

New soft clinical indicators of neonatal illness severity

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Key points

This research is a cohort study of babies in neonatal intensive care. It aims to determine whether parent-provided possessions at the patient bedside might also accurately reflect neonatal illness severity. We found that through gift giving, parents reliably reflected PRISM scores and, by extension, neonatal illness severity.

Abstract

Background

Practitioners rely on the Pediatric Risk of Mortality (PRISM) Score as the standard for assessing neonatal illness severity. Clinicians also may use the Clinical Risk Index for Babies (CRIB) score, the American Society of Anesthesiology (ASA) patient classification system, length of hospitalization, patient weight, and the anecdotal Patient Chart-to-Patient Weight Ratio (PCPWR). This study aims to determine whether parent-provided possessions at the patient bedside might also accurately reflect neonatal illness severity.

Methods

The study is prospective observational trial conducted on tertiary surgical Neonatal Intensive Care Unit (NICU) servicing 250 000 km² in Australia with a culturally diverse population. Participants are all neonates admitted to our surgical NICU within a 12-week period. Primary and secondary outcomes measures: Investigators determined weekly PRISM and CRIB scores, ASA classifications, and patient and case note weights. Addi-

tionally, investigators catalogued private possessions in, around, and attached to patients' cribs, placing each possession into "soft toys", "spiritual amulets" or "other items" categories.

Results

Investigators followed 102 neonates, collecting 249 observations. PRISM scores correlated best with the "spiritual amulets" category ($R^2=0.82$). The TOI (Tokens and Ornaments Index), calculated by combining all possessions in the "soft toys", "spiritual amulets", and "other items" categories, correlated next best ($R^2=0.71$). The CRIB Score ($R^2=0.63$), ASA classification ($R^2=0.61$), and "soft toys" category ($R^2=0.39$) all correlated to lesser degrees than TOI. Birth and current weight, post-conceptual age, NICU days and PCPWR each demonstrated insignificant correlations.

Conclusions

Private bedside possessions reliably reflected PRISM scores and, by extension, neonatal illness severity. Specifically, the number of spiritual items and TOI correlated well and may therefore serve as independent indica-

tors of clinical status. This may have potential for also identifying anaesthetic risk. Despite the widespread belief of an association between application of PCPWR and illness severity, this study found no support for its validity.

Keywords: risk assessment, pediatric anaesthesia, neonatal intensive care, illness severity scoring.

Introduction

Clinicians have a number of scoring systems available to determine neonatal illness severity. The Paediatric Risk of Mortality (PRISM) Score^{1,2} serves as one such clinically supported standard, allowing for an accurate estimation of illness in this difficult and potentially fragile population. Another clinically validity tool, the Clinical Risk Index for Babies (CRIB) score, has also proven useful, but lacks everyday utility in that it is accurate only during the first 12 hours of life.^{3,4} In anaesthesia, the only current clinical index to assess anaesthetic risk in infants is the American Society of Anesthesiology (ASA) patient classification system.⁵⁻⁷ However, the validity of this index has not been assessed for preterm infants. Traditionally clinicians have relied on non-medical assessment tools, such as the widely accepted Patient Chart-to-Patient Weight Ratio (PCPWR) to determine patient morbidity and, by extension, anaesthetic risk. The PCPWR, however, has only anecdotal evidence to support its value. Searching for other neonatal illness severity determinants, attention turns to the parents of sick neonates themselves. Parents have a keen interest in the health of their children. Typically spending hours at the bedside, parents absorb the scale of their child's therapeutic requirements as well as, on occasion, actually participating in the delivery of care. Extended time at the bedside and in the Neonatal Intensive Care Unit (NICU) proper avails parents to frequent clinical updates from the full spectrum of their child's health care providers. Many intensive care units even encourage parental presence during resuscitative efforts and other urgent life-saving interventions in order for parents to understand and accept the seriousness of their child's

medical conditions. Indirectly, then, parents might demonstrate an understanding of the severity of their child's condition in a clinically useful way. This study aims to investigate whether parents can accurately reflect neonatal illness severity compared to established neonatal illness scoring systems.

