



Status: Definitief

Aantal woorden: 3494

Engelse samenvatting: 284

Nederlandse samenvatting: 261

Referentiestijl: British Medical Journal

Journal: Injury

Universiteit Utrecht

Faculteit Geneeskunde,

Afdeling Gezondheidswetenschappen

Richting: Verplegingswetenschap

Naam: D.C. Sagel

Studentnummer: 367994

Docent: J. de Man-van Ginkel



## ***Classifying symptoms of traumatic spinal cord injury by emergency medical services, a feasibility study.***

**D.C. Sagel<sup>a</sup>, J.T. Oosterwold<sup>b</sup>, M. Holla<sup>c</sup>, P. van Grunsven<sup>d</sup>, W. Heutz<sup>e</sup>, J. de Man-van Ginkel<sup>f</sup>, M. Edwards<sup>g</sup>, S. Berben<sup>h</sup>**

- a** Faculty of Medicine, Utrecht University, Ambulance Emergency Medical Service University Medical Centre Groningen, the Netherlands
- b** Faculty of Medicine, Utrecht University and School of Nursing and Health, University Medical Center Groningen, Groningen, the Netherlands
- c** Department of Orthopedic Surgery Radboud University Nijmegen Medical Centre, the Netherlands
- d** Ambulance Emergency Medical Service Gelderland-Zuid, Nijmegen, the Netherlands
- f** Department of Rehabilitation, Nursing Science and Sports, University Medical Centre Utrecht, the Netherlands, and Faculty of Medicine, Clinical Health Sciences, Utrecht University, the Netherlands
- g** Department of traumatology, University Medical Centre Nijmegen, the Netherlands
- h** Research Group, Radboud University Nijmegen Medical Centre, the Netherlands

<b>INTRODUCTION</b>	<b>6</b>
Problem statement	7
<b>OBJECTIVE</b>	<b>7</b>
Research questions	7
<b>METHODS</b>	<b>8</b>
Theoretical rationale and design	8
Setting and population and sampling	8
Materials	9
Ethical considerations	9
Methods of measurement	10
Data analysis	11
<b>RESULTS</b>	<b>11</b>
Usability of the Neurologic Evolution Classification	11
Barriers and facilitators of implementation	13
<b>DISCUSSION</b>	<b>14</b>
<b>REFERENCES</b>	<b>16</b>

## SUMMARY

**Rationale:** A new instrument for emergency medical services has been developed to detect symptoms of spinal cord injury and enables patients to receive appropriate care earlier. As well, it makes research possible on the effectiveness of spinal immobilization. With the implementation of the Neurologic Evolution Classification (NEC), the opportunity arises to describe barriers and facilitators of the implementation for the first time in the Dutch emergency medical services.

**Objective:** The feasibility study explores whether emergency medical services staff is capable of using the NEC to detect symptoms of spinal cord injury. Furthermore, to gain insight into the barriers and facilitators of implementation and usability of the NEC, used by Dutch emergency medical services.

**Methods** A mixed methods study which was conducted in April and May 2013. With telephone interviews, an online survey and patient chart review, we assessed how emergency medical services staff experienced the NEC and determined implementation factors. The population consisted of registered nurses and patients that were suspected of spinal injury in the region of Nijmegen and Arnhem, in the Netherlands.

**Results** Although adjustments are needed, the paramedics found the NEC useful, fast and applicable to multiple types of patients. The NEC is used by 16 of all 160 ambulance nurses. The barriers of implementation were collaboration with emergency department staffs and simultaneous studies in an organization. Motivation of the registered nurses and a multi-faceted implementation strategy with live training, are facilitating factors for implementation.

**Conclusion** Detecting symptoms of spinal cord injury is feasible for emergency medical staff. The next step is to adjust and validate the NEC for national wide use.

**Burden/risk** Approval of Medical Research Ethics Committee was not required.

**Keywords:** EMS, Spinal cord injury, Emergency medicine, implementation.

## **SAMENVATTING**

**Rationale:** Er is een nieuw instrument voor ambulanceverpleegkundigen ontwikkeld om symptomen van traumatisch spinaal letsel te meten, zodat patiënten mogelijk eerder passende zorg ontvangen en onderzoek naar de effectiviteit van wervelimmobilisatie mogelijk is. De implementatie van de Neurologic Evolution Classification (NEC), maakt het mogelijk om de belemmerende en ondersteunende factoren van implementatie van een nieuw instrument in de ambulancezorg, voor het eerst te beschrijven.

**Doelstelling:** De doelstelling is om de haalbaarheid en bruikbaarheid te bepalen van de NEC, uitgevoerd door ambulanceverpleegkundigen bij patiënten met mogelijk spinaal letsel. Daarnaast willen we de belemmerende of bevorderende factoren identificeren van implementatie binnen de Nederlandse ambulancezorg.

**Studiemethode:** Een prospectieve, mixed methods studie, in april 2013 tot juni 2013. Met telefonische interviews, een online enquête en patiëntdossieronderzoek, werd onderzocht hoe ambulancepersoneel met de NEC werkten en werden de implementatiefactoren onderzocht. De studiepopulatie bestond uit ambulanceverpleegkundigen en patiënten die en verdacht werden van spinaal letsel na een trauma, in regio Arnhem en Nijmegen.

**Resultaten** Hoewel er nog aanpassingen nodig zijn, vonden de ambulanceverpleegkundigen de NEC bruikbaar, snel, prettig en toepasbaar bij meerdere typen patiënten. De NEC is gebruikt door 16 van alle 160 ambulanceverpleegkundigen. De factoren die implementatie van het instrument belemmeren waren communicatie met ketenpartners en teveel gelijktijdig onderzoek in één organisatie. Motivatie van verpleegkundige en een multi-facet implementatie strategie met live training, zijn bevorderende factoren voor implementatie.

**Conclusie** Het meten van symptomen van spinaal letsel door ambulanceverpleegkundigen is haalbaar.

**Risico/belasting** Er zal geen toestemming voor deze studie worden gevraagd aan de Medische Ethische Toets Commissie te Nijmegen.

**Steutelwoorden** ambulancezorg, implementatie, traumazorg, instrumentontwikkeling en immobilisatie.

## INTRODUCTION

Primary Traumatic Spinal Cord Injury (TSCI) can occur when the human body is hit by a blunt object or in a collision with a blunt surface, e.g. motor vehicle collision or fall<sup>1, 2</sup>. TSCI affects proximally 385 people in the Netherlands every year and is rated at 2 per 100,000 inhabitants<sup>3</sup>. This is one of the lowest incidence rates of the world<sup>4</sup>. Symptoms of TSCI are loss of motor, sensor or deregulation of organ functions<sup>5, 6</sup>. Besides injury-related pathology, secondary TSCI can occur within minutes or days after trauma due to spinal manipulation<sup>7-12</sup>. In a cohort of 32,117 immobilized patients, Davis et al identified 10 patients with secondary TSCI who had an undiagnosed spinal column injury and was manipulated during endotracheal intubation<sup>12</sup>.

