Factors Associated With Short-Term Bounce-Back Admissions After Emergency Department Discharge

Gabayan GZ, Asch SM, Hsia RY, et al.
Ann Emerg Med. 2013;62(2):136-144.e1.

報告者: R1鄭凱文
指導者: VS 吳柏衡

102.10.14

Introduction

- bounce-back admissions
- → missed diagnoses of serious illness
- → incomplete ED care
- → insufficient outpatient f/u after discharge

About This Study

- 1st large-scale analysis
- US p'ts admitted shortly after MBD from ED
- hospital & patient characteristics

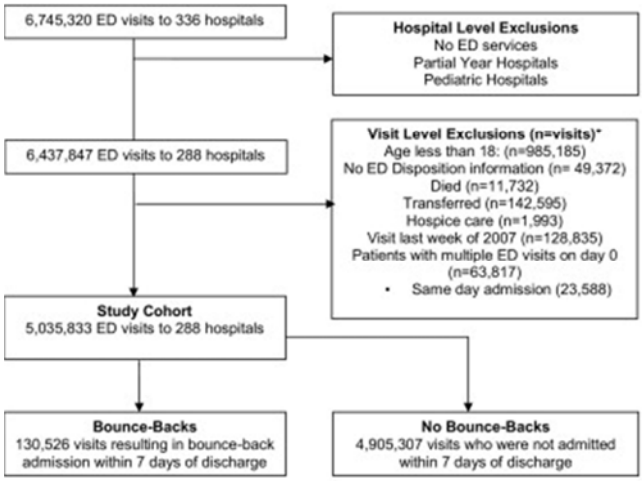
Goal of This Investigation

- 7-day bounce-back admissions after ED discharge in a cohort of California hospitals
  - Prevalence ?
  - Characteristics ?
  - predictors ?

- data from OSHPD
  (Office of Statewide Health Planning and Development)
- study protocol was reviewed & approved by
  - California Committee for Protection of Human Subjects
  - institutional review board of the University of California at Los Angeles

Method

- retrospective cohort study
- In 2007; in California
- general, acute, nonfederal hospitals
- ≥18y/o; discharged from ED
- Bounce-back admission to an inpatient bed within 7 days of the ED visit



統計方法

- continuous variables:
  → assess individual predictors with **hospital-level random effects**
- categorical variables:
  → the **Cochran-Mantel-Haenzel test** stratified by hospital
- Outcome:
  → modeled with **hierarchic logistic regression**, with ED visits clustered within hospitals;
  → all models included a **hospital random effect**
- other candidate predictors → modeled as **fixed effects**
- The unit of analysis was at the patient visit level

- reference group
  - <40y/o
  - 白人♀
  - Weekday
  - no AAD/elope
  - “other” payment
  - ED Dx category=“asthma”
  - not-for-profit、nonteaching、nontrauma center

- odds ratios＆95% confidence intervals
- Data analyses were performed with
  - SAS (version 9.2; SAS Institute, Inc., Cary, NC)
  - R software (Vienna, Austria).

Result

- mean age of the patients
- admitted w/i 7 days: 53.6±20.0yrs
- nonadmitted group: 45.1±19.0yrs

The most common discharge Dx

- other injuries (12.8% → 1.2%)
  - burns, wounds, and superficial injuries
- sprains, fractures, and joint disorders (9.0% → 1.2%)
- diseases of the musculoskeletal system (8.5% → 2.1%)

Table 1. Characteristics of the study cohort.

