



Validation of a surgical neonatal nursing workload tool

Kerry Hart^{a,*}, Allison Marchuk^b, Jessica-Lynn Walsh^c, Alexandra Howlett^d

^a Unit Manager, Neonatal Intensive Care Unit, Alberta Children's Hospital, Calgary, Alberta, Canada

^b Clinical Quality & Safety Lead, Neonatal Intensive Care Unit, Alberta Children's Hospital, Calgary, Alberta, Canada

^c Research Assistant, Neonatology, Alberta Children's Hospital, Calgary, Alberta, Canada

^d Neonatology, Alberta Children's Hospital, Department of Pediatrics, University of Calgary, Calgary, Alberta, Canada



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ABSTRACT

Objective: To describe the development and validation of the Winnipeg Assessment of Neonatal Nursing Needs Tool-Surgical Complex (WANNNT-SC), a nursing workload tool for use in a surgical neonatal intensive care unit (NICU).

Methods: The Winnipeg Assessment of Neonatal Nursing Needs Tool (WANNNT) was modified to create the WANNNT-SC. Nursing staff utilized the tool over 60 consecutive shifts to determine the number of nurses needed to appropriately staff the unit. The charge nurse, based on professional judgement, also determined how many nurses were required to staff the unit on each shift.

Results: The WANNNT-SC determined that 1.76 fewer nurses were needed for direct patient care. The tool was reliable across multiple users (mean difference 0.003, SD 0.32).

Conclusion: The WANNNT-SC is valid, reliable, and can be used to determine the number of nursing staff required to provide direct patient care in a surgical NICU.

1. Introduction

The provision of quality patient care to neonates and their families is a universal goal shared by neonatal intensive care units (NICUs). When working towards optimal patient care, a balance must be struck between budgetary limitations and workload demands on health care providers. With front-line nurses representing the largest budgetary expenditure in NICUs (Milligan et al., 2008), it is imperative to utilize an appropriate tool to measure nursing workload to assist in the development of balanced, safe patient assignments. Surgical neonatal patients have unique and demanding nursing needs, but there is currently no tool that adequately describes the nursing workload associated with these patients. This paper details the process of using a validated tool to develop and validate the WANNNT-SC, a novel surgical NICU nursing workload tool.

1.1. Background

1.1.1. Nursing workload defined

Nursing workload is the nursing time devoted to direct and indirect patient care, workplace activities, and professional development (Alghamdi, 2016). Due to higher levels of acuity and complexity frequently seen in NICUs, significant nursing resources and time are

required to provide care (Rogowski et al., 2015). Utilizing an appropriate nursing workload tool has been recognized as a way to evaluate patient care needs, standardize patient assignments, support safe staffing levels, and justify budgetary expenditures related to nursing care (Kiekkas et al., 2007; Young et al., 2015).

The Canadian Federation of Nurses Unions (CFNU) has highlighted an urgent need to address the issue of nursing workload as a means of improving the care patients and their families receive (Berry and Curry, 2012), while the Canadian Nurses Association (CNA) has stated that the accurate measurement of nursing workload is an important component when providing quality nursing care (CNA, 2004). The National Association of Neonatal Nurses (NANN) in the United States also recognizes that issues related to staffing and nursing workload have the potential to impact patient outcomes both positively and negatively (NANN, 2014).

1.1.2. Impact of increased nursing workload and decreased staffing on patient outcomes

Neonatal patients are at an increased risk of experiencing adverse events related to increases in nursing workload. Due to their small size, even slight variations in fluid and medication administration can result in adverse outcomes (Mark et al., 2007). Neonates who are exposed to adverse events are more likely to experience long-term morbidity in

* Corresponding author.

E-mail address: kerry.hart@albertahealthservices.ca (K. Hart).

