

# **International Prehospital Medicine Institute**



## **IPHMI EMS Literature Review**

Keeping You Up to Date with Current EMS Literature and Studies

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- 1. Implementation of the Modified Canadian C-spine Rule by Paramedics.** Vaillancourt C, Charette M, Sinclair J, et al. *Ann Emerg Med* 2023;81:187-196

The National Emergency X-Radiography Utilization Study (NEXUS) stands as one of the landmark publications in recent decades in the fields of emergency medicine and trauma care. For many years, EMS providers had been taught to perform spinal “immobilization” with a cervical collar and a backboard for any injured patient having the potential for cervical spine injury. This resulted in many patients arriving in the emergency department who remained immobilized until imaging studies ruled out spinal injury. This overly cautious approach was not without its downsides to the patients—pain from laying on a hard board, respiratory impairment from immobilization straps, and even pressure ulcers. Emergency departments could get backlogged with those requiring imaging studies. In 2000, investigators published their findings showing that if patients met certain criteria, they could be safely cleared from immobilization without imaging. In the US, many EMS services revised their spinal immobilization protocols to include the NEXUS criteria, thereby allowing EMS providers to withhold spinal immobilization from many patients.

In 2001, Canadian researchers published their findings testing clinical clearance of the cervical spine using somewhat different algorithm, the Canadian C-Spine Rule (CCR). The CCR was validated as an alternatively safe approach and in a follow up study published in 2003, the CCR performed superiorly to the NEXUS criteria when compared head-to-head. The CCR had a higher sensitivity and specificity for cervical spine injury and would result in less radiography compared to the NEXUS criteria.

Similarly, Canadian researchers slightly modified the CCR to address two criteria that were not applicable to the field setting. This modified CCR was then validated in a multicenter study where nearly 2000 patients were evaluated with the CCR, but immobilization was still provided.

In this current study, Canadian investigators sought to evaluate the ability paramedics to apply the CCR to eliminate the need for spinal immobilization in low-risk patients. The study was conducted in a single agency, Ontario EMS, between 2010 and 2015. Following a one-hour online training session, a

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second hour of training was provided by trained study staff in a small group setting using patient scenarios, after which the medics had to complete an online quiz to confirm baseline knowledge. Throughout the duration of the study, refreshed training was provided in small group settings and through newsletters.

Consecutive victims of blunt trauma were eligible for the study if they were alert (GCS = 15) and stable (systolic BP  $\geq$  90 mm Hg, RR 10 – 24/min). Exclusion criteria included age < 16 years, penetrating trauma, acute para- or quadriplegia, known vertebral disease or were an interfacility transfer. The outcome measures were defined as: safety (missed cervical spine injuries); clinical impact (proportion of patients transported without spinal immobilization) and performance of the modified CCR (accuracy of the paramedic's use of the modified CCR and their comfort with using the CCR). Patients who did not undergo imaging were followed for 30 days, including delayed ED visits for those who refused transport, or revisits for those who were initially evaluated in the ED. The study was registered on clinicaltrials.gov and received funding from the Canadian Institutes of Health.

The study population included 4,794 patients, of which 760 were not evaluable with the modified CCR (54.1% due to GCS < 15). The eligible population (n = 4034) had a mean age of 42.9 years and females accounted for 53.4%. The most common mechanisms of injury were MVC (55.1%) and falls (23.9%). Diagnostic imaging was performed on 952 patients (23.6%). Abnormal findings were identified in 31 cases, but 21 of these were adjudicated to not be clinically important, leaving 10 cases with clinically important findings. There was one additional case of spinal cord injury without radiographic abnormality, for a total of 11 important injuries (0.3%). No injuries were found in the 30-day follow up period. In terms of safety, the modified CCR identified 10 of the 11 important injuries and all were transported with spinal immobilization. The CCR missed one injury (a Hangman's fracture of C2), which was only the second injury missed by the CCR in more than 40,000 patients in published studies. This patient was transported without spinal immobilization and was discharged with a rigid collar. No serious adverse outcomes were reported in any patient assessed with the CCR.

