

Evaluation of pain incidence and pain management in a South African paediatric trauma unit

Tessa Thiadens, Elleke Vervat, Rene Albertyn, Monique van Dijk, A B (Sebastian) van As

Objectives. To evaluate pain incidence and pain management in a South African paediatric trauma unit, and to compare the usefulness of 5 different assessment tools.

Design. A prospective observational study, using the Numerical Rating Scale for pain (NRS pain), Numerical Rating Scale for anxiety (NRS anxiety), the Alder Hey Triage Pain Score (AHTPS), the COMFORT behaviour scale and the Touch Visual Pain Scale (TVPS). All patients were assessed at admission; those who were hospitalised were again assessed every 3 hours until discharge.

Results. A total of 165 patients, with a mean age of 5.3 years (range 0 - 13), were included. NRS scores were indicative of

moderate to severe pain in 13.3% of the patients, and no pain in 24% at admission. Two-thirds of the patients received no analgesics; for them, NRS pain, AHTPS and TVP scores were lower than the scores for the other children.

Conclusion. Pain and anxiety incidences in this paediatric trauma unit are relatively low. Implementation of a standard pain assessment tool in the emergency department triage system can improve pain management. The AHTPS is the most promising for use in non-Western settings.

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Paediatric trauma patients typically experience pain caused by open wounds, burns and fractures. They may also suffer from distress and emotional pain. Two studies found that management in the Emergency Department (ED) setting was not optimal;^{1,2} one found that 74% of patients (children and adults) had moderate to severe pain at discharge,² and the other was a study of pain management practices by nurses in the emergency department (ED) of a large hospital in Rwanda.³ Adult patients presenting to the department in severe pain (visual analogue scale (VAS) scores of 7 or higher) received no analgesic medication until after a median of 150 minutes. The findings mostly pertain to adults, but it seems unlikely that paediatric patients would have more favourable treatment.

Pain assessment in the paediatric ED can be challenging. Since babies and infants are too young to verbalise pain, behavioural pain observations are required to gain insight into the nature and level of pain. Behavioural pain instruments generally are based on facial expression, crying and body movements^{4,5} and have been validated for different age groups and settings. The Alder Hey Triage Pain Score (AHTPS) was developed specifically for use with children at triage in the accident and emergency (A&E) setting.⁶ The validity and reliability of these scales in South African ED settings have been little tested.

We aimed to evaluate the pain management and the feasibility of 4 paediatric pain assessment instruments, including the AHTPS, in a South African paediatric trauma unit.

Department of Paediatric Surgery, Erasmus MC-Sophia Children's Hospital, Rotterdam, The Netherlands
Tessa Thiadens, Doctorandus
Elleke Vervat, Doctorandus
Monique van Dijk, PhD

Department of Paediatric Surgery, Red Cross War Memorial Children's Hospital, Rondebosch, and University of Cape Town
Rene Albertyn, PhD
A B (Sebastian) van As, MB ChB, MMed, MBA, FCS (SA), PhD

Corresponding author: M van Dijk (m.vandijk.3@erasmusmc.nl)

Materials and methods

We conducted a prospective observational study in line with the World Medical Association Declaration of Helsinki. It was approved by the Medical Ethics Committee of the Health Sciences Faculty of the University of Cape Town. We included children aged 0 - 13 years admitted to the trauma unit in the Red Cross War Memorial Children's Hospital (RXCH), which has a dedicated level I trauma unit for children. Patients for whom the attending physician, nurse or parent felt that the study was harmful or too distressing were excluded.

From July to November 2008, 2 medical researchers (TT and EV) who had been trained to reliably assess pain with the selected assessment instruments collected data. Both researchers simultaneously but independently at each measurement moment applied all these 5 instruments in random order. Each eligible child was assessed at triage. If hospitalisation were needed, the assessments were repeated every 3 hours until discharge. Use of analgesics, sedatives and non-pharmacological treatment (distraction, play therapy etc.) was documented at triage at the same time points. Sex, date and time of admission, date and time of discharge, date of birth, type of trauma, type of injury, and procedures were recorded.

