Basics of Clinical Prediction Rules

- Criteria for making specific clinical decision
  - Give or withhold treatment
  - Perform diagnostic test or not
  - Admit to hospital or not
- Useful for low probability/high risk events
- Sensitivity/NPV
- Derivation cohort
- Validation cohort

What's the point?

- Identify high risk groups
- Avoid harm of intervention
- Avoid missing serious conditions
- Save time and money
  - Patient
  - Clinician

Limitations

- Does this apply to my patients?
  - Age
  - Sex
  - Ethnicity
- What risks are acceptable?
  - For the patient?
  - For me?
- Inclusion/Exclusion criteria
- Extenuating circumstances

Case 1

35 year old Hispanic male slipped on some ice on a sidewalk and lost his balance falling backward and hitting his head as he fell. He had a witnessed 15-20 second loss of consciousness. His family brings him in for evaluation and other than a mild headache he feels OK. He remembers all of the events. He is otherwise healthy and has a normal exam except for tenderness in the area of impact.

What Imaging Is Most Appropriate?

1. Skull X-rays
2. CT of head
3. Skull x-rays with CT of head if fracture seen
4. No imaging

Risk Factors	Canadian CT Head Rule	New Orleans Criteria
Vomiting	≥ 2 episodes	Any
Age	≥ 65 years	≥ 60 years
Anterograde amnesia	> 30 minutes before impact	Any
Signs of trauma	Sign of basal skull fracture Suspected open or depressed skull fracture	Trauma above the clavicle
GCS score < 15	2 hours after injury	Arrival at ED
Dangerous mechanism	+	
Drug or alcohol intoxication	*	+
Seizure		+
Headache		+

Stiell IG et al. Lancet 2001
Haydel MJ et al. NEJM 2000

Clinical Perspective

- 2/3 of head trauma is minor
- < 10% of minor trauma have + CT
- < 1% require neurosurgical procedure
- Excludes patients with coagulopathy

	Canadian Rule	New Orleans Criteria
Sensitivity	99%-100%	100%
Specificity	37%-48%	4%-31%
Age range	≥ 16 years	≥ 3 years

Stiell IG et al. Lancet 2001
Haydel MJ et al. NEJM 2000

PECARN Low-Risk Criteria

Children < 2 years	Children 2-18 years
Normal mental status	Normal mental status
No scalp hematoma or only frontal scalp hematoma	no vomiting
Loss of consciousness 0-5 seconds	No loss of consciousness
Non- severe injury mechanism	Non- severe injury mechanism
No palpable skull fracture	No signs of basilar skull fracture
Acting normally according to parents	No severe headache
Sensitivity 100%	Sensitivity 96.8%
NPV 100%	NPV 99.95%

Kuppermann N et al. Lancet 2009

Case 2

47 y.o. WF with history of HTN controlled on lisinopril/HCTZ was involved in an MVA 3 hours ago. She was driving about 35 mph and had to stop short and was rear-ended. She reports her head going forward and snapping back against the headrest. She did not hit her head against anything else. She walks in now because of neck pain that started an hour ago.

Case 2 (cont.)

There is no evidence of head trauma. Her neck is mildly tender with palpation of the right trapezius and she has some mild midline tenderness as well. She has no paresthesias in her extremities or any other focal neurologic deficits

What should be your next step in this assessment?

1. Ask the patient to try to turn her neck and assess her ROM
2. Obtain cervical spine x-rays
3. Obtain cervical spine CT

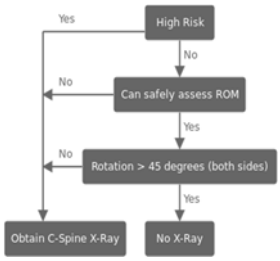
Canadian C-spine Rule

- Used to determine need for imaging in patients with blunt trauma to head or neck
- Use only for alert, stable patients
- Algorithm assessment
  - o High-risk patients – obtain c-spine x-ray
  - o If ROM cannot safely be assessed – obtain x-ray
  - o Otherwise assess neck ROM