Immobilization was not applied to 2,664 patients (66.0%) of eligible patients, and 833 patients refused transport for assessment. There were 50 patients where immobilization by paramedics was not performed despite it being indicated by the modified CCR. Nineteen (38%) of these patients refused immobilization while 17 (34%) include no explanation for why immobilization was not performed. In terms of the paramedic's use of the modified CCR, the sensitivity was 90.9% regardless of the evaluation being performed by paramedics or the study investigators. The specificity was 66.5% when assessed by the paramedics and 68.2% when assessed by study personnel. The Cohen's Kappa agreement between the paramedics' and investigators' application of the modified CCR was 0.94 (95% CI, 0.93 to 0.95). Lastly, in virtually 90% of cases, the paramedics described their comfort level with using the modified CCR as either "comfortable" (21.2%) or "very comfortable" (68.6%).

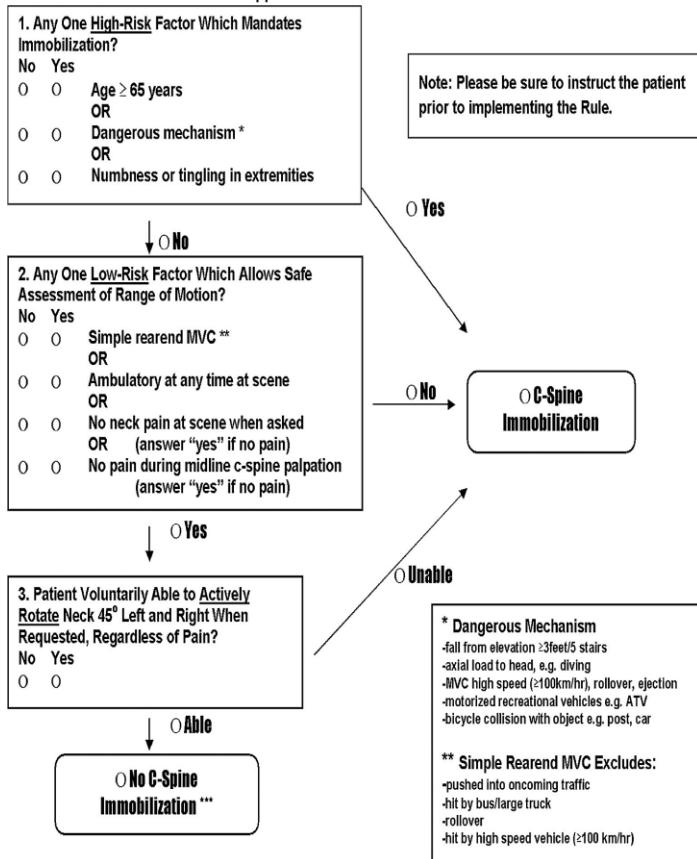
Overall, this is an interesting and important study for several reasons. The Cohen's Kappa of 0.94 shows excellent agreement and demonstrates that paramedics with only 2 hours of baseline training can apply the modified CCR virtually as well as physicians. Next, despite the brief training, the paramedics felt comfortable or very comfortable using the modified CCR in 90% of cases. More importantly, the CCR led paramedics to immobilize 10 of the 11 patients who later turned out to have significant cervical spine injuries, while the one missed injury truly represents a rare exception- a rate of 1 in 20,000 published patients evaluated with the CCR. Despite these very positive findings, there remain a few areas of concern. After subtracting the 19 patients who refused immobilization when indicated, there remained 31 patients where the modified CCR instructed spinal immobilization, but the paramedics elected not to perform. This is a concern for all prehospital guidelines and deserves further evaluation to identify the barriers to protocol adherence. Lastly, there was a rather marked period from the end of data collection until study publication—about 8 years. Such a lengthy delay can raise the question of whether the findings are still valid, however this isn't a major issue for this study.

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Sometimes such delays are because the manuscript is being submitted to multiple journals and the authors are trying to find one sympathetic to their study. In this case, the study was appropriately published in *Annals of Emergency Medicine*, a leading emergency medicine journal. Unfortunately, the manuscript provides no clear rationale for the delay in publication. The modified Canadian C-spine Rule seems a worthy approach to field clearance of the cervical spine by paramedics.