Hospital Characteristic	Facilities (n=287)	Total Visits (%) (n=5,035,833)	Admitted Within 7 Days (%) (n=130,526)	Not Admitted Within 7 Days (%) (n=4,905,307)
Ownership				
Not for profit	207	3,812,303 (75.7)	97,293 (74.5)	3,715,010 (75.7)
For profit	63	778,792 (15.5)	20,370 (15.6)	758,422 (15.5)
County	17	444,738 (8.8)	12,863 (9.9)	431,875 (8.8)
Trauma center	42	1,132,874 (22.5)	32,127 (24.6)	1,100,747 (22.4)
Teaching	22	532,252 (10.6)	16,603 (12.7)	515,649 (10.5)
Medical-surgical hospital beds				
<100	108	1,171,500 (23.3)	27,017 (20.7)	1,144,483 (23.3)
≥100	179	3,864,333 (76.8)	103,509 (79.3)	3,760,824 (76.7)
Patient characteristics				
Age, mean (SD), y		45.3 (19.1)	53.6 (20.0)	45.1 (19.0)
≥80		343,639 (6.8)	17,886 (13.7)	325,753 (6.6)
60–79		776,584 (15.4)	30,916 (23.7)	745,668 (15.2)
40–59		1,720,478 (34.2)	46,928 (36.0)	1,673,550 (34.1)
18–39		2,195,132 (43.6)	34,796 (26.7)	2,160,336 (44.0)
Male		2,144,051 (42.6)	58,944 (45.2)	2,085,107 (42.5)
Race/ethnicity*				
White		2,613,852 (51.9)	74,089 (56.8)	2,539,763 (51.8)
Black		602,999 (12.0)	16,229 (12.4)	586,770 (12.0)
Hispanic		1,212,368 (24.1)	27,676 (21.2)	1,184,692 (24.2)
Asian		238,768 (4.7)	5,891 (4.5)	232,877 (4.8)
American Indian		19,029 (0.4)	488 (0.4)	18,541 (0.4)
Other		348,817 (6.9)	6,153 (4.7)	342,664 (7.0)
Day of week of service				
Weekday		3,584,350 (71.2)	93,711 (71.8)	3,490,639 (71.2)
Weekend		1,451,483 (28.8)	36,815 (28.2)	1,414,668 (28.8)
AMA/eloped		113,811 (2.3)	5,564 (4.3)	108,247 (2.2)
Expected source of payment†				
Self-pay		884,675 (17.6)	15,664 (12.0)	869,011 (17.7)
Medicaid		889,550 (17.7)	25,341 (19.4)	864,209 (17.6)
Medicare		750,342 (14.9)	35,495 (27.2)	714,847 (14.6)
All others		2,511,266 (49.9)	54,026 (41.4)	2,457,240 (50.1)

AMA, Against medical advice.
*The race variable had 3.2% missing information that was included as "other."
†The source of payment variable had 0.04% missing information that was included as "other."

the highest proportions of bounce-back admissions

- renal disease (0.05% → 12.2% raw admission rate)
  - CRD (0.03% → 12.7%)
  - ESRD (0.02% → 11.5%)
- congestive heart failure (0.3% → 10.6%)
- diseases of the blood (0.3% → 8.0%)

3. Top 3 admission diagnoses for bounce-back admissions (16 most common ED discharge diagnoses shown).

ischarge oses	N=130,526	Most Common Subsequent Inpatient Diagnosis*	No. (%)	Second Most Common Subsequent Inpatient Diagnosis*	No. (%)	Third Most Common Subsequent Inpatient Diagnosis*	N
stem diseases	11,832	GI system diseases	6,470 (54.7)	Mental illness	657 (5.6)	Other infectious and parasitic diseases	438
al illness	11,532	Mental illness	8,946 (77.6)	GI system diseases	419 (3.6)	Other injuries	266
toms: abdominal n	10,578	GI system diseases	4,722 (44.7)	Symptoms: abdominal pain	837 (7.9)	Mental illness	592
ses of the sculoskeletal tem, skin, and nnective tissue	8,857	Diseases of the musculoskeletal system, skin, and connective tissue	1,725 (19.5)	Mental illness	1,019 (11.5)	Other infectious and parasitic diseases	636
injuries	7,747	Mental illness	1,816 (23.4)	Other injuries	704 (9.1)	Skin and subcutaneous infections	576
toms: other nptoms, signs, ill-defined ditions	6,241	GI system diseases	1,046 (16.8)	Other infectious and parasitic diseases	576 (9.2)	Mental illness	413
residual codes	5,818	Mental illness	1,268 (21.8)	Other respiratory disease	542 (9.3)	Skin and subcutaneous infections	412
injuries	5,326	Minor injuries	2,087 (39.2)	Mental illness	447 (8.4)	Diseases of the musculoskeletal system, skin, and connective tissue	323
and subcutaneous ctions	5,060	Skin and subcutaneous infections	3,158 (62.4)	Other infectious and parasitic diseases	241 (4.8)	Diseases of the musculoskeletal system, skin, and connective tissue	222
renal and GU eases	5,060	Other renal and GU diseases	2,173 (42.9)	GI system diseases	383 (7.6)	Urinary tract infection	313
us system orders	4,918	Nervous system disorders	1,158 (23.6)	Mental illness	803 (16.3)	GI system diseases	325
toms: chest pain	4,657	Symptoms: chest pain	982 (21.1)	Ischemic heart disease	649 (13.9)	Mental illness	510
ry tract infection	3,912	Urinary tract infection	1,073 (27.4)	GI system diseases	441 (11.3)	Other infectious and parasitic diseases	421
ancy and ldbirth-related orders	3,872	Pregnancy and childbirth-related disorders	3,629 (93.7)	Mental illness	58 (1.5)	GI system diseases	54
respiratory ease	3,740	Other respiratory disease	439 (11.7)	Congestive heart failure	339 (9.1)	Pneumonia	261
toms: headache	3,014	Symptoms: headache	486 (16.1)	Mental illness	406 (13.5)	Other infectious and parasitic diseases	294