Stiell IG et al. JAMA 2001

Canadian C-Spine Algorithm

- Used to determine need for imaging in patients with blunt trauma to head or neck
- Use only for alert, stable patients



Stiell IG et al. JAMA 2001

Canadian C-spine Rule

- High risk findings
  - age > 65 years
  - paresthesias in extremities
  - dangerous mechanism of injury
    - fall > 1 meter (3.3 feet) or > 5 stairs
    - axial load to head (e.g. diving)
    - motor vehicle collision with high speed (> 100 km/hour [62 miles/hour]), rollover, or ejection
    - motorized recreational vehicles
    - bicycle collision

Stiell IG et al. JAMA 2001

Safe ROM Assessment

- Low risk if any of the following present:
  - Simple rear-end motor vehicle collision (excluding any high-risk factors or impact by bus or large truck)
  - Sitting position in emergency department
  - Ambulatory at any time since injury
  - Delayed onset of neck pain
  - Absence of midline cervical spine tenderness
- If low risk: assess ROM
- If no low risk features present: x-ray c-spine

Stiell IG et al. JAMA 2001

Case 3

- 73 y.o. BF comes in with productive cough for 2 days, fever, chills, and fatigue. She has Type 2 DM and HTN both controlled with medication. No hemoptysis, vomiting, diarrhea, or chest pain.
- VS = Temp of 98.8, pulse 110, RR 18, BP 150/84 and pulse ox 94%.
- CXR shows RLL pneumonia
- Abnormal Labs: BUN 32, creatinine 1.4, glucose 270, sodium 132

Which of the following would be your next step?

- Initiate oral antibiotics and treat as an outpatient with azithromycin for 5 days or doxycycline for 7 days.
- Give 2 grams ceftriaxone IV, followed by outpatient therapy with oral levofloxacin 500 mg for 7 days
- Admit to the hospital for treatment of her pneumonia

Pneumonia severity index (PSI) Risk Class I

- Age < 50 years
- No history of
  - Neoplastic disease
  - Heart failure
  - Cerebrovascular disease, renal disease or liver disease
- Normal mental status
- SBP ≥ 90 mm Hg, Pulse < 125, RR< 30, and 95 ≤ Temp < 104 degrees

Fine MJ et al.NEJM 1997

PSI Score

Patient's age (in years) (-10 for females)	
+10 points	Nursing home resident Heart failure, cerebrovascular disease, renal disease Pulse ≥ 125 per minute, PaO_2 < 60 mm Hg (O_2 saturation < 90%) Glucose ≥ 250 mg/dL, hematocrit < 30%, Pleural effusion
+15 points	Temp ≥ 104.0 or < 95.0 degrees
+20 points	Liver disease Altered mental status RR ≥ 30 per minute, SBP < 90 mm Hg BUN ≥ 30 mg/dL, sodium < 130 mmol/L
+30 points	Neoplastic disease Arterial pH < 7.35

Fine MJ et al.NEJM 1997

PSI Risk Classes II-V

Point based scoring system	
Class II	≤ 70 points
Class III	71-90 points
Class IV	91-130 points
Class V	> 130 points

Fine MJ et al.NEJM 1997

Mortality Based on PSI Risk Classes

Risk Class	30 day mortality Outpatients	30 day mortality Inpatients	30-day Overall Mortality
I	0%	0.5%	0.1%
II	0.4%	0.9%	0.6%
III	0%	1.2%	0.9%
IV	12.5%	9%	9.3%
V	0%	27.1%	27%

Fine MJ et al.NEJM 1997

CURB-65

- 1 point for each of the following:
  - Confusion
  - BUN ≥ 20 mg/dL
  - Respiratory rate ≥ 30/minute
  - SBP < 90 mm Hg or DBP ≤ 60 mm Hg
  - Age ≥ 65 years
- Risk of 30-day mortality by CURB-65 score
  - 1.5% for 0-1 points
  - 8.3% for 2 points
  - 23% for ≥ 3 points