The languages most commonly spoken in Cape Town are Afrikaans, English and Xhosa. The researchers were familiar with Afrikaans and English. A Xhosa-speaking nurse explained the study to Xhosa-speaking parents or carers. Before assessing a child, verbal consent was obtained from the attending physician or nurse and from each parent present.

Assessment instruments

The AHTPS was developed and validated for children aged 0 - 16 years at triage in an A&E setting. Five categories of observations are identified: voice/crying, facial expression, posture, movement and colour. Each of these has a possible score of 0, 1 or 2, resulting in a total score ranging from 0 - 10. Scores ≥ 7 are thought to reflect severe pain.⁶

The COMFORT behaviour scale (COMFORT-B scale) describes 7 behaviours of which only 6 are assessed: of the tandem Crying/respiratory response, the first applies to spontaneously breathing children, and the second to ventilated children. The items of Alertness, Calmness/agitation, Facial tension, Muscle tone and Body movement apply to all. As responses are on a 1 - 5 Likert scale, with higher score indicating more pain, the total score can range from 6

to 30. Before scoring, the rater observes the patient for 2 minutes. For each item, the score must reflect the most distressed behaviour observed in the 2 minutes. The COMFORT-B scale has been validated for postoperative pain in children up to 3 years old.⁷ Scores ≥ 17 suggest a high risk for pain.

The Touch Visual Pain Scale (TVPS), developed at RXCH, includes a physical examination and observation of body position, facial and body tension, and breathing. The physical examination includes the gentle touching of the patient's feet, ankles, abdomen, chest, hands and arms where muscle tension can be felt and observed. The total score ranges from 0 to 10. Scores ≥ 4 require intervention.⁸

The Numeric Rating Scale (NRS) has been extensively used in clinical and research practice for self-report and observation of pain and anxiety.^{9,10} It is numbered from 0 to 10, with 0 representing 'no pain /anxiety' and 10 representing 'pain/anxiety as bad as it could be'. The researchers independently and simultaneously applied the NRS both for pain and anxiety. Scores are classified into 3 groups: mild pain (score 1 - 3), moderate pain (score 4 - 6) and severe pain (score 7 - 10).¹¹

The NRS pain and NRS anxiety scores were used to establish criterion validity of the COMFORT-B, TVPS and AHTPS, for pain assessment (AHTPS applied) and pain/anxiety assessment (COMFORT-B and TVPS applied).

Data analysis

Categorical data are presented as frequency (%), whereas continuous data with a normal distribution are presented as mean and standard deviation (SD). Inter-rater reliability was estimated with the intra-class correlation coefficient for continuous variables and with the linearly weighted kappa coefficient for the COMFORT-B items. Coefficients are presented with 95% confidence intervals (CI). The mean scores of both researchers were used in further data analysis.

To determine concurrent validity of COMFORT-B, TVPS and AHTPS, the correlation with NRS pain was determined using Pearson's product moment correlation coefficient. Based on a NRS pain ≥ 4 , optimal cut-off scores were calculated for the 3 instruments using the best combination of good sensitivity and specificity. In all patients, a maximum of 4 assessments were used to calculate sensitivity and specificity.

Data analysis was performed with SPSS version 15.0 (SPSS Inc, Chicago, IL). For all statistical tests, a significance level of 0.05 was considered statistically significant.

Results

Inter-rater reliability

The intra-class correlation coefficient between the 2 researchers was excellent, varying from 0.93 for NRS anxiety to 0.99 for the AHTPS. For the COMFORT-B scale, their kappa coefficient (linearly weighted) was 0.91 for both, based on 14 paired assessments with a qualified nurse.

Patient characteristics

There were 165 patients; 64.2% were boys, mean age 5 years and 4 months (range 0 - 13 years); 67.3% were discharged within 24 hours (Table I). A total of 205 pain assessments were performed: once in 145 (87.9%) patients, and from 2 - 6 times in the remaining 20 patients. Nearly half (46.7%) of the patients came to the trauma unit without referral from a health care provider; 40.0% of the referred patients came from a day hospital or clinical health centre. The trauma resulted from a fall in 43.6%, and pedestrian involvement in a motor vehicle accident in 21.2%.