- Dx: ED ≅ subsequent bounce-back admission
- mental illness was otherwise prevalent (後者)

OR (95% CI) & Predicted Probability (%)

- increasing age (strongly associated with bounce-back admissions)

Age (ref=18–39 y)		1.97
≥80	2.82 (2.76–2.9)†	5.36
60–79	2.18 (2.10–2.22)†	4.19
40–59	1.64 (1.61–1.70)†	3.19

OR (95% CI) & Predicted Probability (%)

AMA/eloped (ref=non-AMA/eloped)	1.9 (1.89–2.00)†	3.75
Expected source of payment (ref=other)		
Self-pay	0.85 (0.83–0.86)†	1.67
Medicaid	1.42 (1.40–1.45)†	2.78
Medicare	1.53 (1.50–1.55)†	2.97

- hospital characteristics

For profit	1.2 (1.1–1.3)†	2.12
Teaching hospital	1.2 (1.0–1.3)§	2.27

OR (95% CI) & Predicted Probability (%)

top 6 primary discharge Dx associated with a bounce-back admission

Index ED visit discharge diagnosis (ref=asthma)		
Chronic renal disease	3.3 (2.8–3.8)†	6.18
End-stage renal disease	2.9 (2.4–3.6)†	5.57
Congestive heart failure	2.5 (2.3–2.6)†	4.69
Diseases of the blood	2.4 (2.2–2.6)†	4.58
Neoplasms	2.2 (2.0–2.4)†	4.24
Mental illness	2.0 (1.9–2.2)†	3.94

小結

- P'ts with a greater chance of returning & being admitted were
- Older (4~5%)
- AAD/eloped (~4%)
- received a Dx of renal disease (~6%)

Limitations

- findings cannot be generalized to the entire US population
- OSHPD ED files lack data about preexisting comorbidities or visit acuity level
- 排除太多人 → 低估bounce-back admission rate

Discussion

- For older p'ts who are less able to care for themselves
  - their ability to recover
  - their support mechanisms

For vulnerable p'ts

- a key component of the ED evaluation
- → assessment of their access to care both before & after the ED visit

- When encountering a p't who may leave before completion of the ED visit, providers should **attempt to prevent the patient from leaving**.

- Original sin of for-profit and teaching hospital

CRD/ESRD, CHF & Blood disease

- chronic conditions that often require regular encounters
- a limitation of appropriate follow-up care after the ED visit ?

CRD/ESRD

- conditions that may seem stable but in reality harbor more devastating disease processes

P'ts w/ mental illness

- substance abuse, psychosis, dementia & developmental delay
- Misdiagnosis↑
  - errors in communication & estimation of risk
  - lack of the ability to receive proper f/u

findings suggest that quality improvement efforts focus on

- high-risk individuals
  - the **old**
  - patients with **renal disease**
- disposition plan of patients include consideration of **vulnerable individuals**

High risk clinical characteristics for subarachnoid haemorrhage in patients with acute headache: prospective cohort study

Perry JJ, Stiell IG, Sivilotti ML, et al.