Methods

This study was approved by the institutional Ethics Committee. Since the study was classified as a quality control audit, written informed consent was waived. Over a 12-week period, the authors reviewed patients in the NICU of our tertiary paediatric centre. Weekly, investigators determined PRISM and CRIB Scores (the latter extended beyond the first 12 hours of life) and assigned an ASA patient classification for each patient.^{1-5,7} Furthermore, investigators noted the gestational age at birth, corrected gestational age at the time of each evaluation, patient birth and current weights, and the weight of patient's case notes. Total number of days each patient had spent in the NICU was also recorded. In addition, investigators catalogued all privately obtained, non-medical objects in, around, and attached to patients' cribs, dividing them into one of three categories: "soft toys" (e.g. teddy bears, cuddly animals), "spiritual amulets" (e.g. prayer cards, holy water, guardian angels, stones and crystals), or "other items" (e.g. blankets, picture books, photographs, drawings, plastic toys). All but one member of the NICU staff were kept unaware of the study's purpose as to not influence data collected. Data were analysed using a linear or polynomial regression, as appropriate, using StatView for Windows (SAS Institute Inc., Cary NC, Version 5.0.1)

Results

One hundred and nine patients contributed to a total of 249 observations. The median weeks gestation at birth was 33 (23-41) weeks with a median birth weight of 2240 (450-4470). The TOI (Tokens and Ornaments Index) was calculated by combining all possessions in the "soft toys", "spiritual amulets", and "other items" categories. The correlations between the different parame-

ters assessed are given in Table 1. Figure 1 a-d depicts the correlation between the PRISM score and the number of soft toys and spiritual items, the TOI, and the weight of the patient charts.

Correlation assessed	Y =	R ²
Spiritual items vs PRISM	$0.007x^2 + 0.0422x - 0.0754$	0.81607
Soft toys vs. PRISM	$0.1522x + 0.8795$	0.39224
Other items vs PRISM	$0.0881x + 0.0344$	0.26826
TOI vs. PRISM	$0.4388x + 0.5485$	0.71152
TOI vs. gestation at birth	$-0.2876x + 12.238$	0.21332
TOI vs. weeks on NICU	$0.22x + 1.8408$	0.11054
TOI vs ASA	$3.1143x - 4.7277$	0.48515
TOI vs. current weight	$-0.0006x + 4.5361$	0.02494
TOI vs CRIB at birth	$0.3562x + 0.7886$	0.2601
Weight of notes vs TOI	$108.33x + 1271.3$	0.19789
Weight of notes vs. PRISM	$23.397x + 1460.5$	0.03411
Weight of notes/current weight (PCPWR) vs PRISM	$0.0451x + 0.491$	0.30841
Weight of notes/birth weight vs PRISM	$0.0883x + 1.0905$	0.10506
PRISM vs. current weight	$-0.0029x + 12.946$	0.14583
ASA vs. PRISM	$-0.0019x^2 + 0.1313x + 1.8936$	0.61128

Table 1. Correlations between the different parameters assessed.

ASA American Society of Anesthesiology patient classification system

CRIB Clinical Risk Index for Babies Score

NICU Neonatal Intensive Care Unit

PCPWR Patient Chart to Patient Weight Ratio

PRISM Pediatric Risk of Mortality Score

TOI Token and Ornament Index

Figures 2 and 3 demonstrate two illustrative examples of parallel changes in PRISM scores and TOI over time in a very small neonate and a set of twins with TOI increasing with increasing PRISM and vice versa.

Before and after correction for length of stay, the PCWR was not significantly correlated to PRISM score.

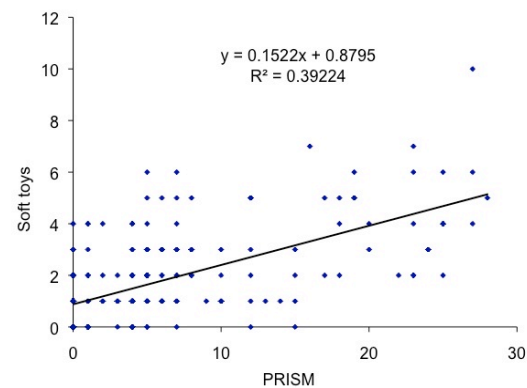


Fig. 1a Correlation between the PRISM score and the number of soft toys in and around the patient's crib