Table 1
Winnipeg assessment of neonatal nursing needs tool – surgical complex (WANNNT-SC).

| ACUITY SCORE | Corrected Gestational Age up to 1 Week of Life | Corrected Gestational Age After 1 Week of Life | Central Nervous System (CNS)/Temperament | Blood Pressure Monitoring | Respiratory/Ventilation | Cardiovascular | Gastrointestinal (GI)/Feeds | Other |
|--------------|--|---|--|---|---|---|---|---|
| 2.0 | | | | | | <ul style="list-style-type: none"> ● Peritoneal Dialysis ● Exchange Transfusion | | <ul style="list-style-type: none"> ● Complex Critically ill ● Congenital Diaphragmatic Hernia (CDH) ● Multi-system failure requiring frequent multiple interventions ● Pre-surgical Gastroschisis or Myelomeningocele ● Post-op complex surgery x 12h ● Unstable CDH pre-op ● Continuous bladder pressure monitoring ● End of Life Care ● Out of town transfer |
| 1.0 | ● ≤ 27 ^{6/7} | <ul style="list-style-type: none"> ● Actively seizing with continuous EEG ● 72 h cooling protocol ● paralyzed patient ● Irritable 76–100% of time (9–12 h/shift ● External Ventricular Drain | ● < q30min | | <ul style="list-style-type: none"> ● Unstable, ventilated ● Multiple chest tubes ● Post-op Tracheostomy x72 h ● Nitric Oxide (NO) requiring frequent changes ● HFO/let Vent acute ● Difficult airway/critical ETT ● Planned ETT change ● Stable intubated ● SIPAP ● Chronic long term HFO on VN ● Chest tube ● Stable/Query PPHN ● Stable on NO ● Suctioning > q2h | <ul style="list-style-type: none"> ● 1 inotrope < 24 h ● > 1 inotrope or frequent titrating of inotrope ● insulin administration ● 24 h post PDA ligation ● Balloon Septostomy + 24 h post procedure ● NIRS monitoring ● Multiple central access sites/IV access issues ● Hourly fluid balance ● 1 inotrope > 24 h with few changes/weaning ● Crystalline fluid loss replacement (replogle etc.) ● Blood product admin > 3 h/shift ● Stable on prostin ● THAM infusion | <ul style="list-style-type: none"> ● Pre-op confirmed NEC/bowel perforation | <ul style="list-style-type: none"> ● Complex Critically ill ● Congenital Diaphragmatic Hernia (CDH) ● Multi-system failure requiring frequent multiple interventions ● Pre-surgical Gastroschisis or Myelomeningocele ● Post-op complex surgery x 12h ● Unstable CDH pre-op ● Continuous bladder pressure monitoring ● End of Life Care ● Out of town transfer |
| 0.7 | ● ≤ 27 ^{6/7} | <ul style="list-style-type: none"> ● Irritable 51–75% of time (irritable 6–9 h/shift) ● Elevated PIPP or NAS scores ● Continuous EEG with no active seizures ● New reservoir requiring tap | ● Invasive UAC/PAL | | | | <ul style="list-style-type: none"> ● Bowel obstruction ● Ostomy requiring > than daily appliance changes ● Rectal irrigation ● Ostomy refeeding ● Critical G-tube | <ul style="list-style-type: none"> ● Isolation ● Off unit procedure (MRI/CT) ● On unit procedure (PICC insertion, chest tube insertion) ● Full Septic Work-up ● Complex dressing change/PICC dressing change ● Ultrasound (ECHO/Cranial) |
| 0.5 | ● 28 ^{0/7-30} ^{6/7} | <ul style="list-style-type: none"> ● Irritable 25–50% of time (3–6 h/shift) ● Stable reservoir requiring tap ● Phototherapy | ● ≥ q3h non-invasive | <ul style="list-style-type: none"> ● HFNP (> 1LPM) ● CPAP | <ul style="list-style-type: none"> ● TPN via PIV/PICC/UVC ● ≥ q3h glucose monitoring ● ≥ 5 bradycardic episodes (HR < 90) q12 h ● > 2 IV medications | <ul style="list-style-type: none"> ● Q2h or trophic feeds ● Feeding takes > 30 min ● NEC ● Ostomy care requiring < daily appliance changes | <ul style="list-style-type: none"> ● Transport to another inner-city hospital ● Complex discharge/parent teaching ● Stable CDH pre-op ● Post-op routine surgery (hernia/ROP) ● Partial Septic Work-up ● ROP Exam ● Healthy infant with significant social issues ● Simple discharge/parent teaching | |
| 0.3 | ● 31 ^{0/7- term +} | <ul style="list-style-type: none"> ● Irritable < 3 h/shift | ● q shift | <ul style="list-style-type: none"> ● Room air ● Low flow NP ≤ 1 LPM | <ul style="list-style-type: none"> ● NS lock PIV ● D10W infusion with ≤ 2 IV medications | <ul style="list-style-type: none"> ● CMD ● Q3h gavage/bottle/breast | | |