To prevent spinal manipulation, prehospital Emergency Medical Services (EMS) immobilizes patients using a rigid collar, backboard with straps and head blocks<sup>2, 13</sup>. However, spinal immobilization causes severe adverse effects, e.g. increased intracranial pressure, ventilation problems or pressure ulcers<sup>14-20</sup>. Researchers suggest that the risk of spinal cord injury due to inadequate immobilization may be over-estimated and recommend research into the effectiveness of spinal immobilization<sup>15, 16, 19-22</sup>. An instrument to monitor symptoms of TSCI is a precondition for research of spinal immobilization.

Currently, EMS lacks a uniform instrument to detect and describe symptoms of TSCI from the moment of impact to arrival at the Emergency Department (ED). TSCI symptoms of patients could remain undetected and patients are at risk of suboptimal care due to a delayed diagnose and treatment of TSCI<sup>7, 23-26</sup>. In the Emergency Department (ED) the damage of the spinal cord of the patient is assessed by standards of the American Spinal cord Injury Association (ASIA-ICLOS)<sup>6, 27</sup>. The 188 points ASIA-ICLOS scale is not a usable instrument for EMS staff to detect symptoms of TSCI. Therefore, two EMS Registered Nurses (RNs), two TSCI rehabilitation physicians and an orthopedic trauma surgeon developed the Neurologic Evolution Classification (NEC)<sup>17, 28-30</sup>. The NEC enables EMS to detect the loss of motor symptoms within 30 seconds<sup>31</sup>. The first step is to study whether EMS is able to detect symptoms of TSCI, by means of the implementation of the NEC.

In the process of knowledge transition, a customized implementation process is a predominating factor for success<sup>32, 33</sup>. The model of Grol guides processes of implementation in health care and prioritize to gain insight into facilitators and barriers<sup>32, 34-36</sup>. However, in Dutch EMS, there is a paucity of reports on barriers and facilitators of implementation<sup>37, 38</sup>.

### ***Problem statement***

There is no instrument for EMS to detect symptoms of TSCI and vital TSCI symptoms remain undetected and possible beneficial treatment is delayed<sup>23, 24, 26, 28</sup>. The feasibility of EMS staff to detect TSCI symptoms and if the NEC is a usable instrument, is not studied. As well, barriers and facilitators of implementation of an instrument are not identified within Dutch EMS.

### **OBJECTIVE**

The aim of this study is to gain insight in the feasibility of assessing the spinal neurologic function of patients by EMS with the NEC. Furthermore, we want to gain insight into the barriers and facilitators related to implementation of the NEC in Dutch EMS. Purposefully, to monitor the neurological function of patients suspected of spinal column injury after blunt trauma and to guide future innovations and research into the effectiveness of prehospital spinal immobilization.

### ***Research questions***

What is the feasibility of the NEC, used by Dutch EMS to measure TSCI symptoms of patients, suspected of spinal injury after blunt trauma?

- What is the usability of the NEC that EMS uses to monitor symptoms of possible spinal cord injury?
- What are the barriers and facilitators of implementation of the NEC in Dutch EMS?

## **METHODS**

### ***Theoretical rationale and design***

The model of Grol advises to investigate the barriers and facilitators of implementation of an innovation on different levels<sup>34, 35, 39</sup>. The NEC feasibility study assessed the levels: the innovation, the patient, the professional and the organization. To understand the nature of implementation in Dutch EMS, quantitative data must be complemented with the perspective of the professional<sup>40</sup>. A prospective mixed methods design was used to study the NEC's usability and facilitators and barriers of implementation in Dutch EMS<sup>41</sup>. The study was performed from the first of April until the first of June 2013.

### ***Setting and population and sampling***

The details of the population are summarized in table 1. Two ambulance EMS organizations participated: "Veiligheidsregio Gelderland Midden" (VGGM) and "Veiligheidsregio Gelderland ZUID" (VRGZ). The organizations provide emergency care in a region with 1.1 million inhabitants within the Netherlands<sup>42</sup>. In this region, 160 Registered Nurses (RNs) provide emergency care<sup>13, 42</sup>. The RNs are trained as Emergency Medical Technicians level 4 and work unsupervised with the help of a medical assistant.

The adult patients, who suffered a blunt trauma and were suspected of spinal column injury, were included in the study if the RN applied the NEC. Bobbink et al studied in the year 2011 patients after trauma within VGGM and described a total of 887 adult patients were immobilized<sup>43</sup>. For the organization VGGM and VRGZ, we estimated a total of 279 patients would have been eligible in the two months. Due to the nature of the feasibility study and the absence of comparative literature, no sample size could be calculated. Furthermore, 160 RNs were invited to participate with the questionnaire by email. For interviews, we used a random purposeful sampling method by calling on duty RNs at their station. Sample size usability literature for indicated a sample size of ten RNs, five from each organization<sup>34, 44, 45</sup>



## ***Materials***

### *The Neurologic Evolution Classification*

The NEC consists of four verbal commands. The RN observes if the verbal command leads to a movement of the muscle group against gravity, without help or added weight. The commands are: "Bend your arm, make a fist, pull your knee up and flex your foot". The reaction is observed in two categories: "Normal" or "Not normal". If the patient's extremity sustained an injury and could not comply with a command, the RNs can use the category "injured". The NEC form has a category "not conscious enough to execute" which can be used if a patient could not comply due to a lower level of consciousness. The RNs assesses the patient twice, before spinal immobilization and prior for entering the ED. The NEC is not validated and can be found in appendix 1.

### *Implementation of the NEC instrument*

In February 2013 in VGRZ and in March 2013 in VGGM, the NEC instrument was implemented using a multi-facet strategy<sup>34, 35, 39, 46</sup>. The strategy consisted of an online instruction film, a personal instruction by email, information hosted on the website of the EMS organizations and of visual reminders on materials that were used for immobilization<sup>31, 34</sup>. Reported questions or problems with the NEC instrument were summarized in an email update and send to EMS staffs.

## ***Ethical considerations***

All data extracted from patient's EPCs was anonymous. The questionnaire did not collect any personal data and when the RN was invited and informed by email, permission was assumed when the RN started the questionnaire. RNs gave informed consent prior to the interview and interviews were anonymous processed on transcript.

## ***Methods of measurement***

### *NEC forms*

The returned forms were observed for the scores of the muscles observations, the injured extremity scores and for unconsciousness classification. As well the forms were checked for visual irregularities. The forms were ignored if the RN assessed a patient younger than 18 or if the reason for immobilization was not traumatic.

### *Patient Chart review*

The patient's data was retrieved by matching the NEC form with Electronic Patient Chart (EPC), provided by both EMS organizations. The data consisted of identification of the RN, baseline, trauma and treatment related information, as well on scene times and transport times. For calculation of the RN fidelity rate, information of the RN who had assessed the patients was retrieved. Baseline data consisted of information on gender and age. Trauma related data consisted of mechanism of injury and the Glasgow Coma Scale (GCS). The mechanism of injury indicates the type of blunt trauma; a traffic accident or a fall from height. The GCS instrument is an international accepted instrument to assess the level of consciousness and is used to compare the scores of "not conscious enough" on the NEC forms. The GCS vary from a score from 3, meaning no eye movement, no muscle responses, no verbal response until 15, which is fully conscious<sup>47</sup>.