BMJ. 2010;341(oct28 1):c5204.

Introduction

- Headache
  - ~ 2% of all ED visits
  - SAH → 1~3% of headache
- neurologically intact p'ts present with headache alone
  - account for up to half of all patients with SAH

Non-contrast CT + lumbar puncture

- Inefficient in alert p'ts w/ non-traumatic headache
- CT
  - costs↑
  - Radiation →risk of cancer↑
  - > 95% of scans to r/o SAH → (-)
- Lumbar puncture
  - Painful
  - Might result in worse headache than the original

Goal

- assess clinical characteristics of p'ts in ED
  - neurologically intact
  - headache peaking w/i 1hr
- to determine predictive variables for SAH

Study design

- @ 6 university affiliated tertiary care teaching hospitals in Canada
- prospective multicentre cohort study
- Nov. 2000 ~ Nov. 2005

Study population

- p'ts ≥16y/o & GCS=15
- Presented to ED with a chief complaint of
  - non-traumatic headache peaking w/i 1hr
  - syncope associated with a headache

exclusion

- history of ≧ 3 recurrent headaches of the same character and intensity as the presenting headache over 6m
- referred from other centers w/ a confirmed SAH
- papilloedema (determined by treating physician)
- new focal neurological deficits
- previous Dx of hydrocephalus, cerebral aneurysm, SAH, or brain neoplasm

Data collection

- Emergency physicians completed data forms to identify the presence or absence of 33 clinical findings in consecutive eligible patients.
- assessment by two physician independantly if feasible
- telephone f/u at 1 & 6 months when necessary

Outcome measures

- SAH
  - subarachnoid blood on non-contrast brain CT
  - with an aneurysm or arteriovenous malformation evident on cerebral angiography
  - RBC (>5 × 10^{6}/L) in the fina
  - xanthochromia in CSF

P'ts discharged w/o CT & lumbar puncture

- reviewed medical records (both enrolled and missed eligible patients)
- telephone interview @ 1 & 6m

Data analysis

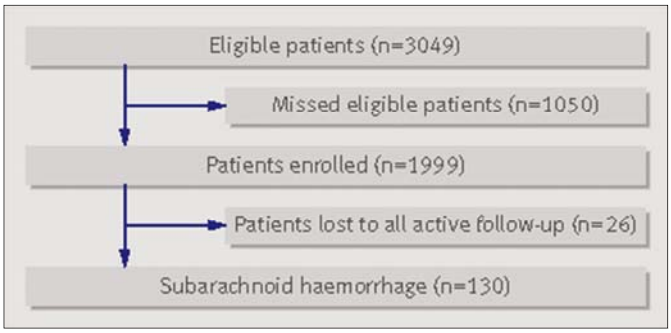
- Univariate analyses determined the strength of the association between each of 26 possible predictor variables and the outcome variable
- Pearson's χ^2 or Fisher's exact test for nominal variables
- unpaired two tailed t test for continuous variables

- further explored variables of potential interest (on statistical or clinical basis)
- ensure the final model didn't contain continuous variables
- → clinicians could categorise patients w/o performing any calculations
- interobserver agreement for each variable
  - κ coefficient
  - Spearman's interclass coefficient

develope multivariate models to predict SAH

- Variables associated at an α <0.20
  → χ^2 recursive partitioning analysis
- KnowledgeSEEKER 6.0 software
- Variables
  - with good interobserver reliability (κ >0.6)
  - made clinical sense
    could be easily incorporated into clinical practice

Result



missed eligible p'ts (1050)

- mean age 44.0y/o
- ♀ 59.9%
- arrived by ambulance 22.9%
- Fewer CT 73.0%
- Fewer lumbar puncture 36.7%
- Fewer SAH 2.7%
- telephone f/u confirmed the absence of subsequent SAH in all patients contacted
  - @ 1month → 87.5%
  - @ 6month → 80.6%

Enrolled p'ts (1999)

- relatively young (43.4±17.1y/o)
- ♀ > 50%
- worst headache of life > 75%
- mean time from onset to peak ~9mins

