déterminer quels patients ont besoin de subir des tests coûteux ou effractifs pour exclure une hémorragie sous-arachnoïdienne. La sensibilité requise pour une telle règle était réaliste. Ces résultats permettront d'informer et d'inspirer l'élaboration, pour les services d'urgence, de règles de décision clinique en cas de céphalée aiguë.

## INTRODUCTION

Severe headache often poses a significant diagnostic challenge for emergency physicians.<sup>1</sup> It can be difficult to distinguish between patients with a serious headache who require costly and/or invasive diagnostic testing (i.e., computed tomography [CT] and/or lumbar puncture) versus those who require nothing more than analgesia. Although the cause of headache in most emergency department (ED) patients is benign, some harbour very serious medical problems that require prompt diagnosis and targeted interventions. Arguably the most serious of these conditions is a subarachnoid hemorrhage,<sup>2</sup> which accounts for only about 1% of headaches seen in the ED. However, emergency physicians spend a great deal of time and resources ruling out this potentially lethal or debilitating condition.<sup>1</sup> Currently, there are no validated clinical decision rules to assist in distinguishing a benign headache from a potentially life-threatening subarachnoid hemorrhage.

A clinical decision rule is an algorithmic decision-making tool that is derived from original research using strict methodological guidelines.<sup>3-5</sup> Based on 3 or more variables from the history, physical examination or simple tests, clinical decision rules can allow computation of a quantitative estimate of the probability of a certain clinical outcome, or can suggest a diagnostic or therapeutic intervention.<sup>3-5</sup> We conducted this survey as part of an ongoing feasibility study for the development of a clinical decision rule for acute headache to rule out subarachnoid hemorrhage.

Our study was an international survey of members of 4 national emergency medicine physician associations in 4 countries: Australia, Canada, the United Kingdom and the United States. We sought to determine what the ED current practice is for investigating acute headache patients, whether emergency physicians would consider

using a clinical decision rule for acute headache and what the required sensitivity of such a rule would be for subarachnoid hemorrhage. We anticipated that the results of this survey would determine whether a clinical decision rule for acute headache would be used by physicians to determine which headache patients require investigations and, if so, how sensitive such a rule should be for subarachnoid hemorrhage.

## METHODS

### *Study design and setting*

We conducted a self-administered electronic mail and postal mail survey of emergency physician members of the national emergency physician associations in Australia, Canada, the United Kingdom and the United States. We used the Dillman tailored design method for survey design and administration.<sup>6</sup> This study, coordinated by our clinical epidemiology program, was conducted between July 2005 and April 2006 and was approved by the Ottawa Hospital Research Ethics Board.

### *Selection of participants*

We approached all members of the Australasian College of Emergency Physicians (total membership  $n = 772$ ), a random sample of 500 members of the Canadian Association of Emergency Physicians (total membership  $n = 1675$ ), a random sample of 350 members of the British Association of Emergency Physicians (total membership  $n = 1700$ ) and a random sample of 500 members of the American College of Emergency Physicians (total membership  $n = 23\ 000$ ) to participate in our survey. The randomization was computer generated by each of the respective organizations. Members returning their surveys who reported that they were not physicians or

not currently practising emergency medicine were excluded from the analysis.

### **Survey content**

This study was part of a larger survey that contained questions pertaining to knowledge of, use of and attitudes toward cervical spine rules and head trauma rules, priorities for future clinical decision rules and physician demographics. Survey participants received a 5-page questionnaire consisting mainly of closed-ended questions. We developed the 1-page section on headache management and the need for clinical decision rules for acute headache, and we revised the section based on feedback from a pilot on approximately 60 emergency physicians at The Ottawa Hospital.

We gave participants the following script:

We are developing a decision rule for investigating alert, neurologically intact, adult patients with acute severe nontraumatic headache (i.e., Glasgow Coma Scale score of 15, headache peaks within 1 hour of onset and no direct head trauma in the previous 7 days). Currently, there are no clear recommendations to indicate which patients require investigations (i.e. computed tomography [CT] and/or lumbar puncture [LP]) to rule out subarachnoid hemorrhage.

We then asked participants to indicate their level of agreement with a series of questions regarding their current practice with respect to this patient group. A 6-point Likert scale (strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree and strongly agree) indicated the level of agreement. We asked participants if all such patients should have a CT scan of their head, if all such patients with a normal CT head should undergo lumbar puncture and if performing a lumbar puncture without first getting a CT head was a safe practice for these patients. We asked participants to indicate how frequently they manage such patients with CT and/or lumbar puncture (always, most of the time, sometimes or never). Finally, we asked participants 2 questions:

- 1) If a highly sensitive and well-validated decision rule was developed that would indicate the need for investigation in alert, neurologically intact patients with acute headache would you consider using this rule in your emergency department practice (yes/no)?
- 2) How sensitive would you require such a rule to be in identifying subarachnoid hemorrhage (given choices of < 85%, 85%–89% and whole number percentages from 90% to 100%)?