### *Online questionnaire*

Grol et al developed an implementation model for health care and Peters et al operationalized the model into a questionnaire<sup>32, 34, 48</sup>. The questionnaire describes four domains: Instrument, Professional, Patient and Organization, with 28 statements with a 5 point Likert scale<sup>34, 49</sup>. We adapted the questionnaire for the specific setting of the EMS and the NEC. The questionnaire is based on 25 reviewed observational studies and has an internal consistency of a Cronbach's alpha of 0.87 till 0.97<sup>34, 48</sup>. The Dutch questionnaire is submitted in appendix 2.

### *Telephone interviews*

The topics for the semi structured interviews were based on the results of the questionnaire, data from EPC study combined with observations from the NEC forms. One student, with a three months training course in qualitative research, executed the interviews.

## ***Data analysis***

All NEC forms scores and the data from EPCs analyzed with descriptive statistics. The answers of the questionnaire were reported in most frequent answer (mode) and for analysis categorized in three categories: agree, neutral and disagree. For comparability, the answers of the questionnaire and de data from EPCs were tested for significant differences between the EMS organizations. Categorical data was tested a Fisher-exact- Chi <sup>2</sup> and continuous data was analyzed with the student-t-test. The interviews were digital recorded, typed verbatim and thematically analyzed with the use of Nvivo software version 10<sup>50</sup>. The digital records and transcripts of the interviews were checked by two research students. Both students debated similarities or conflicts. The final results were discussed in the research group. All statistics were calculated with IBM SPSS, version 20<sup>51</sup>.

## **RESULTS**

The RNs assessed 36 patients using the NEC, 13 (36.1%) patients of VGGM and 23 (63.9%) patients of VRGZ. The data from 7 (19.4%) patients was ineligible, due to the fact that the patient was underage (5/13.9%), not immobilized (1/2.8%) or assessed twice (1/2.8%). 2 out of the remaining 29 patients had returned the NEC forms incomplete therefore only EPC data of the patient was used for analysis.

Out of 160 RNs, 19 (11.9%) RNs completed the online questionnaire, 11(14, 1%) RNs out of 78 RNs from VGGM and 8 (9.8%) RNs out of 82 RNs from VRGZ.

In total 30 (18.8%) RNs were interviewed. 2 (2.5%) RNs of VGGM and 28 (34.1%) RNs of VRGZ. Of the 30 interviewed RNs, 4 RNs had assessed patients with the NEC.

## ***Usability of the Neurologic Evolution Classification***

### ***NEC Forms***

The details of the NEC forms are reported in table 2. On the 27 completed NEC forms no symptoms of TSCI were reported. Also, no differences were reported between the moment before spinal immobilization and the moment upon arrival at the ED. According to the returned NEC forms, 2 (7.4%) patients were partially assessed due to sustained injuries. 2 (7.4%) other patients were assessed as not conscious enough to execute the NEC.

### *EPC review of assessed patients*

The details of EPC data are reported in table 3. The RNs fidelity was 10%, meaning that 16 (10.0%) different RNs out of 160 RNs assessed 29 eligible patients, 10 (12.9%) RNs of VGGM and 6 (7.3%) RNs of VRGZ. The 29 patients had a mean age of 43 years and 16 (55.2%) patients were male. 17 (58.6%) patients sustained an injury from traffic and 10 (34.5%) from a fall. The mean 29 assessed patients had a GCS of 14.6 points. One EPC indicated a patient with a GCS lower than eight points. No significant differences were found in the data of patients between VGGM and VRGZ.

### *Questionnaire*

The details of the questionnaire are reported in table 4. The 19 respondents of the questionnaire agreed that the NEC is not time-consuming, the timing of assessment is convenient, the layout is practical, the NEC is complete, has no faults and there is enough working space in the ambulance to execute the NEC.

Furthermore, the respondents agreed that the NEC can be used when patients are injured, in pain or considered elderly. The respondents agreed that in general patients collaborated, even when the patient has a low social status.

The RNs stated that they were well informed and able to remember the information that was given. The knowledge obtained in advance was sufficient. RNs agreed that by studying information of the NEC they have increased their knowledge of TSCI. The results indicate that the NEC corresponds with the professional attitude of RNs and the NEC leaves room for RNs to integrate their own considerations. The statements between RNs of VGGM or VGRZ did not differ significantly.

### *Interviews*

The aspects of usability are summarized in table 5. Most RNs stated that the NEC instrument is a simple, practical and fast instrument that offers a uniform measurement tool. Three out of four RNs reported a problem with the observation of the verbal command "Bend your knees!" during the second NEC test. RNs explained that the patient could not bend his knees due to the straps (Quote 1).

The RNs reported that none of the patients experienced problems executing the NEC and the NEC could be easily explained to the patients (Quote 2). Furthermore, RNs explained that they felt motivated to assess patients with the NEC, even though they knew only 2.0% of all immobilized patients have symptoms of TSCI (Quote 3). None of the interviewed RNs assessed a patient with low GCS scores or with injuries to an extremity. One RN reported a

patient, who was classified by the NEC as “normal”. However, the patient had a sensory deficit due to a dislocated cervical vertebra. The RN labeled the disability to detect other symptoms of TSCI besides motor dysfunction as an incompetence of the NEC.

The RNs, who used the NEC, experienced the application of the NEC as easy to integrate into their routine. Other RNs did not use the NEC for different reasons. In most cases the NEC was not integrated in the RNs routine so they forgot to use it (Quote 4). An ineligible patient is another reason for not using the NEC. Some RNs stated that they did not read or study the information. Almost every RN expressed the motivation to apply the NEC and they considered the NEC as a uniform instrument that was lacking within the EMS.

### ***Barriers and facilitators of implementation***

All identified barriers and facilitators to implementation are summarized in table 5.

#### ***Attitude of the RN***

One facilitator is motivation. The interviewed RNs expressed a necessity for a uniform TSCI classification tool in prehospital EMS. They expressed feeling strongly affiliated with the topic of spinal immobilization as well. Most RNs explained their belief that spinal immobilization is a hazardous intervention for the patient with no protection to the spinal parenchyma. They expressed their motivation to contribute in EMS related research that leads to new, evidence based, less harmful, immobilization guidelines. However, almost every RN from VRGZ expressed research fatigue or demotivation to participate in the NEC study due to concurrent, hospital related studies, a total of 5 (Quote 5). Therefore, concurrent studies within the same organization, was identified as a barrier.