Table I. Background characteristics of patients (N=165)

	N	%
Gender		
Boy/girl	106/59	64.2/35.8
Age in years on admission		
Mean (SD)	5.3 (3.6)	
Range	0 - 13	
Length of stay		
<24 h	111	67.7
≥ 24 h	53	32.3
Referral from		
Self-referral	77	46.7
Day hospital/clinical health centre	66	40.0
Ambulance	8	4.8
Other hospital	7	4.2
General practitioner	5	3.0
Other	2	1.2
Type of trauma		
Fall-type injury	72	43.6
MVA-ped	35	21.2
Burn	15	9.1
Follow-up*	10	6.1
Foreign body	9	5.5
NAI non-sexual	7	4.2
Ingestion	6	3.6
Laceration	5	3.0
Other	4	2.4
NAI sexual	2	1.2

*Follow-up: 4 - 6 weeks after NAI sexual.
MVA-ped = motor vehicle-pedestrian accident; NAI = non-accidental injury.

Incidence of pain and anxiety

NRS pain scores ≥ 4 (moderate to severe) were assigned to 13.3% of the patients; scores of 1 - 3 (minor pain) to 62.7%; and a score of 0 (no pain) to 24%. NRS anxiety scores ≥ 4 (moderate to severe) were assigned to 7.1%; scores of 1 - 3 (minor anxiety) to 48.9%; and a score of 0 (no anxiety) to 44%.

Psychometric evaluation

The AHTPS correlated best with NRS pain ($r=0.75$). The COMFORT-B scale had the lowest correlation ($r=0.55$) with NRS pain but the highest correlation with NRS anxiety ($r=0.71$). The TVPS had a moderate correlation with both NRS pain ($r=0.66$) and NRS anxiety ($r=0.61$) (Table II).

Cut-off values

With a receiver operating characteristic (ROC) curve based on NRS ≥ 4 in 192 assessments, the best ratio between the sensitivity and specificity was found for an AHTPS score ≥ 3 (sensitivity 0.95, specificity 0.89). For the COMFORT-B scale, a score ≥ 16 resulted in sensitivity of 0.75 and specificity of 0.81. For the TVPS, a score ≥ 2 resulted in a sensitivity of 0.83 and a specificity of 0.79 (Fig. 1).

Table II. Correlations between behavioural pain instruments and NRS pain and NRS anxiety

		NRS	
		NRS pain	NRS anxiety
AHTPS	<i>r</i>	0.75	0.56
	95% CI	0.67 - 0.81	0.44 - 0.66
	<i>N</i>	156	156
TVPS	<i>r</i>	0.66	0.61
	95% CI	0.56 - 0.74	0.50 - 0.70
	<i>N</i>	156	156
COMFORT behaviour	<i>r</i>	0.55	0.71
	95% CI	0.43 - 0.65	0.62 - 0.78
	<i>N</i>	165	156

TVPS = touch visual pain scale; NRS = numerical rating scale; AHTPS = Alder Hey triage pain scale.
All correlations $p < 0.001$.

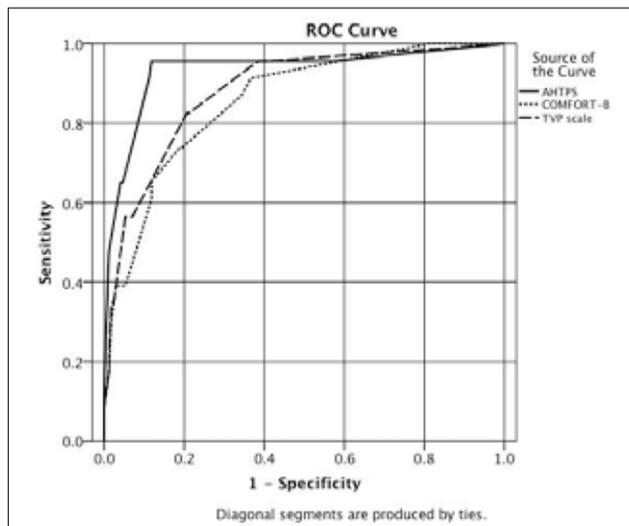


Fig. 1. ROC curve for AHTPS, COMFORT-B and TVP scale.