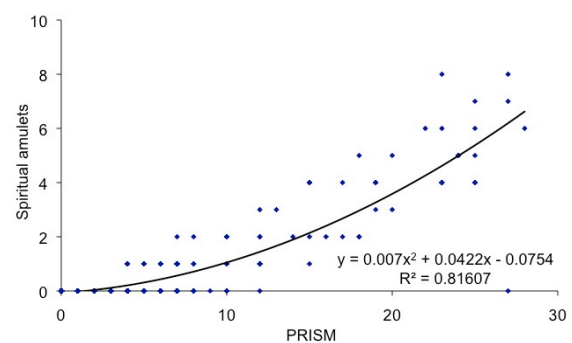


Fig. 1b Correlation between the PRISM score and the number of spiritual items in and around the patient's crib

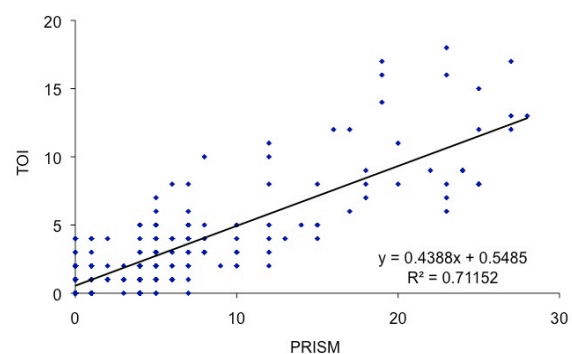


Fig. 1c Correlation between the PRISM score and the TOI (Token and Ornament Index)

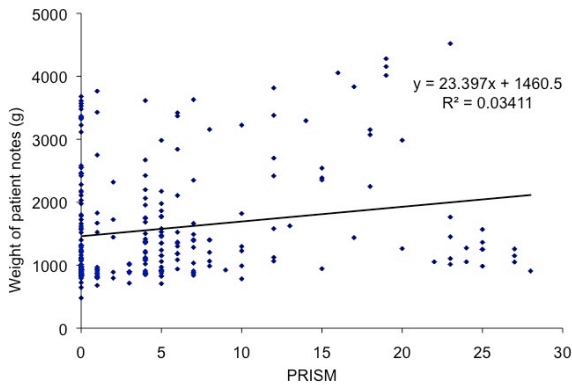


Fig. 1d Correlation between the PRISM score and the weight of the patient charts.

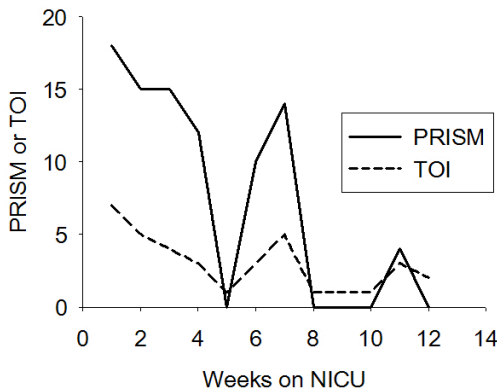


Fig. 2 Changes in TOI (Token and Ornament Index) and PRISM (Pediatric Risk of Mortality Score) over time in a neonate born at 23 weeks gestation, birth weight 470g.

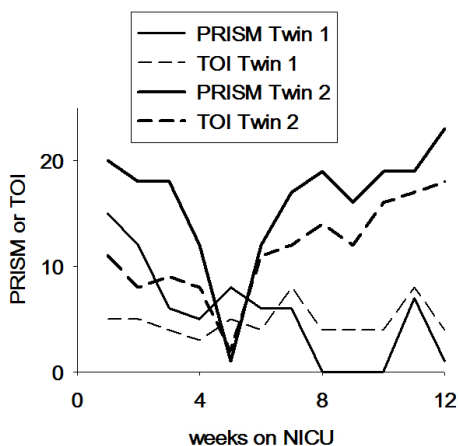


Fig. 3 Changes in TOI (Token and Ornament Index) and PRISM (Pediatric Risk of Mortality Score) over time in a twin couple, born at 24 weeks gestation, birth weights 721g and 610g.