## ***The Canadian C-Spine Rule***

Please check off all choices within applicable boxes:



2. **Paramedic to trauma team verbal handover optimization – a complex interaction.** Cowan S, Murphy S, Kim M, et al. *Can J Surg* 2023 May;66(3):E290. Full text available online at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10228662/>

Effective communication is a critical component in providing quality care to any patient. Trauma handoffs between the prehospital team and the receiving trauma team are especially important, as they must be brief, concise, and accurate. EMS handoffs are not standardized in most prehospital systems, although several formatted options have been described. This study evaluated 2 structured formats of handoff compared to the usual unstructured (ad-lib) handoff currently used by many EMS agencies and in many hospitals.

This study took place in Alberta, Canada and was a random simulation trial evaluating 2 structured formats versus the ad-lib, or unstructured format, for patient handoff in the trauma bay. EMS providers were recruited from their high-volume provincial trauma system to take part in the 3 scenarios. The 2 structured formats evaluated were the IMIST handover (identify, mechanism of injury, injury summary, signs and symptoms, and treatments) and the ISOBAR handover (identify, situation/status, observations,

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background, assessment/actions, and acceptance of responsibility). Three teams of paramedics were assigned to each stream (standard vs training module) for a total of 27 trauma simulations and handovers (9 for each handover format). The paramedic team used a mannequin and a simulated scenario, with the handover to the trauma team based on which study arm they were assigned. Each paramedic team did 3 standardized scenarios in random order, all of similar acuity, injury pattern, and interventions. The handovers were video recorded and reviewed subsequently by independent evaluators consisting of trauma surgeons, emergency medicine physicians, EMS educators, and an ICU physician. Additionally, the physician and nursing staff receiving the handovers from the paramedics completed a survey on the quality of the handover, as well as provided qualitative comments and observations regarding the handover interactions.

Video analysis was conducted on 26 of the 27 scenarios (video failed to capture one scenario). Handovers had a mean duration of 71 seconds, with the longest being the control (ad-lib) handoff at 75 seconds, followed by IMIST (65 seconds) and ISOBAR (66 seconds). Interruption of the handoff by trauma team personnel is noted to be a negative factor in the quality of the handoff. Both intervention groups (IMIST and ISOBAR) were noted to have fewer interruptions than the control group. Participants rated the usefulness of IMIST as the highest (9/10), while ISOBAR received a usefulness rating of 7.5/10. Regardless of the format used, trauma team members viewed a handover as more useful when it was delivered with confidence, with a statement of objective vital signs and a logical format was used. A statement of objective, measured vital signs (instead of “vital signs stable”) was preferred. Overall, there were no significant differences based on the format used.

This study has several limitations. It was a simulation study and not conducted in real-time, so it is difficult to extrapolate the results to the high-intensity environment of the trauma bay. Additionally, EMS providers had only recently been trained in the IMIST and ISOBAR handover formats and were more comfortable with the ad-lib control format. The sample size of the study was small and did not show significant differences among the groups.

This was an interesting study attempting to standardize trauma bay handovers from EMS to the trauma team. Both groups agreed that a standardized format is preferred but more important was the confidence, quality of information, and clarity of the handover regardless of the format. This study shouldn't change practice patterns, but does serve as a useful guide for trauma systems striving to improve patient handoff in the trauma bay.

### **3. Prehospital shock index predicts 24-h mortality in trauma patients with a normal shock index upon emergency department arrival.** Yamada Y, Shimizu S, Yamamoto S, et al. *Amer J Emerg Med* 2023;70:101-108.

There have been an increasing number of papers regarding the utility of the shock index (SI=heart rate divided by systolic blood pressure) in the prehospital assessment of trauma patients. Shock index is characterized as low (<0.4), intermediate or normal (0.4 to 0.9), or high (>0.9). The authors of this study note that some patients with normal SI assessments on admission to the emergency department (ED) still have a poor prognosis. In this study, they sought to determine whether abnormal shock index assessments in the prehospital environment would capture the risk of death in these patients that have normal SI values on admission to the ED.