The area under the curve (AUC) for AHTPS was not statistically significantly different from the AUC of TVP ($z=1.19$, $p=0.23$) and AUC of COMFORT-B ($z=1.78$, $p=0.08$).

Pain treatment

Only 37% of patients received analgesics (Table III); in 6.6%, the prescribed analgesics and sedatives were not, or only partly, given. Children with moderate to severe pain (NRS ≥ 4) received analgesics significantly more often (χ^2 test 11.13, $p=0.001$), i.e. 18/31 v. 36/134 of the others (NRS < 4).

Of all the patients, 24 (14.5%) received opioids, 37 (22.4%) received paracetamol or paracetamol with codeine, and 6 (3.6%) received a sedative. Of those who received opioids, 10 had been involved in a motor vehicle accident as a pedestrian, and 11 had had falls. At discharge, 15 (9.1%) of all patients were given paracetamol to take home.

Regarding the first pain assessment, the mean NRS pain score for those who afterwards received analgesics was significantly higher than that for those who did not (mean 2.4 (SD 1.8) v. mean 1.5 (SD 1.3) (t -test, $p=0.002$). Likewise, the mean AHTPS score for those who

Table III. Analgesics and sedatives prescribed and given (N=165)

	<i>N</i>	%
Analgesics		
Paracetamol	31	18.8
Paracetamol+codeine	6	3.6
Opioids*	24	14.5
None	104	63.0
Sedatives		
Benzodiazepines	5	3.0
Chloral hydrate	1	0.6
None	158	95.8

*Tilidine drops orally = 21; IV morphine = 3.

received analgesics was significantly higher than that for those who did not (mean 2.4 (SD 1.9) v. mean 1.3 (SD 1.3) (t -test, $p < 0.001$).

Discussion

Our study showed a low incidence of moderate to severe pain and anxiety in the RXCH paediatric trauma unit. Children with moderate to severe pain received analgesics significantly more often than children with less intense or no pain. The RXCH trauma unit does not apply pain assessment instruments during the triage process.

We compared the use of 5 different pain assessment instruments, using the NRS pain and NRS anxiety as the gold standard. The AHTPS assessment tool appeared to be easy to use and takes little time. Compared with the COMFORT-B scale, the AHTPS 'physical movement' concentrates on the affected body area instead of the whole body, which might be more accurate for use in a trauma unit. Validated cut-off scores for the AHTPS have not been established. Our findings for the ratio between sensitivity and specificity for an AHTPS ≥ 3 suggest that score 3 is a good cut-off to differentiate between pain and no pain.

A possible limitation of the COMFORT-B scale in the trauma unit is that it takes approximately 3 minutes to complete, which is long for the ER setting. The TVPS had a moderate correlation with both the NRS pain and the NRS anxiety. As a practical consideration: although touch is an essential part of the TVPS, it was in many cases impossible to touch the patient. The TVPS was originally designed for hospitalised chronically ill infants (e.g. HIV+ infants), which explains why it is not an ideal assessment instrument for the trauma unit, where acute injuries predominate. The overall findings show that the AHTPS, already validated for use in the paediatric A&E department,⁶ is most promising for developing a pain treatment algorithm.

Some nurses were reluctant to provide opioids since they thought these drugs to be addictive. Other nurses reported that taking pain medication was a sign of weakness and that pain was a logical consequence of injury. Nurses in a hospital in Rwanda felt that cultural factors influenced how they treated pain,³ which is similar to a finding in Australia, providing further indications that assessment of pain in a multi-cultural environment is prone to subjectivities that can conduce to ineffective pain management.¹²

The question arises whether the true incidence of pain and anxiety was low or whether the instruments used were unsuitable for this particular setting. Possible differences in pain expression between African and Western children might lie in low NRS scores assigned by the two foreign researchers.