### **Survey administration**

All participants received a prenotification letter that described the study and requested their participation. One week later, we sent out correspondence containing the cover letter that described the study, assured confidentiality, provided instructions for completion of the survey and the survey instrument. A minimum of 2 reminder letters with surveys were sent to nonresponders at 4-week intervals. Because of restrictions of their respective associations, we contacted members practising in Australia and the United States by postal mail only. Members practising in Canada and the United Kingdom were sent the prenotification letter, cover letter and 2 reminder letters by email; a further 2 reminders were sent by postal mail. All postal surveys included postage-paid, preaddressed reply envelopes. No incentives were provided.

### **Data collection and processing**

We entered all data into an electronic database using single data entry with 3 levels of data review before saving the data in the database. Paper surveys were dropped off at the data centre, where data entry staff performed initial data entry into an electronic format in order to save the data as a PDF file. Data entry staff did an initial review before saving the file. We initiated a second manual review and then either submitted the electronic files to the Teleform Verifier tool (Version 9.1, Verity TeleForm), or flagged data checks that could not be resolved during the initial entry. Cases that were not resolved using these data entry procedures were flagged and discussed with the study coordinator. The flags were reviewed with the study coordinator, and when an answer to the flag was provided, corrections were made to the electronic data. This was the second manual review performed on the data. A third review was made using the Teleform Verifier tool, which provided the last view of the data before saving it to the underlying database. During the data entry process, we performed an audit of data quality on a random sample of 5% of cases; since no errors were found, we maintained the single data entry process for the duration of the study.

### **Analysis**

Our primary outcome measures were as follows: the percentage of physicians who would use a clinical

decision rule for acute headache patients, and the required sensitivity of such a rule for subarachnoid hemorrhage. Secondary outcomes included a variety of data collected to describe current practice.

We analyzed the data using SPSS version 13 (SPSS Inc.) and descriptive statistics. We generated frequency distributions for all closed-ended questions (each clinical priority and most physician demographic, professional and practice setting characteristics). We also stratified responses by country.

## RESULTS

Of the 2100 emergency physicians who were approached, 1149 responded to the survey, resulting in an

aggregate response rate of 54.7%. Country-specific response rates were as follows: Australia 54.0% (416/770), Canada 69.0% (339/491), the United Kingdom 44.5% (155/348) and the United States 48.7% (239/491). The numerator represents all returned surveys, and the denominator represents all surveys sent, less those returned because surveys were undeliverable (6 surveys) or subjects failed to meet inclusion criteria (16 surveys).

Participant demographic, professional and practice setting characteristics are summarized in Table 1. Of the respondents, 75.5% were male. Rates of full-time ED employment of participants varied from 51.7% in the United Kingdom to 87.2% in the United States. Of the respondents in the United States, 52.0% had

Characteristic	% of participants*				
	Australia, n = 416	Canada, n = 339	United Kingdom, n = 155	United States, n = 239	Overall, n = 1149
Mean (range) age, yr	41.5 (31–61)	41.6 (29–66)	42.2 (27–69)	45.9 (29–69)	42.5 (27–69)
Male sex	73.1	77.8	68.6	80.6	75.5
Full-time status in ED	82.3	75.1	51.7	87.2	77.1
Mean (range) years of practice	12.1 (0–35)	11.3 (1–41)	10.8 (1–30)	15.0 (0–32)	12.3 (0–41)
Practice setting					
Teaching hospital	91.3	74.2	90.7	48.5	77.4
Nonteaching hospital	8.7	25.8	9.3	51.5	22.6
CT scanner available					
24 h/d	92.5	79.6	98.6	99.1	90.9
During working hours	6.3	9.4	0.7	0.4	5.2
Annual ED visits					
≤ 50 000 visits	74.3	51.9	21.2	61.1	58.0

CT = computed tomography; ED = emergency department.  
\*Unless otherwise indicated.

Response	% of participants				
	Australia, n = 416	Canada, n = 339	United Kingdom, n = 155	United States, n = 239	Overall, n = 1149
Agree that all such patients should have CT head	49.3	46.2	47.2	56.1	49.5
Agree that if CT head is normal all such patients should have lumbar puncture	55.7	60.0	66.0	51.4	57.4
Agree that performing a lumbar puncture in such patients without first getting a CT is a safe practice	31.9	45.3	11.1	31.3	32.5
Manage these patients with CT and lumbar puncture always or most of the time	65.1	57.5	53.4	57.5	59.7
Would consider using a well-validated clinical decision rule for similar headache patients	94.1	97.0	94.6	97.3	95.7

CT = computed tomography.

more than 15 years of clinical experience compared with approximately one-third of respondents in the other study countries. Seventy-seven percent of respondents worked at a teaching hospital (Australia 91.3%, Canada 74.2%, United Kingdom 90.7%, United States 48.5%).