Another barrier is the collaboration between EMS and ED staffs. The majority of the RNs expressed a fear or concern that ED staff will be reluctant to collaborate with the NEC or adjusting immobilization guidelines. The RNs had experienced multiple occasions where ED staff would argue with RNs, when a RNs had not immobilized a patient, although the RNs felt he had followed the national guidelines (Quote 6). A minority of the RNs stated to immobilize patients unnecessary to avoid an argument with ED staff. As well, RNs stated that ED staff needs to be informed of the NEC, so ED staff will understand the classification of TSCI symptoms.

### *Training and dissemination*

Live training and a multi-facet dissemination strategy have been identified as facilitator. In questionnaire and interviews, most RNs stated to feel well informed and well trained. However, the interviewed RNs preferred live training or a live presentation on a staff meeting in addition to the instructional film and emails. RNs expressed that live training could break with old routines. As well, RNs explained that attending a demonstration along with the opportunity to ask questions, would have contributed to their and their colleague's motivation.

## **DISCUSSION**

As perceived by RNs, the NEC seems to be usable on conscious and adult patients after blunt trauma and RNs are able to assess most patients for possible TSCI symptoms. Motivation of the RNs and multi-facet dissemination strategy with live training are identified as facilitators. Too many concurrent studies and collaboration between EMS and ED staffs are identified as barriers.

Leonard et al thematically described 17 barriers and 12 facilitators of research participation within the EMS by interviewing 88 EMS staff and 35 EMS researchers<sup>46</sup>. Our study seems to be the first to describe the actual barriers and facilitators of implementation of a new instrument in the Dutch EMS and enables customization of implementation processes<sup>33-35, 46</sup>. Feasibility studies in EMS are not new. Dieperink et al implemented a device in Dutch EMS in 2002 and other major implementation successes are described in literature<sup>52-55</sup>. Most feasibility literature lacks information of experienced barriers and facilitators nor report the overall fidelity, based on unique RNs. Dieperink et al did not provided information of the patients who were not included or how many unique RNs used the new device. Spijker et al, researched the fidelity of RNs to apply the device and described a low intervention fidelity of 27.0%<sup>52, 56</sup>. Therefore, researchers should report experienced barriers and facilitators of implementation and information of fidelity.

Only 10.0% of the RNs assessed patients and 11.3% of the 160 RNs completed the questionnaire. The low fidelity and response contradicts the expressed motivation and positive attitude of RN towards the NEC. The contradiction can be explained by three factors. In the same time period, in the EMS organization VRGZ had 5 different studies run simultaneously. In both organizations made mayor changes in daily practices, like the implementation of a new patient monitor and a new computerized patient chart system in the months prior to the NEC implementation. Last, the study period was maybe too short for RNs to get used to the NEC and integrate the NEC in daily routine.

Although RNs was instructed to assess patient over 17 years, 5 (17,2%) children were assessed with the NEC, implying the NEC's usability on children. On the NEC, 2 patients were assessed as unconscious, however, 1 patients had a corresponding GCS in the EPC. This data mismatch remains not clarified. Some RNs experienced a problem to apply the NEC on a patient who was strapped down on a backboard. As well, 1 RN described a possible problem of the validity of the NEC. The NEC is not validated however based on the motor score of the ASIA-ICLOS and observes the muscle movement against gravity force<sup>5, 6, 57, 58</sup>. In this particular patient, the NEC failed to detect symptoms of TSCI because the patient was able to move all four muscles against gravity. In future validation, revision of the second test, assessment of level of consciousness and the research of usability on children are necessary.

### *Limitations*

One research student interviewed the RNs. Despite the fact that the transcripts were read by another student and the results were discussed within the research group, complete saturation cannot be assured. Furthermore, only 4 (25.0%) of 16 RNs that had assessed the NEC could be interviewed so saturation of usability is not accomplished. However, the usability was assessed by means of the questionnaire and confirmed the experiences of the RNs. Due to technical problems, no EPC data was retrieved of the total number of patients who were eligible in the study period. Purposefully, to compare characteristics between patients who were not assessed and assessed with the NEC. As well, the EPC data could be used for future fidelity and sample size calculation.

## **CONCLUSION AND RECOMMENDATIONS**

To detect TSCI symptoms of patients after blunt trauma seems to be feasible in the EMS. Furthermore, some barriers and facilitators related to implementation of innovations in prehospital EMS have been identified. By identifying barriers and facilitators of implementation, and assessing the usability, this study contributes to earlier TSCI patient care and enables researchers to guide future innovations and research within the EMS.

Future research should validate the NEC, in means of sensitivity, specificity and interclass correlation as well to study the feasibility of the NEC on children. Furthermore, new research should study which implementation strategy enhances RNs fidelity and therefore success of implementation of innovations within the EMS.

## REFERENCES

1. Ahn H, Singh J, Nathens A, MacDonald RD, Travers A, Tallon J, et al. Pre-hospital care management of a potential spinal cord injured patient: a systematic review of the literature and evidence-based guidelines. *J Neurotrauma* 2011; Aug;28(8):1341-61.
2. American College of Surgeons. Committee on Trauma. ATLS: Advanced Trauma Life Support for Doctors (Student Course Manual), 8th ed. Chicago, IL: American College of Surgeons; 2008.
3. Databank cbs. Available at: <http://statline.cbs.nl/statweb/?LA=nl>. Accessed 31-05-2013, 16:26.
4. van den Berg ME, Castellote JM, Mahillo-Fernandez I, de Pedro-Cuesta J. Incidence of spinal cord injury worldwide: a systematic review. *Neuroepidemiology* 2010;34(3):184,92; discussion 192.
5. Kirshblum SC, Waring W, Biering-Sorensen F, Burns SP, Johansen M, Schmidt-Read M, et al. Reference for the 2011 revision of the International Standards for Neurological Classification of Spinal Cord Injury. *J Spinal Cord Med* 2011; Nov;34(6):547-54.
6. The Section on Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons. Clinical assessment following acute cervical spinal cord injury. The Section on Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and; 2001.
7. Toscano J. Prevention of neurological deterioration before admission to a spinal cord injury unit. *Paraplegia* 1988; Jun;26(3):143-50.
8. Oyinbo CA. Secondary injury mechanisms in traumatic spinal cord injury: a nugget of this multiply cascade. *Acta Neurobiol Exp (Wars)* 2011;71(2):281-99.



