Children. Our everything.
Interrater Reliability and Predictive Validity of the FOUR Score Coma Scale in a Pediatric Population

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Disclosures:

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Background

- Adult human brain 2% total body weight
- Consumes more than 20% of oxygen used at rest
- Metabolically active
- No oxygen or glucose storage
- Even a brief interruption can result in acute changes in level of consciousness
- Increased morbidity and mortality
Background

- Clinical assessment is key to identifying subtle changes and is fundamental to management of neuroscience patients

- Quality care depends on the nurses’ ability to accurately and consistently assess and communicate these changes
Background

- Glasgow Coma Scale (GCS) 1974 to objectively describe neuro status and predict outcome
- GCS has become the gold standard for coma assessment and measuring LOC
- Incorporated into Intensive Care and Trauma scores (internationally) to assess risk of in-hospital mortality and predict future disability
- Accuracy of the GCS is therefore crucial
- Despite its widespread use it has several well documented limitations…
Limitations

- Heavily weighted motor assessment
  - Paralytics
  - Sedatives
  - Spinal Cord Injury

- Verbal
  - Intubated
    - Inconsistent scoring

- Eye
  - Injury
  - Edema
Limitations

- Wide variation in GCS scoring *within* organizations among nurses with varying levels of expertise, and *between* healthcare organizations (Ingram, 1994)
- Only moderate degree of interrater agreement (Gills, Reiley, & Green, 2004)
- Many attempts over the years to modify or simplify GCS
- Dissatisfaction and need for better tool
Background

- Full Outline of UnResponsiveness (FOUR) score
- Proposed replacement for GCS
- Developed and validated by Mayo Clinic in adults 2005
- No studies to validate its use in pediatrics

- The purpose of this study was to compare the interrater reliability and predictive validity of the FOUR score and the GCS in pediatric patients
FOUR Score

- Value of 0-4 in each of 4 functional categories:

- In each of these categories, a score of zero indicates nonfunctioning while a score of four represents normal functioning

GCS varies E-4, V-5, M-6

(Wijdicks, et al., 2005)
PICO Question

• Among neurosurgical PICU patients,
• Does nursing assessment using the FOUR score
• Compared to the traditional assessment using the GCS
• Result in a more reliable and comprehensive assessment and/or predictor of patient morbidity and mortality?
Purpose of Study

• Evaluate and compare the interrater reliability of nurse rater scores on the GCS and FOUR score in pediatric patients

• Evaluate and compare the predictive validity of the two scoring systems

• Determine nurse rater comfort with the use of the FOUR Score assessment tool
Protocol

• PICU Nurses were asked to voluntarily participate in study
• Nurses who agreed were educated on:
  – Study protocol
  – GCS and FOUR Score Assessments

• Patient inclusion criteria
  – In-patient status
  – Neuroscience patients
  – Ages 2 years-18 years of age

• Patient exclusion criteria
  – Sedatives or Neuromuscular Blockades
  – Patients less than 2 years or greater than 18 years of age
Protocol

- 2 nurse raters assessed the patient at the time of admission to the PICU using both GCS and FOUR Score.

- Assessments were performed at the same point in time (within 10 minutes) and documented on separate score cards without knowledge of each other’s scores.

- Raters immediately sealed score cards in separate envelopes and placed them into a secure box.

- Each rater agreed not to discuss their scoring.
Subjects

- Convenience sample of 60 neuro patients admitted to CHOC PICU

- 4 categories:
  - Alert
  - Drowsy
  - Stuporous
  - Comatose

Hydrocephalus
TBI
Seizure
Brain tumor, various
Near drowner
AVM
Moya-moya
Craniosynostosis
Leukemia
Spina Bifida
Encephalitis
Chiari Malformations
Rater Demographics

35 Nurse Raters, with wide variety of experience

• Ages 23-60
• 12 ADN, 20 BSN, 3 MSN
• <1-40 years of experience in nursing
• Certifications 10 CCRNs
### Interrater Reliability

#### Weighted Kappa Statistics

<table>
<thead>
<tr>
<th>Value of $K$</th>
<th>Strength of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;0.40$</td>
<td>Poor</td>
</tr>
<tr>
<td>0.41-0.60</td>
<td>Fair</td>
</tr>
<tr>
<td>0.61-0.80</td>
<td>Good</td>
</tr>
<tr>
<td>0.81-1.00</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

*(Landis & Koch, 1977)*
Weighted kappa (κ) values, standard error (SE) and 95% confidence intervals (CI) for interrater agreement on the FOUR Score and GCS (N=60 patients)

<table>
<thead>
<tr>
<th>Weight κ</th>
<th>FOUR Score</th>
<th>Glasgow Coma Scale</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Eye</td>
<td>Motor</td>
</tr>
<tr>
<td>Total</td>
<td>0.975</td>
<td>0.860</td>
</tr>
<tr>
<td>SE</td>
<td>0.025</td>
<td>0.081</td>
</tr>
<tr>
<td>95% CI</td>
<td>0.93-1.00</td>
<td>0.70-1.00</td>
</tr>
</tbody>
</table>
## Modified Rankin Score Upon Patient Discharge (Select One):

- **0= No symptoms**
- **1= No significant disability despite symptoms**
  - (able to carry out all usual duties and activities)
- **2= Slight disability**
  - (unable to carry out all previous activities)
- **3= Moderate disability**
  - (requiring some help, but able to walk without assist)
- **4= Moderately severe disability**
  - (unable to walk without assist)
- **5= Severe disability**
  - (bedridden, incontinent, constant care)
- **6= Dead**
Conclusions

• Weighted Kappa for FOUR score total 0.951
  – Very Good

• Weighted Kappa for GCS total 0.738
  – Good

• FOUR score better predictor of outcome (71% of patients correctly classified vs. 63% with GCS)

• Nurses found the FOUR score clinically relevant and easy to use
Nursing Implications

• Nursing assessment using FOUR score was more reliable between raters than GCS

• Nurses were comfortable with FOUR and described the tool as easy to use
Limitations and Areas for Future Research

- Small $n$ in stuporous and comatose categories

- Need for future studies on interrater reliability and outcome prediction of FOUR score compared to GCS in a wide variety of settings and subjects

- Need for more studies on sicker patients

- More pediatric studies on implications of FOUR Score for this population
Acknowledgements

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Thank you.
References