Results for the series of questions related to current management of alert, neurologically intact acute headache patients are shown in Table 2. Across the 4 countries, approximately one-half of respondents believed that all acute headache patients require a head CT scan. Slightly more than one-half of respondents believed that all patients require a subsequent lumbar puncture if the initial CT scan is normal. Although most physicians from all countries do not believe that it is safe practice to perform a lumbar puncture on these patients without first getting a CT scan, a sizable minority believe that it is sometimes safe to do so. The proportion of physicians who believe that it is safe to perform a lumbar puncture without a CT ranged from a high of 45.3% in Canada to a low of 11.1% in the United Kingdom. Despite stating that they did not believe that CT and/or lumbar puncture was always necessary, most respondents in all countries indicated that they would either “always” or “most of the time” investigate acute headache patients with a CT head and/or a lumbar puncture (the options were as follows: always, most of the time, sometimes and never). Of the respondents, 95.7% indicated that they would consider using a well-validated clinical decision rule in their ED care of patients with acute headache to determine the need for investigations to rule out subarachnoid hemorrhage.

Figure 1 demonstrates the sensitivity deemed to be required of any proposed clinical decision rule for identification of patients with acute headache who require investigation. Physicians in all countries required a highly sensitive rule for subarachnoid hemorrhage, with the physician in the United Kingdom willing to accept a slightly lower sensitivity than those in Australia, Canada and the United States. Overall, the median sensitivity deemed to be required for a clinical decision rule was 99% (interquartile range 98%–99%).

## DISCUSSION

Our survey confirms that emergency physicians would support a clinical decision rule to guide their use of costly and/or invasive testing to rule out subarachnoid hemorrhage in neurologically intact patients with acute

headache. The median sensitivity of 99% for subarachnoid hemorrhage deemed required for such a rule indicates that physicians were generally pragmatic, acknowledging that no rule can be absolutely perfect. However, almost 1 in 5 physicians stated that the rule needs to be 100% sensitive. Hence it is clear that a rule would need to be highly sensitive, approaching 100% to be used by physicians. Although no rule can be absolutely 100% sensitive, other clinical decision rules, such as the Canadian C-Spine Rule and Canadian CT Head Rule have over 99% sensitivity. Any headache rule would have to strive to have a similar sensitivity to be clinically acceptable.

Although emergency medicine textbooks indicate that all patients with a new acute headache must be investigated with CT of the head followed by lumbar puncture if the CT is normal, this is not consistent with current practice.<sup>7</sup> We found that about one-half of all physicians thought that all of these patients required a CT and just over one-half felt that if a CT head was normal, a lumbar puncture was always indicated. This response is consistent with actual clinical practice in Canadian centres, where a prospective multicentre cohort study of acute neurologically intact headache patients indicated 54.8% of such patients do not undergo lumbar puncture after normal a CT head.<sup>8</sup> Another retrospective study found that physicians performed CT in only 35% of acute headache emergency patients and only 9% had a lumbar puncture.<sup>9</sup> Part of this apparent discrepancy may lie in a different degree of concern for patients with instantaneous peaking headaches, versus headaches that take up to 1 hour to peak.

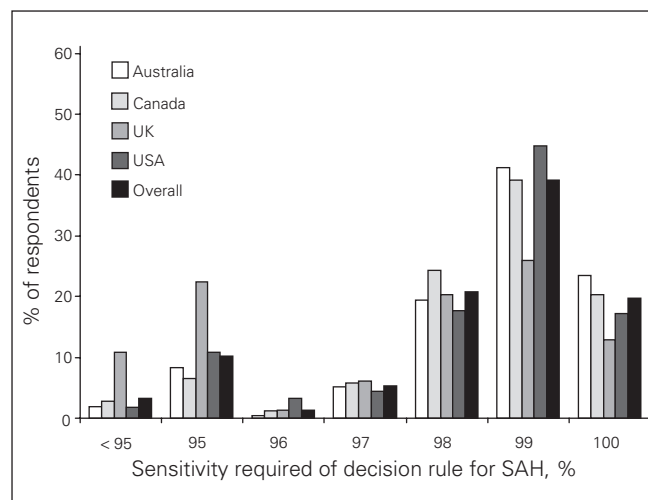


Fig. 1. Required sensitivity for clinical decision rule for acute headache from subarachnoid hemorrhage (SAH), stratified by country.

This survey was a large international study including 4 of the largest English-speaking countries in the world. These results indicate that emergency physicians are willing to consider using an evidence-derived clinical decision rule to selectively determine which patients require investigations for acute headache. It also confirms that physicians are willing to consider using new clinical decision rules, given that the vast majority reported that they would use a new clinical decision rule for acute headache, should a well-validated highly sensitive rule be developed.