9. Gebauer G, Osterman M, Harrop J, Vaccaro A. Spinal Cord Injury Resulting From Injury Missed on CT Scan: The Danger of Relying on CT Alone for Collar Removal. *Clin Orthop Relat Res* 2012; Mar 1;.
10. Levi AD, Hurlbert RJ, Anderson P, Fehlings M, Rampersaud R, Massicotte EM, et al. Neurologic deterioration secondary to unrecognized spinal instability following trauma--a multicenter study. *Spine (Phila Pa 1976)* 2006; Feb 15;31(4):451-8.
11. Muckart DJ, Bhagwanjee S, van der Merwe R. Spinal cord injury as a result of endotracheal intubation in patients with undiagnosed cervical spine fractures. *Anesthesiology* 1997; Aug;87(2):418-20.
12. Davis JW, Phreaner DL, Hoyt DB, Mackersie RC. The etiology of missed cervical spine injuries. *J Trauma* 1993; 1993/;34(3):342-6.
13. Ambulance Zorg Nederland. Landelijke Protocol ambulancezorg 2011;.
14. Baez AA, Schiebel N. Evidence-based emergency medicine/systematic review abstract. Is routine spinal immobilization an effective intervention for trauma patients?. *Ann Emerg Med* 2006; Jan;47(1):110-2.
15. Deasy C, Cameron P. Routine application of cervical collars--what is the evidence?. *Injury* 2011; Sep;42(9):841-2.
16. Hauswald M. A re-conceptualisation of acute spinal care. *Emerg Med J* 2012; Sep 8;.
17. Holla M. Value of a rigid collar in addition to head blocks: a proof of principle study. *Emerg Med J* 2012; Feb;29(2):104-7.
18. Kwan I, Bunn F, Roberts Ian G. Spinal immobilisation for trauma patients. John Wiley & Sons, Ltd; 2009.

19. Lin HL, Lee WC, Chen CW, Lin TY, Cheng YC, Yeh YS, et al. Neck collar used in treatment of victims of urban motorcycle accidents: over- or underprotection?. *Am J Emerg Med* 2011; Nov;29(9):1028-33.
20. Orledge JD, Pepe PE. Out-of-hospital spinal immobilization: is it really necessary?. *Acad Emerg Med* 1998; Mar;5(3):203-4.
21. Abram S, Bulstrode C. Routine spinal immobilization in trauma patients: what are the advantages and disadvantages?. *Surgeon* 2010; Aug;8(4):218-22.
22. Sundheim SM, Cruz M. The evidence for spinal immobilization: an estimate of the magnitude of the treatment benefit. *Ann Emerg Med* 2006; Aug;48(2):217,8; author reply 218-9.
23. Fehlings MG, Perrin RG. The timing of surgical intervention in the treatment of spinal cord injury: a systematic review of recent clinical evidence. *Spine (Phila Pa 1976)* 2006; May 15;31(11 Suppl):S28,35; discussion S36.
24. Fehlings MG, Vaccaro A, Wilson JR, Singh A, W Cadotte D, Harrop JS, et al. Early versus delayed decompression for traumatic cervical spinal cord injury: results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). *PLoS One* 2012;7(2):e32037.
25. Fenstermaker RA. Acute neurologic management of the patient with spinal cord injury. *Urol Clin North Am* 1993; Aug;20(3):413-21.
26. Furlan JC, Noonan V, Cadotte DW, Fehlings MG. Timing of decompressive surgery of spinal cord after traumatic spinal cord injury: an evidence-based examination of pre-clinical and clinical studies. *J Neurotrauma* 2011; Aug;28(8):1371-99.

27. Waring WP,3rd, Biering-Sorensen F, Burns S, Donovan W, Graves D, Jha A, et al. \_  
2009 Review and Revisions of the International Standards for the Neurological Classification  
of Spinal Cord Injury. *J Spinal Cord Med* 2010;33(4):346-52.
28. Bartels RH, Hosman AJ, van de Meent H, Hofmeijer J, Vos PE, Slooff WB, et al. Design  
of COSMIC: a randomized, multi-centre controlled trial comparing conservative or early  
surgical management of incomplete cervical cord syndrome without spinal instability. *BMC  
Musculoskelet Disord* 2013; Jan 31;14:52,2474-14-52.
29. van Middendorp JJ, Barbagallo G, Schuetz M, Hosman AJ. Design and rationale of a  
Prospective, Observational European Multicenter study on the efficacy of acute surgical  
decompression after traumatic Spinal Cord Injury: the SCI-POEM study. *Spinal Cord* 2012;  
Sep;50(9):686-94.
30. Van de Meent H, Baken BC, Van Opstal S, Hogendoorn P. Critical illness VR  
rehabilitation device (X-VR-D): evaluation of the potential use for early clinical rehabilitation.  
*J Electromyogr Kinesiol* 2008; Jun;18(3):480-6.
31. Neurologic Evolution Classification, instructional and training video for ambulance staff.  
Private link. Available at: <http://youtu.be/7COiJVg7fyU>. Accessed 03/05, 2013.
32. Zorg Onderzoek en Medische Wetenschappen: hulp bij implementatie. Available at:  
<http://www.zonmw.nl/nl/themas/thema-detail/implementatie/zonmw-helpt-implementeren/>.  
Accessed 11/06, 2012.
33. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of  
change in patients' care. *Lancet* 2003; Oct 11;362(9391):1225-30.
34. Peters MAJ, Harmsen M, Laurant MGH, Wensing M. Ruimte voor verandering?  
Knelpunten en mogelijkheden voor verandering in de patiëntenzorg [Room for improvement?  
Barriers to and facilitators for improvement of patient care]. 2002;.

35. Grol R, Wensing M. What drives change? Barriers to and incentives for achieving evidence-based practice. *Med J Aust* 2004; Mar 15;180(6 Suppl):S57-60.
36. Grol R, Grimshaw J. Evidence-based implementation of evidence-based medicine. *Jt Comm J Qual Improv* 1999; Oct;25(10):503-13.
37. Berben SA, Meijs TH, van Grunsven PM, Schoonhoven L, van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury* 2012; Sep;43(9):1397-402.
38. Berben SA, Schoonhoven L, Meijs TH, van Vugt AB, van Grunsven PM. Prevalence and relief of pain in trauma patients in emergency medical services. *Clin J Pain* 2011; Sep;27(7):587-92.
39. Grol R. Successes and failures in the implementation of evidence-based guidelines for clinical practice. *Med Care* 2001; Aug;39(8 Suppl 2):II46-54.
40. Creswell JW, Fetters MD, Ivankova NV. Designing a mixed methods study in primary care. *Ann Fam Med* 2004; Jan-Feb;2(1):7-12.
41. Creswell JW, Plano Clark VL. Designing and Conducting Mixed Methods Research, Second Edition 2011; Designing and Conducting Mixed Methods Research, Second Edition.
42. Boers I, Duijf P, Grummels E, Leerkess G, Van der werf H. Ambulance in Zicht, 2011. Facts of Dutch Emergency Medical Services. Tiel: Stimio Consultants Drukwerk & Design, Tiel; 2011. Report No.: 2011.
43. Bobbink R, Limpers E, Poppen H, Diets R, Heutz W. wervelkolomimmobilisatie. 01 2012;.
44. Krueger RA, Casey MA. *Focus Groups A Practical Guide for Applied Research*. 4th ed. California: SAGE Publications Inc; 2008.