Discussion

Clinical scoring systems for the severity of neonatal illness offer information upon which to make medical and surgical decisions. The validity of most scoring systems relies on knowing individual bedside and laboratory values and their proper application within each scoring system. However, these scoring systems might not be known to a non-neonatology clinician, such as an anaesthetist, who needs to quickly and accurately assess how ill a neonate might be. A non-clinical scoring system would provide all clinicians, regardless of training, with a simpler way to make such assessments. PCPWR is one such scoring system that enjoys widespread favor despite the absence of clinical validation. This study compared PCPWR to PRISM scores and found little support for PCPWR as a predictor of neonatal illness severity compared to the clinically established PRISM scoring system. Even when corrected for length of stay in the NICU, birth or subsequent weights, PCWR did not demonstrate a correlation with PRISM scores. In contrast, CRIB scores correlated much better to PRISM scores, even when applied beyond the first 12 hours of life as originally intended. However, CRIB scoring, like PRISM, obliges the clinician to have specific up-to-date information and knowledge of its proper application to calculate meaningful scores. By virtue of their attendance at their babies' bedsides throughout large portions of NICU stays, parents of ill neonates have opportunities to observe firsthand the clinical condition of their infants. Lacking medical training and experience, parents certainly have the capability, even if solely on a subconscious level, to express judgments pertaining to the health status of their children. Casual observation seems to reflect this as sicker neonates appear to receive more gifts from their families than less ill neonates. This study quantified these observations. The actions of parents, through gift and token giving to their newborn children, correlated better to PRISM scores than any other clinical and non-clinical scoring systems. The giving of toys and other non-spiritual items by themselves did not demon-

strate parental understanding of the health status of their babies. The newly described Tokens and Ornaments Index, composed of the aggregate number of spiritual amulets, soft toys, and other items accrued by a neonate during his or her days in the NICU, though, linearly correlated more strongly to PRISM scores than other clinical and non-clinical scoring systems. This suggests the TOI might serve as a new non-clinical tool with which one could estimate neonatal illness severity. Furthermore, parents even more strongly reflected an understanding of the overall health status of their children through the bestowing of spiritual amulets. Such giving proved comfortingly non-linear, with the number of spiritual items increasing with illness and decreasing with improved health. TOI values of individuals dropped primarily through a reduction in the number spiritual items, not soft toys or other items. We found that illness severity correlated poorly with patient weight alone and length of NICU stay, both commonly quoted, but poorly defined non-clinical scoring systems. An example of this is the long-held, but little substantiated beliefs that neonates that are smaller or experience an increased length of stay in NICU comprise a sicker subcategory. However, a majority of sick neonates will recover and therefore the length of NICU stay or PCPWR will not reflect this. Furthermore, length of NICU stay will not assure a patient of even receiving a toy or other family token if it was not severely ill. It is a limitation of this study that we assumed PRISM scores as the gold standard for the indication of illness severity. However, in the future, the independent evaluation of TOI or the number of spiritual items is needed to assess whether these might be a more accurate measures of illness severity compared with PRISM scores.

Conclusion

In conclusion, through gift giving, parents reliably reflected PRISM scores and, by extension, neonatal illness severity. Specifically, the number of spiritual items and TOI correlated well with illness severity and may there-

fore serve as independent indicators of clinical status. Whether the anaesthetic risk is reflected by these new soft clinical scores and can reliably be used to predict the anaesthetic risk remains to be tested. Despite widespread application of length of hospitalization, patient weight, and PCPWR, this study found no support for their validity.

Source of funding

Prof. Britta S von Ungern-Sternberg is partly funded by the Princess Margaret Hospital Foundation and Woolworths Australia.

References

1. Pollack MM, Ruttimann UE, Getson PR. Pediatric risk of mortality (PRISM) score. *Crit Care Med.* 1988;16:1110-1116.
2. Pollack MM, Patel KM, Ruttimann UE. PRISM III: an updated Pediatric Risk of Mortality score. *Crit Care Med.* 1996;24:743-752.
3. The CRIB (clinical risk index for babies) score: a tool for assessing initial neonatal risk and comparing performance of neonatal intensive care units. The International Neonatal Network. *Lancet.* 1993;342:193-198.
4. Parry G, Tucker J, Tarnow-Mordi W. CRIB II: an update of the clinical risk index for babies score. *Lancet.* 2003;361:1789-1791.
5. Saklad M. Grading of patients for surgical procedures. *Anesthesiology.* 1941;2:281-284.
6. Dripps RD, Lamont A, Eckenhoff JE. The role of anesthesia in surgical mortality. *JAMA.* 1961;178:261-266.
7. House of Delegates of the American Society of Anesthesiologists Incorporated. New Classification of physical status. *Anesthesiology.* 1963;24:111.