comparison to other pediatric and adult populations (Sharek et al., 2006).

Decreased staffing has been related to an increase in major morbidity and mortality among neonates (Beltempo et al., 2018), an increased incidence of nosocomial infections in very low birth weight (VLBW) infants (Rogowski et al., 2013), and higher rates of bloodstream infections (Cimiotti et al., 2006). When nursing workload increases, adverse events related to mechanical ventilation also increase (Lamy Filho et al., 2011), as does the rate of risk-adjusted mortality (Hamilton et al., 2007). Elevated workload is also associated with impaired weight gain in preterm neonates (Profit et al., 2010). Conversely, when appropriate nurse-to-patient ratios exist, neonates are more likely to meet oxygen saturation goals (Sink et al., 2011) and receive increased breastfeeding support (Hallowell et al., 2014).

Insufficient staffing in the NICU has also been associated with missed nursing care. In situations of elevated workload, a variety of nursing tasks are missed, including mouth care for patients on ventilators, parent education, and discharge planning (Rochefort and Clarke, 2010). Involving parents in care delivery and infant feedings also decreases when nursing workload increases (Tubbs-Cooles et al., 2014). When important and necessary nursing care is missed, adverse events and poor patient outcomes are more likely.

1.1.3. Rationale for WANNNT selection

Despite a thorough literature search, no neonatal nursing workload tool for use in a surgical NICU was found. The decision was made to modify a validated NICU nursing tool to better meet the needs of the surgical NICU patient population.

Several neonatal nursing workload tools were found in the literature: the Neonatal Therapeutic Intervention Scoring System (Gray et al., 1992); the Northern Neonatal Network Score (1993); the British Association of Perinatal Medicine (BAPM) Categories of Babies Requiring Neonatal Care (2001); the Neonatal Acuity System (Mullinax and Lawley, 2002); and the Winnipeg Assessment of Neonatal Nursing Needs Tool (WANNNT) (Sawatzky-Dickson and Bodnaryk, 2009). All tools assign a number to represent patient acuity and care needs. By quantifying patient acuity, nursing assignments with balanced workloads can be created despite being comprised of very different patients (Hurst, 2002). Except for the WANNNT, all other neonatal-specific workload tools were more than 15 years old. The care of neonates has changed markedly since then due to advances in medical technology and clinical research.

The WANNNT was selected because it was easy to implement, and permission was granted to modify the tool (Sawatzky-Dickson and Bodnaryk, 2009). The Alberta Children's Hospital level III NICU (ACH NICU), a 14 bed unit caring for neonates with surgical, neurocritical, and complex medical needs employed 90 nurses in casual to full-time positions. Thus, it was important to select a workload tool that could be modified to reflect the unique patient population and the complexities of staff scheduling associated with NICUs with higher level of care classifications (American Academy of Pediatrics, 2012).

2. Methods

A search of the literature was performed from December 1st to 10th 2016 using PubMed, Medline (Ovid), Proquest, and the Cumulative Index of Nursing and Allied Health Literature (CINAHL). The terms “neonate,” “nurse,” “workload,” and “tool,” were used as search keywords to identify existing neonatal nursing workload tools. “Surgical” was initially included as a key word but was removed when the search yielded zero results.