45. Turner CW, Lewis JR, Nielsen J. Determining usability test sample size. *International Encyclopedia of Ergonomics and Human Factors* 2006;:3084-8.
46. Leonard JC, Scharff DP, Koors V, Lerner EB, Adalgais KM, Anders J, et al. A qualitative assessment of factors that influence emergency medical services partnerships in prehospital research. *Acad Emerg Med* 2012; Feb;19(2):161-73.
47. Gabbe BJ, Cameron PA, Finch CF. The status of the Glasgow Coma Scale. *Emerg Med (Fremantle)* 2003; Aug;15(4):353-60.
48. Questionnaire for evaluation the Neurlogic Evolution Classificatiion, based on the Grol questionnaire, for implementational research. Available at: Appendix 2.
49. Linge van R. *Innoveren in de gezondheidszorg. Theorie, praktijk en onderzoek*. first ed. Maarssen: Uitgeverij Elsevier Gezondheidszorg,; 2006.
50. QSR International Pty Ltd. NVivo qualitative data analysis software; QSR International Pty Ltd. Version 10, 2012 2012;10.
51. IBM SI. SPSS for Windows 2008;18(Rel. 11.0.1. 2009).
52. Dieperink W, Weelink EE, van der Horst IC, de Vos R, Jaarsma T, Aarts LP, et al. Treatment of presumed acute cardiogenic pulmonary oedema in an ambulance system by nurses using Boussignac continuous positive airway pressure. *Emerg Med J* 2009; Feb;26(2):141-4.
53. Guerra WF, Mayfield TR, Meyers MS, Clouatre AE, Riccio JC. Early detection and treatment of patients with severe sepsis by prehospital personnel. *J Emerg Med* 2013; Jun;44(6):1116-25.

54. Wennman I, Klittermark P, Herlitz J, Lernfelt B, Kihlgren M, Gustafsson C, et al. The clinical consequences of a pre-hospital diagnosis of stroke by the emergency medical service system. A pilot study. *Scand J Trauma Resusc Emerg Med* 2012; Jul 10;20:48,7241-20-48.
55. De Luca A, Toni D, Lauria L, Sacchetti ML, Giorgi Rossi P, Ferri M, et al. An emergency clinical pathway for stroke patients--results of a cluster randomised trial (isrctn41456865). *BMC Health Serv Res* 2009; Jan 21;9:14,6963-9-14.
56. Spijker EE, de Bont M, Bax M, Sandel M. Practical use, effects and complications of prehospital treatment of acute cardiogenic pulmonary edema using the Boussignac CPAP system. *Int J Emerg Med* 2013; Apr 8;6(1):8,1380-6-8.
57. Graves DE, Frankiewicz RG, Donovan WH. Construct validity and dimensional structure of the ASIA motor scale. *J Spinal Cord Med* 2006;29(1):39-45.
58. Marino RJ, Jones L, Kirshblum S, Tal J, Dasgupta A. Reliability and repeatability of the motor and sensory examination of the international standards for neurological classification of spinal cord injury. *J Spinal Cord Med* 2008;31(2):166-70.

Content

	VRGZ	VGGM	Total
Inhabitants in region, 2011	534,234*	659,449*	1,193,683*
Total calls, 2011	31,968*	34,431*	66,399*
Calls with high priority, 2011	13,114*	14,333*	27,447*
Eligible immobilized patients, total calls per year**	723**	887***	1610**
Immobilized patients over 17 years, high priority calls	495**	605**	1,100**
Immobilized patients over 17 years, high priority call, during study period April until June 2013	103**	145**	248**
Total of RNs	82*	78*	160*
Total of ambulances	21*	23*	44*

**Table 1: overview of both EMS organizations facts and estimations of target population.**

\* = 2011 Taken from "Ambulance in Zicht 2011" by Boers et al<sup>42</sup>

\*\* = 2011 estimations, based on Dutch article "Wervelkolomimmobilisatie" by Bobbink, R et al, 2012, Critical Care "Ambulance in Zicht 2011" by Boers et al<sup>42,43</sup>

\*\*\*= Data from Dutch article "Wervelkolomimmobilisatie" by Bobbink, R et al, 2012, Critical Care<sup>43</sup>.

		EMS Organization VRGZ	EMS Organization VGGM	Total
<b>Returned NEC forms</b>				
	Total NEC forms	13	23	36
	Eligible	10	19	29
	Incomplete/faulty	2	0	2
	Total remaining NEC forms	8	19	27
<b>Scores NEC before immobilization</b>				
	Scored unconscious	0	2	2
	Full function	7	16	23
	Scored partial injured	1	1	2
	No function	0	0	0
	Total	8	19	27
<b>Scores NEC after immobilization</b>				
	Scored unconscious	0	2	2
	Full function	7	16	23
	Scored partial injured	1	1	2
	No function	0	0	0
	total	8	19	27
<i>Table 2: Details of the returned NEC forms, per score, per organization and total scores.</i>				



		Total EPCs N=29	EPCs VRGZ N=10	EPCs VGGM N=19	P-value
<b>Baseline</b>					
	Age, in mean years (SD)	43.3(16.6)	42.0(17.8)	45.3(14.6)	.621†
	Male in n (%)	16(55.2%)	7(70.0%)	9(47.4%)	.434‡
<b>RN fidelity</b>					
	Unique RNs n (%)*	16 (10.0%)	6 (7.3%)	10 (12,2%)	.297
<b>GCS</b>					
	Mean GCS, in gcs points(SD)	14.6(1.9)	14.9(0.3)	14.4(2.4)	.388†
	GCS< 8 in n (%)	1(3,4%)	0(0%)	1(5.3%)	N/A
<b>Mechanism</b>					
	Traffic n (%)	17(58.6%)	4(40.0%)	13(68.4%)	.415‡
	Falls n (%)	10(34.5%)	4(40.0%)	6(31.6%)	
<b>Time</b>					
	Time on scene, in min(SD)**	24(8)	25(9)	21(6)	.170†
	Time of transport, in min(SD)**	18(10)	20(12)	15(5)	.131†
<p><b>Table 3 Descriptive statistics of data taken from EPCs, consists of patient collected EPCs during study period, total and per EMS organization.</b></p> <p>* = out of 160 available RNs, 78 of VVGM, 82 of VGRZ</p> <p>** = Based on 28 EPC;</p> <p>† = two tailed, Student-t-test;</p> <p>‡ = two sided Fisher exact Test;</p> <p>N/A= Not applicable:</p>					