- ~1/3 neck pain
- ~1/3 vomiting

- brain CT and/or lumbar puncture
- → 1657 p'ts (82.9%)
- Most were diagnosed with benign headaches
- (1521, 81.4%)

- CT/lumbar puncture in 48 p'ts
- → other serious illnesses

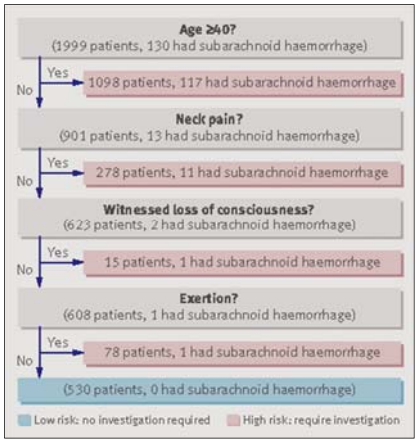
- 9 cases of SAH weren't identified by the radiologist's final interpretation of CT
  - 7 xanthochromia
  - 2 had RBC in CSF with cerebral angiography (+)

103 p'ts who had two independent physician assessments

- substantial interobserver agreement
  - being awoken by headache
  - transient loss of consciousness
  - Vomiting
  - complaint of neck stiffness or pain
  - onset with exertion
  - *peak pain intensity*

- Poor Interobserver agreement
  - the worst headache of life
  - needing to rest
  - *time from onset to peak of headache*

Example of recursive partitioning analysis



Variables included in each of three proposed rules

For each rule, patients should be investigated if one or more of the variables are present

Rule 1
- Age >40
- Complaint of neck pain or stiffness
- Witnessed loss of consciousness
- Onset with exertion

Rule 2
- Arrival by ambulance
- Age >45
- Vomiting at least once
- Diastolic blood pressure >100 mm Hg

Rule 3
- Arrival by ambulance
- Systolic blood pressure >160 mm Hg
- Complaint of neck pain or stiffness
- Age 45-55

Table 3 | Classification of performance of rules to identify patients who require further investigation for subarachnoid haemorrhage

	Subarachnoid haemorrhage		Sensitivity (95% CI)	Specificity (95% CI)	Negative predictive value	Investigation rate
	Yes	No				
Rule 1*						
High risk	130	1339	100% (97.1% to 100.0%)	28.4% (26.4% to 30.4%)	100% (99% to 100%)	73.5%
Low risk	0	530				
Rule 2†						
High risk	130	1186	100% (97.1% to 100.0%)	36.5% (34.4% to 38.8%)	100% (99% to 100%)	65.8%
Low risk	0	683				
Rule 3‡						
High risk	130	1143	100% (97.1% to 100.0%)	38.8% (36.7% to 41.1%)	100% (99% to 100%)	63.7%
Low risk	0	726				

*Age ≥40, complaint of neck stiffness or pain, witnessed loss of consciousness, onset of pain during exertion.
†Arrival by ambulance, age ≥45, vomiting, diastolic blood pressure ≥100 mm Hg.
‡Arrival by ambulance, systolic blood pressure ≥160 mm Hg, complaint of neck stiffness or pain, age 45-55.

Discussion

- Variables strongly and reliably associated with SAH
  - Arrival by ambulance
  - Age ≥40
  - complaint of neck stiffness or pain
  - onset with exertion
  - Vomiting
  - witnessed loss of consciousness
  - raised BP

- More selective testing can also shorten length of stay in an overcrowded ED
  - CT → + 3hrs
  - Lumbar puncture → + 4hrs
    - Can J Emerg Med2002;4:333-7.

- variables proposed by other studies
  - ♀>50y/o、♂< 50y/o、stressful events
  - Drinking, smoking, HTN and oral contraceptives
- prevalent among many patients in ED
- might not be clinically useful for differentiating SAH from other headaches.

Uncommon connective tissue disorders can lead to SAH

- Ehlers-Danlos syndrome type IV
- ADPKD autosomal dominant polycystic kidney disease
- Marfan's syndrome, can lead to subarachnoid haemorrhage

- Why keep one model w/o the ambulance variable for additional study？
- Given the heterogeneity of headache, it would be impractical to generate one clinical decision rule for all causes.