A possible limitation of this study is that the nurses were aware of our study topic, which might have encouraged a stricter pain medication administration.

Conclusion

We suggest implementing a combination of the NRS pain scale, NRS anxiety scale and the AHTPS in the ED triage system. Nurses and doctors would be alerted early to a patient's pain and anxiety and so improve pain management. A pain management training module for nursing and medical staff that addresses recognition of pain, pain treatment, and its benefits for the healing process, should be developed. The 2009 guideline of The South African Society of Anaesthesiologists provides information on pain treatment.¹³ Traditional beliefs and myths about pain and pain treatment should be corrected as an essential factor in further improvement of pain management.

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Appendices

The AHTPS chart, TVPS and COMFORT behaviour scale have been included as appendices 1, 2 and 3. The scales are readily available online, and have therefore been excluded from the printed version of this article, but they appear in the online version.

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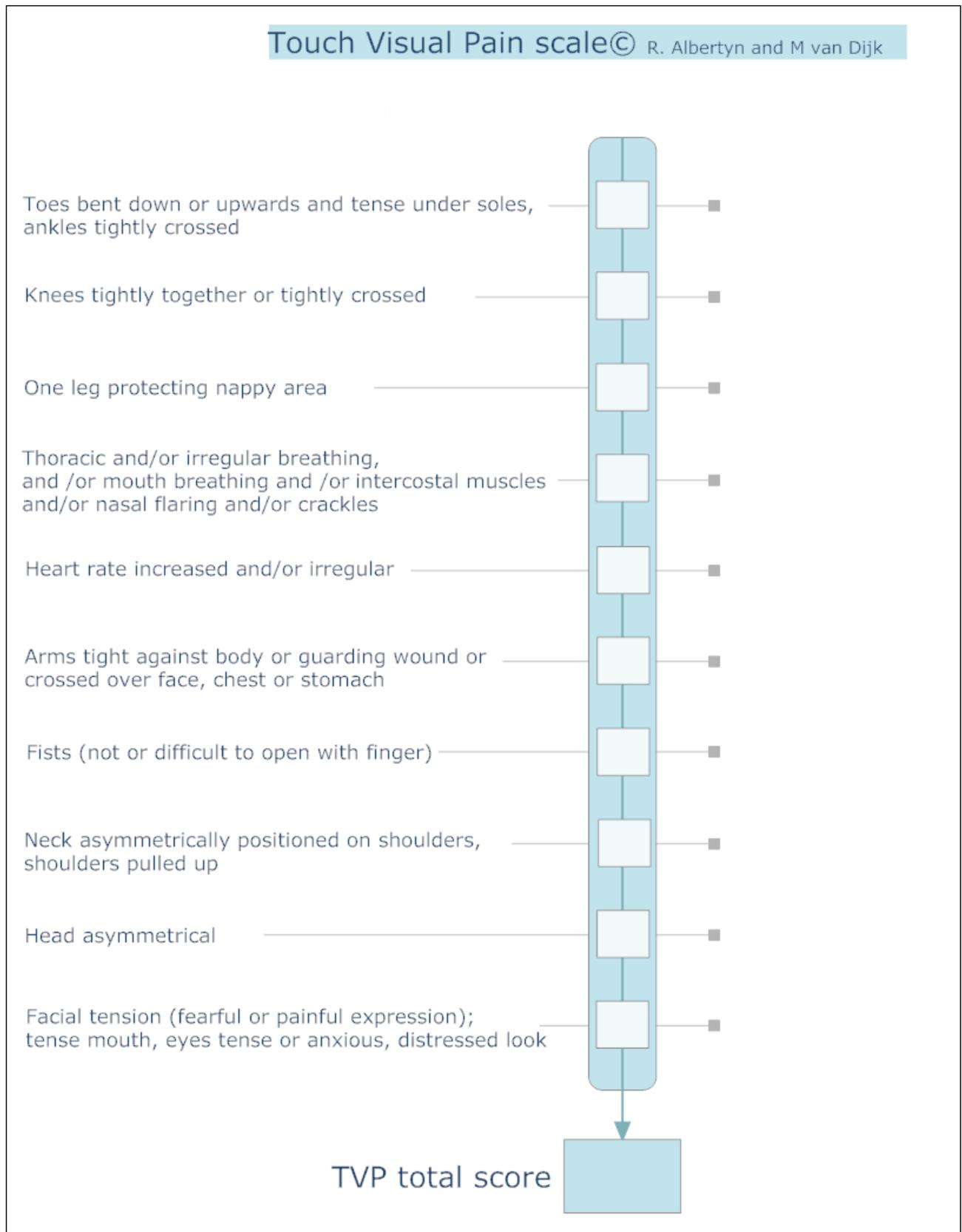
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Appendix 1. The Alder Hey Triage Pain Score; reference scoring chart