Organization		Overall N=19	VGGM N=11	VRGZ N=8	P-value
	<i>Other disciplines were not collaborative.</i>	Neutral	Neutral	Neutral	.486(*)
	<i>Some colleague RNs didn't collaborate with the NEC.</i>	Neutral	Neutral	Neutral	1.00(*)
	<i>Management staff did not collaborate.</i>	Neutral	Disagree	Neutral	.650(*)
	<i>The application of this instrument is difficult due to little or no knowledge of my medical assistant.</i>	Disagree	Disagree	Neutral	.098(*)
	<i>Applying the NEC should be financially compensated.</i>	Disagree	Disagree	Disagree	1.00(*)
Patient					
	<i>The NEC is not applicable within elderly patient.</i>	Disagree	Disagree	Disagree	1.00(*)
	<i>The timing when symptoms of TSCI were measured is not convenient.</i>	Disagree	Disagree	Disagree	.604(*)
	<i>Patient specific information can be merged within the classification of the NEC.</i>	Agree	Agree	Agree	1.00(*)
	<i>Difficulties with patients who had different cultural status.</i>	Neutral	Neutral	Disagree	.567(*)
	<i>The NEC is not applicable to patients in pain.</i>	Disagree	Neutral	Disagree	.307(*)
	<i>Patients with low social status refused collaboration.</i>	Disagree	Disagree	Disagree	1.00(*)
	<i>The application of the NEC is difficult on patients that are not (badly) injured.</i>	Disagree	Disagree	Disagree	.633(*)
	<i>Patients in general did not collaborate in application of the NEC.</i>	Disagree	Disagree	Disagree	.546(*)
Instrument					
	<i>The NEC layout is practical.</i>	Agree	Agree	Agree	.429(*)
	<i>The NEC is likely to be misused in disciplinary hearings.</i>	Disagree	Disagree	Neutral	.109(*)
	<i>Some parts within the NEC are faulty.</i>	Disagree	Disagree	Disagree	.462(*)
	<i>Some parts are missing of the NEC.</i>	Disagree	Disagree	Disagree	1.00(*)
	<i>There is insufficient working space in the ambulance to complete the NEC.</i>	Disagree	Disagree	Disagree	.333(*)
	<i>Applying the NEC consumes a lot of time.</i>	Disagree	Disagree	Disagree	.546(*)
Caregiver/EMS staff					
	<i>My own considerations can be accounted for within the NEC.</i>	Agree	Agree	Agree	1.00(*)
	<i>Thanks to the NEC, I now know more of TSCI.</i>	Agree	Neutral	Agree	.627(*)
	<i>I need more knowledge before I can work with the NEC.</i>	Disagree	Disagree	Disagree	.550(*)
	<i>I am not well trained for application of this instrument.</i>	Disagree	Disagree	Disagree	1.00(*)
	<i>I did not read or study or remember given information concerning the application of the NEC.</i>	Disagree	Disagree	Disagree	.175(*)
	<i>The application of the NEC does not fit in my professional attitude.</i>	Disagree	Disagree	Disagree	.412(*)
	<i>In general, I am reluctant to work according to standards.</i>	Disagree	Disagree	Disagree	.603(*)
	<i>I have difficulties to change routines.</i>	Disagree	Disagree	Disagree	.164(*)
	<i>I am reluctant to use the NEC because I was not involved in the development</i>	Disagree	Disagree	Disagree	1.00(*)
<p><b>Table 4: translated statements from the questionnaire with the mode responses of the RNs in each and both EMS organizations. VRGZ= Gelderland Zuid, VRGM= Gelderland Midden. Fisher exact test (*) 2-sided test was used to compare differences of the responses between the RNs of the organizations. Significant below p= 0.05. Adapted from the GroI implementation model, described by Peters et al<sup>27</sup>.</b></p>					

		VRGZ	VGGM
<b>Barriers</b>	<i>Attitude</i>	<ul style="list-style-type: none"> <li>- Simultaneous research</li> <li>- Research fatigue in general</li> <li>- Fear for arguments on EDs</li> <li>- Fear of missing a vertebra fracture</li> <li>- Frustration of EPC registration</li> <li>- Difficulty to break with routines</li> <li>- Forgot about study</li> </ul>	<ul style="list-style-type: none"> <li>- Informing ED is important</li> <li>- Arguments with ED staff</li> <li>- Didn't read or study material</li> </ul>
	<i>Training</i>	<ul style="list-style-type: none"> <li>- Need for live training</li> <li>- Need for a demonstration</li> <li>- Need for opportunity for questions</li> <li>- Movie was too long</li> <li>- No received mail</li> </ul>	<ul style="list-style-type: none"> <li>- No live training or demonstration at a staff meeting</li> <li>- No received mail.</li> <li>- No forms or reminders in ambulance or too late.</li> </ul>
	<i>Instrument</i>	<ul style="list-style-type: none"> <li>- Not sensitive for sensory deficits</li> <li>- Patient cannot pull his knees up</li> </ul>	<ul style="list-style-type: none"> <li>- Patient cannot pull knees up</li> </ul>
<b>Facilitators</b>	<i>Attitude</i>	<ul style="list-style-type: none"> <li>- RNs field of interest</li> <li>- Need for better guidelines</li> <li>- Need for evidence</li> <li>- Less material</li> <li>- Topic in Hospitals</li> <li>- Quality improvement</li> <li>- First study with a EMS topic</li> <li>- Less harmful for a patient</li> </ul>	<ul style="list-style-type: none"> <li>- Need for TSCI measurement</li> <li>- Complications of spinal immobilization</li> <li>- Unnecessary immobilization</li> </ul>
	<i>Training</i>	<ul style="list-style-type: none"> <li>- Good visual reminders</li> <li>- Good movie,</li> <li>- Clear text</li> <li>- Enough information</li> <li>- Monitoring implementation was experienced as motivating</li> </ul>	<ul style="list-style-type: none"> <li>- Instructional online movie was enough.</li> </ul>
	<i>Instrument</i>	<ul style="list-style-type: none"> <li>- Uniform instrument</li> <li>- Quick</li> <li>- Easy</li> <li>- Integration in physical assessment</li> <li>- Simple test</li> <li>- Applicable tool</li> </ul>	<ul style="list-style-type: none"> <li>- easy to integrate with routine</li> </ul>
<p><b>Table 5: Thematic analyses of 8 interviews of EMS organizations VRGZ and VGGM. Quote's are translated and summarized.</b></p>			

"I find it difficult to differentiate between the first and second test. When a patient is strapped down, he cannot pull his knees up."

**Quote 1: Comment of subject VRGZ-06, on the question if he experienced any problems when working with the NEC.**

"I just incorporate the test in my physical assessment routine, so patients believed it was normal. They don't think of it as obligatory but just part of a test. I think it was experienced as fine."

**Quote 2: Comment of VRGZ-02 who used the NEC on a question what who patients experienced executing the NEC.**

"I dont share your view. Don't get me wrong, I too only have seen two patients with TSCI in the last 20 years. How many times do you measure a patient's blood pressure and it will probably be normal. It doesn't demotivate you from doing it again the next time."

**Quote 3: Comment of subject VRGZ-01, on the statement if a low TSCI incidence of 2% is demotivating.**

"I have had some patients who required immobilization, but i just did not thought of it. It is not yet in my routine integrated."

**Quote 4: Comment of VRGZ-03 on if an opportunity was missed to apply the NEC.**

"At first, I though, o boy, what have we getting ourselves into. We are fatigue of all the research in our organization. But I just stumbled into it and read the information carefully. We have the form and placed the visual reminders. Let's say it was wide accessible. Well, I got to used it twice and it was a piece of cake, done in a second!"

