The Prehospital Validation of the Canadian C-Spine Rule by Paramedics

CAEP, Victoria 2007
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                        Julie Cummins

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Database Management:    My-Linh Tran
### Our co-investigators

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<thead>
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<th>Andy Anton</th>
<th>Martin Lees</th>
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<tbody>
<tr>
<td>Steve Donaldson</td>
<td>Dallas Labarre</td>
</tr>
<tr>
<td>Matt Stempien</td>
<td>Paul Bradford</td>
</tr>
<tr>
<td>Carrie Parkinson</td>
<td>Catherine Hedges</td>
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<tr>
<td>John Trickett</td>
<td>Corinne Burke</td>
</tr>
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<td>Pierre Poirier</td>
<td>Jennifer Girard</td>
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Sponsors

Physicians’ Services Incorporated Foundation

EHS Branch of the MOH and Long-Term Care
The Clinical Problem...

- Estimated 185,000 ED visits per year in Canada
- Enough to occupy 4 large Emergency Departments, full time
- Only 1% will have c-spine injury
Drawback of immobilization…

- Progressive pain in head, neck, and back
- Marked pulmonary restriction from chest straps
- Risk of aspiration
- Claustrophobia / Agitation
- Time and resource utilisation
The Canadian C-Spine Study

0. Variation in Use of C-Spine Radiography (N=6,855)
   *Can Med Assoc J* 1997

I. Derivation of the Rule (N=8,924)
   *JAMA* 2001

II. Prospective Validation (N=8,283)
   *SAEM* 2002
### Cumulative Classification Performance for 16,462 Cases

<table>
<thead>
<tr>
<th>Rule Positive</th>
<th>C-Spine Injury</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>312</td>
<td>9,036</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>1</td>
<td>7,013</td>
</tr>
</tbody>
</table>

**Sensitivity**: 99.7% (98-100)

**Specificity**: 43.7% (43-45)

**NPV**: 100%
Objectives

- To prospectively assess the **Canadian C-Spine Rule** when used by paramedics for alert and stable trauma patients
- Specific objectives are to determine:
  - **accuracy** of the rule
  - **reliability** of the rule
  - **clinical sensibility**, i.e. paramedics' accuracy, comfort, and ease of use
  - **potential to reduce** the need for prehospital c-spine immobilization
Design, Setting, Subjects

- Prospective cohort study
- 7 Canadian Sites
- Includes alert, stable, and cooperative adults with blunt trauma and potential injury to the neck
- Patients for whom standard basic trauma life support (BTLS) protocols require immobilization
Patient Assessments

- PCPs and ACPs have been taught to use the Canadian C-Spine Rule
- They assess patients at the scene, including tenderness and range of motion
- They immobilize according to current guidelines, NOT according to the rule
- They record findings on data form
The Canadian C-Spine Rule

1. Any High-Risk Factor?
2. Any Low-Risk Factor?
3. Ability to Rotate the Neck?
The Canadian C-Spine Rule

Please check off all of the following choices:

1. Any One High-Risk Factor Which Mandates Immobilization?
   No  Yes
   ○  ○  Age≥ 65 years
   ○  ○  Dangerous Mechanism
   ○  ○  Numbness or Tingling in Extremities
   ○  No

2. Any One Low-Risk Factor Which Allows Safe Assessment of Range of Motion?
   No  Yes
   ○  ○  Simple rearend MVC **
   ○  ○  Ambulatory at any time at scene
   ○  ○  No neck pain at Scene
   ○  ○  Absence of midline c-spine tenderness
   ○  No

3. Patient Voluntarily Able to Actively Rotate Neck 45° Left and Right When Requested, Regardless of Pain?
   No  Yes
   ○  ○
   ○  Yes

○ Unable

○ Yes

C-Spine Immobilization

* Dangerous Mechanism
- fall from elevation≥ 3feet/5 stairs
- axial load to head, e.g. diving
- MVC high speed (≥ 100km/hr), rollover, ejection
- motorized recreational vehicles e.g. ATV
- bicycle collision

** Simple Rearend MVC Excludes:
- pushed into oncoming traffic
- hit by bus/large truck
- rollover
- hit by high speed vehicle (≥ 100 km/hr)

○ No C-Spine Immobilization

○ Able

○ Yes

C-Spine Immobilization

○ No
Outcome Measures

- Clinically Important Cervical Spine Injury
- Standard Radiography in ED, CT, MRI
- Telephone Follow-up if No Radiography
Clinically Unimportant Injuries

Require neither specialized treatment nor follow-up:

- Isolated avulsion fracture of osteophyte
- Isolated fracture of transverse process not involving body or facet joint
- Isolated fracture of spinous process not involving the lamina
- Isolated simple compression fracture < 25% of body height
Canadian Participants

Ottawa – May, 2002
Sarnia – October, 2002
Windsor – March, 2003
Halton – March, 2003
Calgary – May, 2003
Niagara – December, 2003
Nova Scotia – July, 2005
Recruitment by Center

- Ottawa: 1117
- Calgary: 591
- Windsor: 218
- Nova Scotia: 200
- Halton: 110
- Sarnia: 104
- Niagara: 57

Total Cases
2,397 Enrolled for interpretation of the rule
1,310 (55%) Had diagnostic imaging
   1,087 Telephone F-up
      783 (72%) Were reached
      670 Passed the telephone F-up
1,980 Patients included for rule accuracy
### Patient Characteristics

(N= 2,397)

<table>
<thead>
<tr>
<th>Age (median)</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Gender</td>
<td>48%</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
</tr>
<tr>
<td>MVC</td>
<td>63%</td>
</tr>
<tr>
<td>Falls</td>
<td>20%</td>
</tr>
<tr>
<td>Pedestrian struck</td>
<td>2%</td>
</tr>
<tr>
<td>Bicycle struck</td>
<td>2%</td>
</tr>
<tr>
<td>Admitted to Hospital</td>
<td>10%</td>
</tr>
<tr>
<td>C-Spine Fracture (n=14)</td>
<td>0.6%</td>
</tr>
</tbody>
</table>
### Patient Outcomes  
\((N = 1,980)\)

<table>
<thead>
<tr>
<th>Cervical spine injury (n, %)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>14</td>
<td>0.6%</td>
</tr>
<tr>
<td>Clinically important injury</td>
<td>12</td>
<td>0.5%</td>
</tr>
<tr>
<td>Ligamentous instability</td>
<td>7</td>
<td>0.3%</td>
</tr>
<tr>
<td>Dislocation</td>
<td>3</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stabilizing treatments (n, %)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal fixation</td>
<td>5</td>
<td>0.2%</td>
</tr>
<tr>
<td>Rigid collar</td>
<td>3</td>
<td>0.1%</td>
</tr>
<tr>
<td>Brace</td>
<td>2</td>
<td>0.08%</td>
</tr>
<tr>
<td>Halo</td>
<td>1</td>
<td>0.04%</td>
</tr>
</tbody>
</table>
### Classification Performance for 12 ‘Clinically Important’ Injury Cases

<table>
<thead>
<tr>
<th>Rule Positive</th>
<th>C-Spine Injury</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>929</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>691</td>
</tr>
</tbody>
</table>

- **Sensitivity**: 100% (74-100)
- **Specificity**: 42.7% (40-45)
- **NPV**: 100%
## Classification Performance for 17 Cervical Spine Injury Cases

<table>
<thead>
<tr>
<th>Rule Positive</th>
<th>C-Spine Injury</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes 16, No 925</td>
</tr>
<tr>
<td>No</td>
<td>Yes 1, No 690</td>
</tr>
</tbody>
</table>

- **Sensitivity**: 94.1% (69-100)
- **Specificity**: 42.7% (40-45)
- **NPV**: 100%
# Classification Performance for 16 Cervical Spine Injury Cases

<table>
<thead>
<tr>
<th>Paramedic Pos.</th>
<th>C-Spine Injury</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1158</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>717</td>
</tr>
</tbody>
</table>

- **Sensitivity**: 93.8% (68-100)
- **Specificity**: 38.2% (36-41)
- **NPV**: 100%
### Classification Performance for 12 ‘Clinically Important’ Injury Cases

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Sensitivity**: 100% (74-100)
- **Specificity**: 38.2% (36-41)
- **NPV**: 100%
Agreement Among Paramedics
N = 149

Kappa = 0.96 (0.94 – 0.98)

Rule Interpretation by Paramedics
N = 2,397

6.0% Misinterpreted the Rule
3.3% Did not evaluate ROM
How Comfortable…
N= 2200

![Bar chart showing comfort levels](chart.png)
Not all eligible cases enrolled

Some cases indeterminate for CCR

Some mis-interpretation by paramedics

Not all cases underwent radiography

One case not identified
Importance

- Could lead to a dramatic change in policies and protocols for EMS services throughout Canada and the U.S.
- Great potential to have the Canadian C-Spine Rule applied by paramedics
- 916 immobilizations could have been avoided
- Reduced patient discomfort, improved paramedic efficiency, and reduced pressure on our overcrowded EDs