- rules should not be applied to p'ts with chronic recurrent headaches

Clinical implications

- considered carefully for SAH if
  - Age ≥40
  - witnessed loss of consciousness
  - complaint of neck pain or stiffness
  - onset with exertion
  - arrival by ambulance
  - Vomiting
  - diastolic BP ≥100 mmHg
  - systolic BP ≥160 mm Hg

Clinical decision rules to rule out subarachnoid hemorrhage for acute headache.

Perry JJ, Stiell IG, Sivilotti ML, et al.

JAMA. 2013;310(12):1248-55.

Introduction

- Headache
  - ~ 2% of all ED visits
  - SAH → 1~3% of headache
- diagnostic dilemma
- → 50% SAH is on p'ts with headache alone
- 5.4% SAH were missed during initial ED assessment
  - Stroke. 2007;38(4):1216-1221.

3 rules, each have 4 variables

Box 1. Variables Included in Each of the 3 Proposed Rules

Rule 1
Investigate if ≥1 high-risk findings present:
1. Age ≥40 y
2. Neck pain or stiffness
3. Witnessed loss of consciousness
4. Onset during exertion

Rule 2
Investigate if ≥1 high-risk findings present:
1. Age ≥45 y
2. Arrival by ambulance
3. Vomiting (≥1 episodes)
4. Diastolic blood pressure ≥100 mm Hg

Rule 3
Investigate if ≥1 high-risk findings present:
1. Age 45-55 y
2. Neck pain or stiffness
3. Arrival by ambulance
4. Systolic blood pressure ≥160 mm Hg

Method

- prospective multicenter cohort study
- ED of 10 university-affiliated urban Canadian tertiary care teaching hospitals
- April 2006~July 2010

enrollment

- p'ts ≥16y/o & GCS=15
- Presented to ED with a chief complaint of
- non-traumatic headache peaking w/i 1hr
- no fall or direct head trauma in previous 7 days
- presented w/i 14 days of headache onset

ineligibility

- established recurrent headache syndromes
- referred from other centers w/ a confirmed SAH
- papilloedema (determined by treating physician)
- new focal neurological deficits
- previous Dx of hydrocephalus, cerebral aneurysm, SAH, or brain neoplasm

- The research ethics board
- → no need for written consent

Assessment

- record 19 clinical findings on data forms before ordering CT or CSF analysis
- Sensibility
- (1) Are investigations indicated for this p't according to the decision rule? (Yes/No)
- (2) How comfortable would you be in actually using the rule for this p't? (5-point scale)

- assessment by two physician independantly if feasible
- telephone f/u at 1 & 6 months when necessary

Outcome measures

- SAH
  - subarachnoid blood on non-contrast brain CT
  - with an aneurysm or arteriovenous malformation evident on cerebral angiography
  - RBC (>1×10^{6}/L) in the final sample of CSF
  - xanthochromia in CSF

- Physicians were instructed not to alter their practice according to the proposed rules.
- Proxy Outcome Assessment Tool

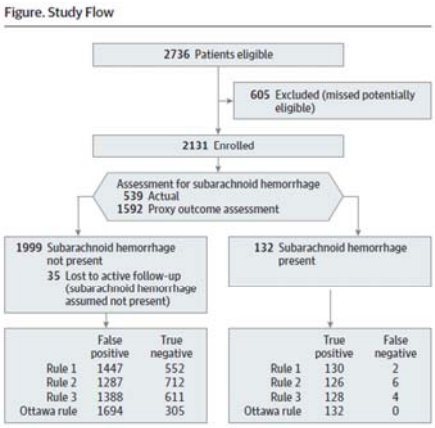
Statistical Analysis

- Interobserver agreement → κ coefficient
- Univariate analysis
  - continuous variables → 2-sided t test
- categorical variables → Pearson χ^{2} test
- Potential refinement of the rules
  → multivariate recursive partitioning analysis