### **Limitations**

This study has several potential limitations. Our target population was emergency physicians, as clinical decision rules are often used by these front-line caregivers. We chose to sample members of 4 national emergency medicine associations. Although poorly studied, it is likely that the memberships in emergency medicine associations are skewed toward physicians working in large urban teaching centres. This is reinforced by the substantial number of respondents from large teaching centres in all countries except the United States, which had a high proportion of respondents from nonteaching institutions. In Canada, it appears that up to 11% of the respondents were from smaller centres, as this is the number who reported not having a CT scanner in their centre. We have no information on how representative our samples are of all physicians practising in the EDs of these 4 countries. It is likely that emergency physicians working in the same environment, regardless of affiliation with their national association, would have similar priorities. However, there are likely to be differences in practice in urban versus rural centres where it is much more difficult to obtain CT scans. In order to respect the privacy and confidentiality of their members, the associations would not provide demographic information regarding nonrespondents, thus an analysis of response bias could not be completed. Attitudes of other professional groups involved in diagnosis or treatment of subarachnoid hemorrhage (e.g., neurosurgeons, radiologists and neurologists) may not be the same and this may challenge uptake of a proposed rule.

We surveyed only 4 of the predominantly English-speaking countries, as the practice and training in emergency medicine is well established within these countries. As well, the majority of clinical decision rules have been developed in English and the use of

these tools would be most familiar to an English-speaking audience. The results of this survey cannot necessarily be extrapolated to other geographic or cultural areas.

Although our response rate was less than the 80% sometimes deemed necessary in other realms of research, previous physician studies have shown the average response rate for published physician surveys is 52%–54%.<sup>10,11</sup> Although the response rates from the United Kingdom and the United States were slightly below this, our primary outcome measure was the overall ranking of clinical priorities and our overall response rate of 55% is slightly above average for physician surveys. It is impossible to determine what impact this still arguably low response rate would have on the results of the study.

An additional potential limitation of this study is the wording of our question. We stated that we were developing a clinical decision rule for acute headache. This could potentially alter the responses in participants impacted by a social desirability bias, as they could decide to agree with a clinical decision rule given that we are already working on one. We would not expect that this would bias the required sensitivity of the rule or the responses to any of the other survey questions.

### **CONCLUSION**

This large international study indicates that current emergency medicine practice in the evaluation of acute headache differs from the recommendations of textbooks. Practising physicians report that they would consider a clinical decision rule for headache that would indicate which patients require costly and/or invasive tests to rule out subarachnoid hemorrhage. The required sensitivity of such a rule was generally realistic with 4 out of 5 physicians indicating that an acceptable final rule could be less than 100% sensitive for subarachnoid hemorrhage. These results will inform and inspire the development of a clinical decision rules for acute headache in ED patients.

**Competing interests:** None declared.

### **REFERENCES**

1. Ramirez-Lassepas M, Espinosa CE, Cicero JJ, et al. Predictors of intracranial pathologic findings in patients who seek emergency care because of headache. *Arch Neurol* 1997;54: 1506-9.
2. Latchaw RE, Silva P, Falcone SF. The role of CT following

- aneurysmal rupture. *Neuroimaging Clin N Am* 1997;7:693-708.
3. Laupacis A, Sekar N, Stiell IG. Clinical prediction rules: a review and suggested modifications of methodological standards. *JAMA* 1997;277:488-94.
  4. Stiell IG, Wells GA. Methodologic standards for the development of clinical decision rules in emergency medicine. *Ann Emerg Med* 1999;33:437-47.
  5. Wasson JH, Sox HC, Neff RK, et al. Clinical prediction rules: applications and methodological standards. *N Engl J Med* 1985;313:793-9.
  6. Dillman D. *Mail and internet surveys: the tailored design method*. New York (NY): Wiley; 2000.
  7. Denny CJ, Schull MJ. Headache and facial pain. In Tintinalli JE, Kelen GD, Stapczynski JS, editors. *Emergency medicine: a comprehensive study guide*. Whitby (ON): McGraw-Hill; 2004. p. 1375-82.
  8. Perry JJ, Sivilotti ML, Stiell IG, et al. Should spectrophotometry be used to identify xanthochromia in the cerebrospinal fluid of alert patients suspected of having subarachnoid hemorrhage? *Stroke* 2006;37:2467-72.
  9. Perry JJ, Stiell IG, Wells GA, et al. Historical cohort study "use and yield of investigations for alert patients with possible subarachnoid hemorrhage." *CJEM* 2002;4:333-7.
  10. Cummings SM, Savitz LA, Konrad TR. Reported response rates to mailed physician questionnaires. *Health Serv Res* 2001;35:1347-55.
  11. Asch DA, Jedrzewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol* 1997;10:1129-36.
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