Response	Score 0	Score 1	Score 2
1. Cry or voice	No complaint/cry Normal conversation	Consolable Not talking negative	Inconsolable Complaining of pain
2. Facial expression	Normal	Short grimace <50% of time	Long grimace >50% of time
3. Posture	Normal	Touching/rubbing/sparing	Defensive/tense
4. Movement	Normal	Reduced or restless	Immobile or thrashing
5. Colour	Normal	Pale	Very pale/'green'

Touch Visual Pain scale © R. Albertyn and M van Dijk



Appendix 2. Touch Visual Pain Scale (TVPS)

COMFORT behavior © scale

Date _____

Time _____

Observer _____



Please place a mark

Alertness

- Deeply asleep (eyes closed, no response to changes in the environment) 1
- Lightly asleep (eyes mostly closed, occasional responses) 2
- Drowsy (child closes his/her eyes frequently, less responsive to the environment) 3
- Awake and alert (child responsive to the environment) 4
- Awake and hyper-alert (exaggerated responses to environmental stimuli) 5

Calmness/Agitation

- Calm (child appears serene and tranquil) 1
- Slightly anxious (child shows slight anxiety) 2
- Anxious (child appears agitated but remains in control) 3
- Very anxious (child appears very agitated, just able to control) 4
- Panicky (severe distress with loss of control) 5

Respiratory response

(score only in mechanically ventilated children)

- No spontaneous respiration 1
- Spontaneous and ventilator respiration 2
- Restlessness or resistance to ventilator 3
- Actively breathes against ventilator or coughs regularly 4
- Fights ventilator 5

Crying

(score only in spontaneously breathing children)

- Quiet breathing, no crying sounds 1
- Occasional sobbing or moaning 2
- Whining (monotonous sound) 3
- Crying 4
- Screaming or shrieking 5

Physical movement

- No movement 1
- Occasional, (three or fewer) slight movements 2
- Frequent, (more than three) slight movements 3
- Vigorous movements limited to extremities 4
- Vigorous movements including torso and head 5

Muscle tone

- Muscles totally relaxed; no muscle tone 1
- Reduced muscle tone; less resistance than normal 2
- Normal muscle tone 3
- Increased muscle tone and flexion of fingers and toes 4
- Extreme muscle rigidity and flexion of fingers and toes 5

Facial tension

- Facial muscles totally relaxed 1
- Normal facial tone 2
- Tension evident in some facial muscles (not sustained) 3
- Tension evident throughout facial muscles (sustained) 4
- Facial muscles contorted and grimacing 5

Total score

VAS (Visual Analogue Scale)

Put a mark on the line below to indicate how much pain you think the child has at **this very moment**.

no pain |-----| worst pain

VAS score

Details medication _____

Details child's condition _____

Type of assessment _____

(before or after medication or standard assessment)

Mean arterial blood pressure and heart rate are not included in this version of the COMFORT Scale.

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