This was a retrospective study of ED-admitted trauma patients using data from the Japan Trauma Data Bank (JTDB). The study looked at ED trauma patient admissions in Japan from 2004 to 2017, aged  $\geq 16$  years with an abbreviated injury score (AIS) of  $\geq 3$  that were transported directly from the field to the ED and had a normal SI on admission to the ED.

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After exclusions, 89,495 patients were eligible for the study. Males predominated (62%) Blunt trauma accounted for 96.7% of cases and penetrating injury for 1.9%. While all of the patients in this study had normal SI ratings on admission to the ED, 4.8% had a low prehospital SI, 88.2% had a normal SI, and 7.1% had a high SI. Of all patients, 1,350 (1.5%) died within 24 hours of admission to the ED. Of these, 176 had low prehospital SI readings, 1,017 had normal SI readings and 157 had high SI readings. An abnormal (low or high) prehospital SI resulted in higher odds ratios for mortality within 24 hours compared to those with a normal prehospital SI.

There are a number of limitations of this study. It is difficult to extrapolate these findings to populations with less serious injuries since this study only included patients with serious trauma. The study population was comprised primarily of blunt trauma victim and the results likely do not apply to countries that have more penetrating trauma injuries. Lastly, as with many retrospective studies, there were cases with missing data, however they did not find any differences in results in patients with missing data compared to those that had complete data.

This study provides further evidence on the value and importance of prehospital SI. Calculation of the prehospital SI could improve triage, destination decisions, and targeted care for victims of traumatic injury.

#### **4. Shot through the heart: A 17-year analysis of pre-hospital and hospital deaths from penetrating cardiac injuries.** McNicoll CF, McNickle AG, Vanderet D, et al. *Injury* 2023;54:1349-1355

Penetrating cardiac injury (PCI) has long demonstrated a poor prognosis for survival without immediate surgical intervention. There is little the prehospital provider can do short of supportive care and rapid transport to the nearest trauma center capable of definitive cardiac surgical intervention.

The authors of this retrospective study examined seventeen (17) years of data from January 1, 2000, to December 31, 2016, from a single level 1 trauma center in Las Vegas NV, USA. Data was obtained from the trauma registry for victims transported to the trauma center and via the coroner's office for those who were pronounced on the scene. Criteria for enrolment in the study was all persons aged thirteen (13) and older with PCI. A total of 1561 victims were identified during the 17-year study period, 261 through the trauma registry and 1300 through the coroner's office. After review of hospital and autopsy reports for exclusion criteria, a total of 591 subjects were analyzed.

During the study period there were 66 survivors, 173 deaths at the trauma center, 45 deaths at other hospitals, and 359 prehospital deaths. The overall survival rate was 10.3%. The survivors demonstrated a statistically significant younger age (32.6 years vs. 41.1 years). Self-inflicted PCI accounted for 29% of the study group and were less likely to be transported (21% vs. 53%). Survival to discharge was also lower in the self-inflicted sub-group at 6% vs. 11%. Single chamber injuries were more common than multiple chamber injuries (373 vs 200). Single chamber injuries had a higher probability of survival (13% vs. 5%). Of the single chamber group, the left ventricle was the most commonly injured with 30% of all PCI injuries and accounted for 60% of all prehospital deaths. Stab wounds accounted for 26.4 % of the PCI in the study group but had a higher likelihood of survival at 26.6% vs. 4.3% for GSW.

This is a retrospective study which limits the data which can be analyzed. Information that was not available included the timing of therapeutic interventions as well as the specifics about the hospital treatment and resuscitation, all of which help determine outcome.

While advances in prehospital trauma care have decreased mortality and morbidity during the last several decades for many critical injuries and illnesses, patients suffering from PCI have not reflected these survival improvements. There are few if any procedures that can be performed by prehospital clinicians in the USA that will have an impact on those who have sustained a PCI. Even advances in trauma surgery aimed at cardiac repair have not produced a significant impact on survivability.