The ACH NICU unit manager (study co-investigator) initiated modifications to the WANNNT, creating the initial draft of the WANNNT-SC. Modifications included adding corrected gestational age, dividing the tool into systems, and including indicators related to neurocritical and surgical care. Neurodevelopmental care, such as transfers for skin-to-skin care, and certain subjective aspects of

workload such as interacting with parents were not explicitly addressed but as an inherent patient care activity, were expected to be captured by corrected gestational age scoring. Indicators, including pre- and post-operative care, and transfers off-unit or to other sites were added to reflect the patient population the ACH NICU serves. Indicators included in the WANNNT that were removed from the WANNNT-SC were post-natal care of the healthy term newborn, post-operative cardiac care, and extracorporeal membrane oxygenation (ECMO) as these patient populations are not cared for in the ACH NICU. The draft WANNNT-SC was reviewed by the unit nurse educator and 2 senior clinical support nurses to establish face validity. Table 1 shows the final version of the surgical tool.

Ethical approval was obtained from the University of Calgary Research Ethics Board. Senior neonatal nurses were recruited for study participation and written informed consent was obtained. For the purposes of this study, a senior nurse was someone who had at least 2 years of neonatal nursing experience. The WANNNT-SC was tested on 60 consecutive day and night shifts over a 30-day period, from April 1st to 30th 2017. We compared the WANNNT-SC against the current standard which was the charge nurse's judgement of how many nurses were needed to staff the NICU on a shift.

Staff nurses were blinded to the WANNNT-SC acuity scores. Indicators were grouped in levels numbered 1 through 5. To determine tool validity, the charge nurse on each shift was asked how many nurses, based on professional nursing judgment, were required to meet unit-staffing needs. Using the blinded tool, the charge nurse was then asked to complete a data collection form by assigning each patient on the unit to the most appropriate indicator level. To assess inter-rater reliability, another senior nurse was asked to complete the blinded surgical tool within 1 h of the charge nurse, completing a second data collection form as described above.

This method of asking charge and senior nursing staff to answer based on their professional nursing judgment does introduce subjective responses but was minimized by only including those who have worked within a NICU setting for at least two years.

The research team collected the data forms and used the levels indicated to determine the acuity score in the WANNNT-SC. The acuity scores for all patients were combined to calculate the number of nurses needed to staff the unit for each shift according to the tool. The number of nurses judged to be needed by the charge nurse on each shift was also collected. Data was entered for each of the 60 shifts into a Microsoft Excel spreadsheet, excluding any participant or patient information. All information collected contained no identifying data so that the investigators and the statistician could not identify patients or nurses.

Data analysis was conducted with SAS v9.4 and Microsoft Excel. For demographic information, means and medians were calculated. Paired samples *t*-tests were used to assess tool validity and inter-rater reliability. Inter-rater reliability was also assessed by the Kappa statistic. A Kolmogorov-Smirnov goodness of fit test to determine an empirical distribution function was calculated and plotted.

A second literature search, using the same search criteria as above, was completed on January 7, 2019 to capture any new studies on neonatal nursing workload tools. One additional article (Dye and Wells, 2017) looked at both subjective and objective workload metrics, and the NASA Task Load Index to measure neonatal nurse practitioner workload. While surgical components were added in their objective metric, there were few surgery specific indicators, and this metric did not determine the number of staff required.

3. Results

A total of 44 nurses were recruited for study participation representing 46% of nursing staff. Nursing participants had a mean of 14.97 years of nursing experience, with a median of 11 years, and a mean of 13.13 years and a median of 9 years of neonatal nursing experience. Additionally, there was a mean of 4.25 years and a median of

patients in their implementation of this tool.

The next step will be to plan and implement the clinical use of the WANNNT-SC in the ACH NICU to study the economic effect in a multi-center trial.

5. Conclusion

The delivery of quality patient care is a goal shared by all NICU's. Determining appropriate nurse-staffing levels is central to this. In this study, the process of developing a surgical NICU nursing workload tool and its validation are described. The WANNNT-SC is the first NICU nursing workload tool that is validated to support the development of safe, balanced patient assignments in a surgical level III NICU. Nursing managers of surgical NICU's can use the WANNNT-SC to support staffing decisions and justify budgetary expenditures related to staffing.

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Conflicts of interest

None.

Ethical statement

The study design and procedures were approved by the University of Calgary Research Ethics Board (Approval Number: REB16-2483).

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