ORIGINAL ARTICLE

Determining the reliability of the Withdrawal Assessment Tool-1 in comparison to the Neonatal Drug Withdrawal Scoring System

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ABSTRACT

Background: Children that receive opioids and/or benzodiazepines can develop dependence and demonstrate withdrawal symptoms if the medication is abruptly discontinued. In addition, neonates that are exposed to intrauterine drugs can also manifest symptoms of withdrawal. Due to the limited research, reliability and validity remains unclear among clinical conditions and instruments.

Objective: The purpose of this study was to determine the reliability of the Withdrawal Assessment Tool-Version 1 (WAT-1), in comparison to the Lipsitz Neonatal Drug Withdrawal Scoring System (NDWSS).

Methods: A prospective cross sectional study was conducted at a University-affiliated academic Children's Hospital. An Advanced Practice Nurse (APN) and a nursing student were trained on the use of both instruments. The student nurse and APN independently filled out both the NDWSS and the WAT-1 based on reports of symptoms and direct observation. Results were analyzed using descriptive statistics and correlations.

Results: One hundred assessments were completed. The correlations between the WAT-1 and the NDWSS scores were high (correlation > 0.8 and $p < .001$). There was a significant difference between the NDWSS scores based on diagnosis ($p \leq .01$). Cardiac and neurologic diagnoses tended to score higher when the NDWSS was used.

Conclusions: The NDWSS instrument should be used cautiously in children with varying diagnoses especially cardiac and neurological diagnoses.

Key Words: Pediatrics, Acute care, Iatrogenic withdrawal, Neonatal abstinence syndrome

1. INTRODUCTION

Opioids and benzodiazepines are commonly administered to critically ill children, those who have required ventilation and undergone surgery, and other complex procedures to relieve pain, anxiety, and reduce stress response.[1,2] Prolonged administration of opioids and benzodiazepines often leads to physiologic tolerance, the decreasing clinical effects of a drug after prolonged exposure and a need to increase dosage to mitigate the child's pain.[2]

Children that receive opioids and/or benzodiazepines for a minimum of seven days can develop dependence and demonstrate withdrawal symptoms if the medication is abruptly

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discontinued or tapered to quickly.[3] In addition, neonates that are exposed to intrauterine drugs can also manifest symptoms of withdrawal if not promptly and adequately managed.[4] Characteristics of withdrawal symptoms in a child can present as behavioral or physiologic changes. Behavioral symptoms of withdrawal can include anxiety, agitation, difficulty sleeping, and tremors. Additionally, physiologic symptoms of withdrawal can include increase in muscle tone, nausea, vomiting, diarrhea, decreased appetite, tachypnea, tachycardia, fever, sweating and increased blood pressure.[3]

Failure to promptly recognize and treat withdrawal adversely affects the child and the health care system. Withdrawal symptoms impair normal functioning and can lead to life-threatening complications. Sequelae such as aspiration after vomiting and dehydration from excessive diarrhea can create critical conditions, particularly for children.[5] Furthermore, the management of withdrawal from opioids or benzodiazepines, promulgates prolonged length of stays and an associated increase in hospital costs.[1,6,7] Yet, appropriate identification and management can mitigate these factors.

There are two types of withdrawal most frequently experienced by children in the acute care population. The first, neonatal abstinence syndrome (NAS), is a syndrome characterized by withdrawal symptoms in a baby born to an opiate-addicted mother or a mother taking other addictive substances.[1] The other is iatrogenic withdrawal, which can occur when a baby or child is treated with opioids or benzodiazepines and the medication is abruptly discontinued or tapered and withdrawal symptoms are present.[4] Unfortunately, the majority of the research to date focuses on neonatal abstinence syndrome; however, iatrogenic withdrawal is becoming an increasing concern for many because its prevalence is on the rise. In 2009, approximately 7.2 million outpatient opioid prescriptions were written for children in the United States. In addition, the frequency of opioid prescriptions reportedly doubled in the last decade and the majority of the prescriptions dispensed were for children between the ages of 10 and 17.[3]