- post hoc bootstrapping analysis
- → derivation cohort on 2010

- SAS version 9.2

Result



enrolled

- mean age 44.1y/o
- Women 1290 [60.5%]
- arrived by ambulance 559 [26.2%]
- CT scan obtained 1767 [82.9%]
- lumbar puncture performed, 833 [39.1%]
- subarachnoid hemorrhage, 132 [6.2%]

missed potentially eligible patients

- mean age 46.0y/o
- Women 345 [57.0%]
- arrived by ambulance 173 [28.6%]
- CT scan obtained, 503 [83.1%]
- lumbar puncture performed, 227 [37.5%]
- subarachnoid hemorrhage, 33 [5.5%]

univariate & κ analysis

- Patients with subarachnoid hemorrhage were
  - Older
  - had more rapid peaking headaches
  - onset during exertion
  - loss of consciousness
  - neck pain or stiffness
  - Vomiting
  - more frequently arrived by ambulance
  - the worst headache of their lives
  - (commonly reported in benign headaches)

Ottawa SAH Rule

- recursive partitioning analysis to refine the existing rules
  - rule 1
  - thunderclap headache
    - instantly peaking pain
  - limited neck flexion on examination
    - inability to touch chin to chest or raise the head 8 cm off the bed if supine

Table 3. Sensitivity, Specificity, and Negative Predictive Value of the Original Derived Rules and the Ottawa SAH Rule for Subarachnoid Hemorrhage

Result of Assessment	Rule			
	1	2	3	Ottawa SAH
Positive, No.				
SAH	130	126	128	132
No SAH	1447	1287	1388	1694
Negative, No.				
SAH	2	6	4	0
No SAH	552	712	611	305
Sensitivity, %	98.5 (94.6-99.6)	95.5 (90.4-97.9)	97.0 (92.5-98.8)	100.0 (97.2-100.0)
Specificity, %	27.6 (25.7-29.6)	30.6 (28.6-32.6)	35.6 (33.6-37.7)	15.3 (13.8-16.9)
Negative predictive value, %	99.6	99.0	99.4	100.0
Interobserver agreement, κ (95% CI)	0.86 (0.70-1.0)	0.96 (0.89-1.0)	0.79 (0.62-0.96)	
Likelihood ratio (95% CI)				
Positive	1.36 (1.31-1.40)	1.48 (1.41-1.55)	1.39 (1.33-1.45)	1.17 (1.15-1.20)
Negative	0.054 (0.013-0.21)	0.127 (0.058-0.27)	0.099 (0.037-0.26)	0.024 (0.001-0.39)

bootstrap analysis for Ottawa SAH Rule

- using the previous phase 1 derivation data set
  - sensitivity 100% (95% CI, 100%-100%)
  - specificity 20.6% (95% CI, 20.5%-20.6%)
- combined cohort (N=1999+2131)
  - sensitivity 100% (95% CI, 98.6%-100%)
  - specificity 17.8% (95% CI, 16.6%-19.1%)

potential influence on clinical practice

- baseline rate of investigation → 84.3%
- Rule 1 → 74.0%
- Rule 2 → 71.0%
- Rule 3 → 66.4%
- Ottawa SAH Rule → 85.7%

Sensitivity↑

- the trade-off is
  - loss of specificity
  - testing ↑
  - associated costs ↑
- Ottawa SAH Rule does not lead to a reduction of testing

Discussion

- it is impractical to generate a single clinical decision rule for all causes of headache

- **physicians may overlook exclusion criteria**
- Headaches different from the patient's usual headache pattern
- → represent a different etiology
- → need investigation

- Additional study could assess the relative benefits in rural vs urban settings.
- The Ottawa SAH Rule may help to standardize which patients with acute headache require investigations.

Box 2. The Ottawa SAH Rule

For alert patients older than 15 y with new severe nontraumatic headache reaching maximum intensity within 1 h

Not for patients with new neurologic deficits, previous aneurysms, SAH, brain tumors, or history of recurrent headaches (≥3 episodes over the course of ≥6 mo)

Investigate if ≥1 high-risk variables present:

1. Age ≥40 y
2. Neck pain or stiffness
3. Witnessed loss of consciousness
4. Onset during exertion
5. Thunderclap headache (instantly peaking pain)
6. Limited neck flexion on examination

SAH indicates subarachnoid hemorrhage.