Lim WS Thorax 2003

IDSA/ATS Recommendations

- Candidates for outpatient treatment may be identified using prognostic models (such as PSI) and severity-of-illness scores (such as the CURB-65 criteria)
- Always supplement objective criteria or scores with physician judgment of subjective factors
- Hospitalization or intensive in-home health care services (where available and appropriate) usually warranted for patients with CURB-65 scores ≥ 2

Mandell LA et al. Clin Infect Dis. 2007

Evaluation of DVT or PE

ACP/AAFP Recommendation

"Validated clinical prediction rules should be used to estimate pretest probability of venous thromboembolism (VTE), both deep venous thrombosis (DVT) and pulmonary embolism, and for the basis of interpretation of subsequent tests."

Qaseem A et al. Ann Fam Med. 2007

Wells Prediction Score

- 1 point for each of the following
  - Active cancer
  - Paralysis, paresis or recent plaster immobilization of lower extremities
  - Being bedridden > 3 days or major surgery within 4 weeks
  - Localized tenderness
  - Swelling of entire leg
  - Calf swelling > 3 cm compared with other leg (measured 10 cm below tibial tuberosity)
  - Pitting edema confined to symptomatic leg
  - Collateral superficial veins
- Subtract 2 points if alternative diagnosis as likely or more likely than DVT

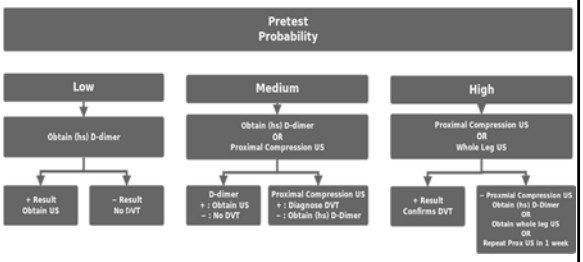
Wells PS et al. Lancet 1997

Interpretation of Wells Score

- Score ≤ 0 = low probability
- Score 1-2 = intermediate probability
- Score ≥ 3 = high probability

Wells PS et al. Lancet 1997

DVT Diagnostic Approach



Adapted from Bates SM et al. ACCP Diagnosis of DVT Guidelines. Chest. 2012

Additional considerations

- Other prediction rules available (Netherlands)
- Wells most widely studied and used
  - Recommended by AAFP, ACP , and AACP
  - Developed to predict first DVT
  - Less reliable with history of prior DVT or other RF
- D-Dimer may be elevated even without DVT
  - Pregnant patients
  - Malignancy
  - Elderly

CHA_2DS_2-VASc

Condition	Score
Congestive heart failure or LV dysfunction	1
Hypertension	1
Age ≥ 75 years	2
Diabetes mellitus type 2	1
(previous) Stroke, transient ischemic attack, or thromboembolism	2
Vascular disease (MI, PVD, aortic plaque)	1
Age 65-75 years	1
Female Sex	1

Lip GY et al. Chest. 2010

ACC/AHA Recommendations For Nonvalvular AF

Risk	Treatment Options
CHA_2DS_2-VASc = 0 (lone afib)	No treatment
CHA_2DS_2-VASc = 1	No treatment, Aspirin, or Oral anticoagulation
CHA_2DS_2-VASc ≥ 2	Oral anticoagulation

January CT et al. JACC 2014

Additional Prediction Rules

Condition	Prediction Rule
Cardiovascular Event	Framingham Risk score
Ankle/foot trauma	Ottawa Foot and Ankle Rules
Knee Trauma	Ottawa Knee Rule Pittsburgh Knee Rule
Pulmonary Embolus	Wells score Geneva score Pisa score PERC rule

Summary

- Validated prediction rules can improve quality of care
- Use rules endorsed by national guidelines
- Know the clinical limitations of prediction rules
- Document use of rules as part of note