Assessing withdrawal

Several instruments are available for assessing withdrawal in children. Instruments including the Neonatal Drug Withdrawal Scores System (NDWSS), Finnegan Neonatal Abstinence Scoring Tool, and Neonatal Withdrawal Inventory, are designed to evaluate NAS. However, there are only two assessment methods that are validated to evaluate iatrogenic withdrawal in a broader pediatric population.[7] These include the Withdrawal Assessment Tool-1 (WAT-1) and the Sophia Opioid and Benzodiazepine Withdrawal Checklist. From 1998 to 2012, the American Academy of Pediatrics (AAP) recognized the NDWSS as the most reliable method of assessing neonatal withdrawal.[4] However, in 2012, the AAP guidelines for neonatal drug withdrawal were modified to recommend Finnegan's Neonatal Abstinence Scoring instrument.[4] Furthermore, the AAP expanded their guidelines to cover iatrogenic withdrawal in addition to NAS.[4] However, these guidelines still make no distinction between the instruments that should be used for NAS and iatrogenic withdrawal. Additionally, the AAP does not recommend a specific instrument for iatrogenic withdrawal. Due to the limited research and choices of reliable and valid instruments to assess the different types of withdrawal in children (NAS and iatrogenic), questions exist about the effects of using one instrument to assess both types of withdrawal using the NDWSS despite updated recommendations.

The primary objective of this study was to determine the reliability of the WAT-1 in comparison to the NDWSS, among children1 month-17 years of age, during acute hospitalization. The hypothesis was that the WAT-1 is as reliable as the NDWSS in the hospitalized pediatric population ages 0-17 years.

2. METHODS

2.1 Setting and patient enrollment

This study was conducted in three acute care pediatric units and a pediatric intensive care unit at a University-affiliated academic Children's Hospital on the East coast. A convenience sample was obtained of children, ages 0-17 years, of varying diagnoses, and regardless of their current use or non-use of opioid and benzodiazepine medications. Children that were not receiving opioids and benzodiazepines were included to ensure that the researchers did not have a preconceived bias that the child was at risk for the development of withdrawal due to the medications he or she were prescribed. Children were excluded from the study if they or their legal guardian was non-English speaking or if they were medically paralyzed. A power analysis was used to determine that the sample size of 100 assessments would generate greater than 80% power. The study was approved through the Institutional Review Board and was low risk to all involved participants.

2.2 Study design and procedure

A cross-sectional study design was utilized. An Advanced Practice Nurse (APN) and a nursing student were trained on the use of both withdrawal assessment tools. The APN and nursing student identified eligible children for the study. The child's guardian was educated on the purpose and process of the study, the guardian then had the opportunity to enroll or

decline to participate in the study. After receiving consent from the guardian, the student nurse filled out both the NDWSS and the WAT-1 based on the guardian or the bedside nurse report of symptoms as well as direct observation. The APN followed the same procedure using both instruments immediately after the student nurse's assessments were complete. Both the APN and student nurse were blinded to a participant's diagnosis, medication status, and all other pertinent medical history upon filling out the initial evaluation to prevent bias. Following the completion of both instruments by both the APN and the student nurse, additional variables of interest were obtained from the electronic medical record. Additional variables included demographic information (age and gender), primary diagnosis, pain score, if the child was being prescribed scheduled opiates and/or benzodiazepines, and if the child was being prescribed as needed opiates and/or benzodiazepines.

2.3 Instrument description

The NDWSS is an 11-item tool that allows the observer to rank the frequency and severity of withdrawal symptoms (see Table 1). The instrument requires evaluation of the patient every 2-4 hours. The nurse must rank the symptoms on a scale from 0-3, with a range from 0-20. A score of greater than or equal to 4 is indicative of withdrawal using this instrument.[8] To determine validity of the instrument, two pediatric residents scored a series of newborns while unaware of pertinent history. After scoring was complete, the medical history was revealed. The probability of determining successful identification of a newborn was 77%.[8]

Table 1. Comparisons of instruments and symptoms to assess withdrawal

WAT-1	NDWSS
Loose/watery stools	Stools
Vomiting/wretching/gagging	Vomiting
Temperature > 37.8℃	Fever
State	Reflexes
Tremor	Tremor
Sweating	Skin abrasions
Uncoordinated/repeative movements	Respiratory rate per minute
Yawning or sneezing	Sneezing
Startle to touch	Yawning
Tone	Tone
Time to gain calm state	Irritability