**Quote 5: Comment of VRGZ-06 on the question how he experienced the online movie and submitted instructions.**

"One time, a resident of the emergency department taunted me after I presented a patient without a rigid collar, stating it was procedure. That's what I call a lack of common sense like applying rigid collar on a patient with lumbar spinal injury."

**Quote 6: Comment of VRGZ-01 on the question if he thought the NEC could be used in future research.**

Appendix 1: The Neurologic Evolution Classification

Meetmoment 1: Bepaal voor het immobiliseren het spinaal letsel, omcirkel de passende score							
Patient in staat opdrachten uit te voeren, AVPU=Alert	Nee Geen score	JA					
kracht armen		links			rechts		
Observatie		Niet afwijkend	Niet uitvoerbaar/letsel	Af wijkend	Niet afwijkend	Niet uitvoerbaar / letsel	Af wijkend
flexie elleboog instructie: buig elleboog	nvt	+	X	-	+	X	-
flexie vingers/instructie: maak vuist	nvt	+	X	-	+	X	-
kracht benen		links			rechts		
flexie heup instructie: beweeg knie omhoog	nvt	+	X	-	+	X	-
plantair flexie enkel instructie: geef gas met voet	nvt	+	X	-	+	X	-

Meetmoment 2: Bepaal voor aankomst ziekenhuis opnieuw het spinaal letsel, omcirkel de passende score							
Patient in staat opdrachten uit te voeren, AVPU=Alert	Nee Geen score	JA					
kracht armen		links			rechts		
Observatie		Niet afwijkend	Niet uitvoerbaar/letsel	Af wijkend	Niet afwijkend	Niet uitvoerbaar / letsel	Af wijkend
flexie elleboog instructie: buig elleboog	nvt	+	X	-	+	X	-
flexie vingers/instructie: maak vuist	nvt	+	X	-	+	X	-
kracht benen		links			rechts		
flexie heup instructie: beweeg knie omhoog	nvt	+	X	-	+	X	-
plantair flexie enkel instructie: geef gas met voet	nvt	+	X	-	+	X	-

Datum: 25/5/2013 Voertuignummer: 125  
Ritnummer: 31032

Beste ambulanceverpleegkundige,

Wat fijn dat je de moeite hebt genomen om de enquête in te gaan vullen. In een paar minuten, geef je het onderzoeksteam een helder overzicht van de knelpunten die te maken hebben met de verspreiding en implementatie van het meetinstrument. De resultaten van deze enquête worden anoniem verwerkt en besproken in focusgroepen. Met de uitkomsten van deze enquête, de focusgroepen en specifieke ritgegevens van patiënten, hopen we de bruikbaarheid van de Neurologic Evolution Classification te beoordelen. Je bijdrage is van groot belang. Onze dank daarvoor.

veel succes met de enquête!

## Innovatie NEC studie **Knelpunten voor Implementatie- Algemeen.**

Hieronder volgt een aantal uitspraken over het werken met het meetinstrument, de Neurologic Evolution Classification. Het is de bedoeling dat u aangeeft in hoeverre u het met de uitspraak 'eens' of 'oneens' bent. Dit kost u minder dan 5 minuten.

### **1. Dit meetinstrument laat genoeg ruimte voor mij om zelf afwegingen te maken.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **2. Dit meetinstrument geeft mij genoeg ruimte om informatie van de patiënt mee te wegen in de classificatie.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **3. Dit meetinstrument is een goed aanknopingspunt voor zelfstudie bijvoorbeeld: verdieping in de onderwerpen "wervelimmobilisatie" of meetmethodes om spinaal neurologisch letsel op te sporen.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **4. Dit meetinstrument kan makkelijk misbruikt worden in het verpleegkundig tuchtrecht.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **5. Ik heb informatie over dit meetinstrument niet grondig genoeg gelezen of onthouden.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **6. Ik wil graag (nog) meer over dit meetinstrument weten voordat ik besluit om deze toe passen in de praktijk.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **7. Ik heb moeite met het veranderen van mijn oude routines.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

### **8. Ik denk dat bepaalde onderdelen van dit meetinstrument onjuist zijn.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

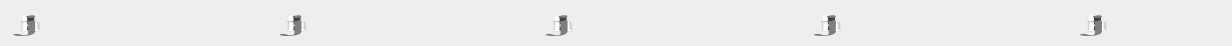
                                                                                      

### **9. Ik heb in het algemeen weerstand tegen het werken volgens protocollen.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

**10. Collega ambulance verpleegkundigen werkten niet mee aan het toepassen van dit meetinstrument.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens




**11. Andere hulpverleners, zoals spoedeisende hulp medewerkers, solo-ambulances, etc, werkten niet mee aan het toepassen van dit meetinstrument.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens




**12. Leidinggevendenden werkten niet mee aan het toepassen van het meetinstrument.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens




**13. Patiënten werkten niet mee aan het toepassen van het meetinstrument.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens



**14. Het werken met dit meetinstrument kost veel tijd.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens




**15. Dit meetinstrument past niet goed bij mijn werkstijl.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens




**16. Het werken met dit meetinstrument vereist een financiële vergoeding.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens



**17. De lay-out van dit meetinstrument maakt het handig voor het gebruik.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens





Nu volgt een aantal vragen over de knelpunten die met het implementeren van het meetinstrument te maken hebben. Welke knelpunten ervaart u momenteel?

**18. Ik vind het toepassen van dit meetinstrument een probleem omdat er onvoldoende kennis is bij de collega ambulance chauffeur.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**19. Ik vind het toepassen van dit meetinstrument een probleem omdat er onderdelen missen in het instrument.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**20. Ik vind het toepassen van dit meetinstrument een probleem omdat het moment waarop het meetinstrument wordt afgenomen onhandig is.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**21. Ik vind het toepassen van dit meetinstrument een probleem omdat er onvoldoende fysieke ruimte is om het meetinstrument te gebruiken zoals door de locatie van de patiënt of in de ambulance.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**22. Ik vind het toepassen van dit meetinstrument een probleem omdat ik niet ben opgeleid voor het toepassen van dit meetinstrument.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**23. Ik vind het toepassen van dit meetinstrument een probleem omdat ik niet betrokken ben bij de ontwikkeling van het meetinstrument.**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**24. Ik merk dat het toepassen van dit meetinstrument moeilijk is bij patiënten met een andere culturele achtergrond**

zeer oneens      oneens      niet oneens, niet mee eens      mee eens      zeer mee eens

**25. Ik merk dat het toepassen van dit meetinstrument moeilijk is bij patiënten die overwegend gezond of niet gewond zijn.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

**26. Ik merk dat het toepassen van dit meetinstrument moeilijk is bij patiënten met een lage-sociale-economische status.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

**27. Ik merk dat het toepassen van dit meetinstrument moeilijk is bij oudere patiënten (60+)**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

**28. Ik merk dat het toepassen van dit meetinstrument moeilijk is bij patiënten met veel pijn.**

zeer oneens                      oneens                      niet oneens, niet mee eens                      mee eens                      zeer mee eens