The WAT-1 is an instrument is an 11-item, 12-point scale requiring a nurse to respond yes (1 point) or no (0 points) to observable symptoms of withdrawal (see Table 1). The instrument requires evaluation of the patient every 12 hours.[9, 10] The WAT-1 is designed to use data collected from the child's chart, a pre-stimulus observation, a stimulus observation, and the post-stimulus recovery in which the nurse evaluates how long it takes the child to regain a calm state.[6] A score of greater than or equal to 3 on the WAT-1 is indicative of withdrawal and the total score ranges from 0-12. Psychometric properties report concurrent validity as high sensitivity (0.872) and specificity (0.88).[9] An additional study performed by Franck and colleagues confirmed that the WAT-1 demonstrated feasibility and utility.[10]

2.4 Statistical analyses

Results were analyzed using descriptive statistics and correlations to determine reliability of the instruments. Correlations were determined using the Kruskal-Wallis test to identify the relationship between the APN scoring and student scoring of both instruments, as well as each individual's scoring between the two. The Kruskal-Wallis test was also used to determine reliability of the instruments based on diagnosis.

3. RESULTS

3.1 Demographic characteristics

Of the 100 assessments completed, participant mean age was 4.21 years and ages ranged from less than 30 days to 17 years of age, though the largest age group (26%) was ages 12 months to 3 years. Fifty-seven percent of children were female. When participants were classified by diagnosis, the largest group of participants had a hematology-oncologic diagnosis (27%), followed closely by cardiac diagnoses (21%), though diagnoses from a wide range of systems were included. Fifty-seven percent of patients were on scheduled opioids or benzodiazepines while only 19% were prescribed opioids or benzodiazepines as needed (see Table 2).

Table 2. Demographics of sample

Variable	N (Percentage)	Mean	Standard Deviation
Age		4.2	4.9
< 30 days	5 (5%)		
31 days-6 months	20 (20%)		
6-12 months	12 (12%)		
12 months-3 years	26 (26%)		
3-5 years	6 (6%)		
6-10 years	12 (12%)		
> 10 years	19 (19%)		
Gender			
Male	43 (43)		
Female	57 (57%)		
Diagnosis by system			
Cardiac	21 (21%)		
Respiratory	8 (8%)		
GI/GU	17 (17%)		
Neurology	17 (17%)		
Hem/Oncology	27 (27%)		
ID	4 (4%)		
Endocrine	4 (4%)		
Ortho/Trauma	2 (2%)		
Prescribed scheduled opioids and/or benzodiazepines			
No	43 (43%)		
Yes	57 (57%)		
Prescribed as needed opioids and/or benzodiazepines			
No	81 (81%)		
Yes	19 (19%)		
Pain Scores		0.5	1.6

Pain scores were recorded based on the last pain score documented in the patient's electronic medical record for that shift. The mean pain score for all children was 0.5 with a standard deviation of 1.6, and a pain score of zero was recorded for almost 90% of the children (see Table 2).

3.2 Correlations between the WAT-1 and the NDWSS instruments

When both instruments were used by the APN, there was complete agreement, meaning that the scores were identical, between the WAT-1 and the NDWSS 61% of the time (p = .059). When scores obtained by the APN were different, the NDWSS scores tended to be higher 20% of the time the NDWSS produced a score one point higher than the WAT-1. A 2-point difference was seen 6% of the time. WAT-1 scores were higher by one point 10% of the time. Three percent of the WAT-1 scores were higher than the NDWSS by two or three points (see Table 3).

The student WAT-1 and NDWSS scores were in complete agreement 58% of the time (p = .001), and when they differed, the NDWSS score also tended to be higher (see Table 3).

3.3 Correlations between APN and student nurse scoring

The scores recorded by the student and APN were in agreement 75% of the time when using the WAT-1 tool and 81% of the time when using the NDWSS ($p < .001$ and correlation > 0.9). When there was a difference in the score between the APN and student using the WAT-1, the score most often differed by one point (n = 21, 21%). When using the NDWSS, the APN and student scores differed by one point only 17% (n = 17) of the time. This indicates a high correlation between the WAT-1 and NDWSS for withdrawal scores and inter-rater reliability (see Table 3).

Table 3. Correlations

	Correlation	*p* - value	Agreement
WAT1-APN and WAT1-student	0.94	< .001	75%
NDWSS-APN and NDWSS- student	0.96	< .001	81%
WAT1-APN and NDWSS-APN	0.88	< .001	61%
WAT1-student and NDWSS-student	0.88	< .001	58%

3.4 Reliability based on independent variables

Scores varied significantly based on diagnosis when evaluating withdrawal using the NDWSS, for both the APN (p = .010) and student nurse (p = .016). When using the NDWSS, the diagnoses that tended to score higher were cardiac, with a mean score of 2.67 +/- 2.19, and neurologic diagnoses with a mean score of 2.36 +/- 2.04. There was a slight difference in scores based on diagnosis when evaluating withdrawal with the WAT-1 but these were not statistically significant. There were no statistically significant differences in scores for either withdrawal instrument when looking at pain, gender, scheduled opioids and/or benzodiazepine medications for either the NDWSS or the WAT-1 when scored by either the APN or student.

4. Discussion

The primary aim of this study was to evaluate the reliability, the degree to which an assessment instrument produces stable and consistent results when administered by an APN and a student, of the WAT-1 as compared to the NDWSS. The correlations between the WAT-1 and the NDWSS were high when administered by the student and by the APN, r = 0.88 and $p < .001$.

When scored by the APN, there was complete agreement of scores on the two instruments 61% of the time and 58% of the time when scored by the student nurse. For both individuals, when the scores differed, the NDWSS score tended to be higher. The statistical significance of these outcomes indicates the ability of the two instruments to produce consistent results when compared to one another, and supports the hypothesis that the WAT-1 is just as reliable as the NDWSS. A slight difference in the scores however is expected, because the threshold for withdrawal of the NDWSS is one point higher than in the WAT-1. Furthermore, results showed that the numerical scores for the NDWSS, when scored by both the APN and student nurse, agreed 81% of the time, while scores for the WAT-1 agreed 75% of the time. The ability of a student nurse to use both instruments and obtain the same scores as an APN shows that these instruments are both user-friendly and will successfully produce the same or similar scores when scoring the same child. Thus, these results demonstrate the solid inter-rater reliability of the WAT-1 as compared to the NDWSS.

When looking at scores based on diagnosis, a statistically significant difference was found for the NDWSS. Cardiac and neurologic diagnoses tended to score higher when the NDWSS was used. Because the NDWSS was designed for evaluating NAS, it is reasonable to conclude that its use would be most pertinent for neonates born with NAS. This has led to the idea that the WAT-1 may be more suitable for evaluating children with varying diagnoses, the exact population that is typically experiencing iatrogenic withdrawal.[9, 10]

No correlation was found between pain scores recorded for a child and their withdrawal score on either instrument. This shows that evaluating a child's pain is not a helpful or even supplemental indicator for evaluating withdrawal. Furthermore, there was no difference in a child's scores based on their gender and whether they were receiving scheduled or as needed opioids or benzodiazepines. None of the symptoms used to evaluate withdrawal are specific to the phenomenon; most are common symptoms seen in certain diseases, conditions, or even the common cold. This means that even if a child presented with symptoms that led to a score indicative of withdrawal, it did not necessarily mean they were experiencing withdrawal, or were even on withdrawal-inducing medications.

The results of this study provide preliminary evidence that the WAT-1 is as reliable as the NDWSS. Furthermore, the data suggests that the NDWSS should be used cautiously in children with varying diagnoses. It is also reasonable to suggest that a withdrawal score should be used as a supplement for making medical decisions. Withdrawal symptoms can present like a variety of other illnesses and conditions. It is essential for nurses to be educated on the symptoms of withdrawal. Nurse education on the differences in the instruments and their reliability of predicting withdrawal for different populations and diagnoses of critically ill children should also be stressed in order to achieve the most accurate withdrawal score for a child, and thus more timely and appropriate treatment.

4.1 Limitations

A limitation of this study is that it did not include neonates admitted to the neonatal intensive care unit with varying di-

agnoses, thus giving the study a very small sample size of children under the age of 30 days. Additional studies are needed to include neonates and children that are truly at risk for iatrogenic and NAS withdrawal, this study included both children that were not at risk and at risk for withdrawal. This study also only evaluated reliability, validity of the instruments was assumed based on previous studies.[8–10]

4.2 How might this affect nursing practice

The WAT-1 was found to be just as reliable as the NDWSS in pediatric patients' ages 0-17 years. The NDWSS instrument should be used cautiously in children with varying diagnoses especially cardiac and neurological diagnoses. The WAT-1 may be better suited to evaluate the older pediatric population with varying diagnoses. When nurses use reliable instruments for determining withdrawal, they are more able to quickly identify and treat the early stages of withdrawal. From this, they are able to prevent pain, discomfort, life-threatening complications, and ultimately reduce hospital stay and associated costs.[1,6,7]

Conflicts of Interest Disclosure

The authors report no actual or potential conflicts of interest.

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