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Clinical Scoring Systems for Bronchiolitis

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Abstract:

Worldwide, bronchiolitis is the most common severe acute lower respiratory tract infection. The usual criteria for hospitalization of a child with bronchiolitis are the need for oxygen or fluid management. Some infants have very high hospitalization rates of bronchiolitis (352 per 1,000) and the majority are retrieved from remote communities. In these settings, there are often no resident medical practitioners and nurses are the acute care providers. Availability of a scoring system for bronchiolitis that is valid when used by different providers, would be beneficial as acute assessment of the severity of bronchiolitis will contribute to good clinical management. Standardization of severity scoring is also important for clinical research purposes. A number of clinical scoring systems, some with modifications, have been used in the many research studies on bronchiolitis. Despite their widespread use, many of these scoring systems have limited validity when systematically evaluated and often were modified to suit individual research outcomes. These scoring systems have different levels of complexity (such as auscultation in “segmental lobes” and distinction of wheeze through parts of inspiratory and expiratory phases), clinical parameters (e.g. the widely used Lowell score does not take into account SpO₂ or cyanosis) and varying degrees of validation (many were not validated), thus making it difficult to evaluate across clinical research studies. Not surprisingly, the Scottish Intercollegiate Guidelines Network (SIGN) bronchiolitis guideline stated “No good quality evidence on the use of formal clinical scoring systems in infants with acute bronchiolitis was identified.”

Keywords: Clinical Scoring Systems, Bronchiolitis, Respiratory Infection.

Introduction:

Bronchiolitis is a potentially life-threatening viral respiratory infection that affects children under 2 years of age. It is common and occurs worldwide. The bronchiolitis mortality rate is approximately 2 per 100 000 infants and is higher in developing than in developed countries (1).

The assessment of the severity of bronchiolitis is necessary not only in daily practice but also in clinical trials. Children with severe bronchiolitis are at risk for severe hypoxaemia, and in daily practice paediatricians are often faced with the task of deciding which children require hospitalisation so as to avoid unnecessary morbidity and mortality. Factors that contribute to severity of viral bronchiolitis (2).

As pulmonary functions are difficult to perform in infants, respiratory scores are often used to evaluate the efficacy of medications for bronchiolitis. Respiratory scores consisting of a combination of clinical symptoms and physical signs, are frequently used to estimate the severity of acute lower airway infection in children. Reports on the reliability of such signs have shown considerable disagreement among physicians, leading to unreliable clinical observations in respiratory diseases. Therefore, it is important to investigate the inter-observer agreement on the presence or absence of physical signs in acute bronchiolitis in order to derive a consistent diagnosis from different examiners irrespective of the situation (3).

Bronchiolitis severity can be assessed using different clinical scores. Some of the most used are the Wang Bronchiolitis Severity Score (WBSS), the Kristjansson Respiratory Score (KRS), the Global Respiratory Severity Score (GRSS), the Tal score (TS) and the modified-Tal score (mTS), and the Respiratory Distress Assessment Instrument (RDAI) (4)

➤ Wang Bronchiolitis Severity Score (WBSS)

The 4-item Wang Respiratory Score consists of respiratory rate, wheezing, chest retraction and general condition ([Table 1](#)) and each clinical sign was scored from zero to 3 except for the general condition, which was scored zero for normal and 3 for irritability or lethargy. The possible total score ranged from 0–12. The respiratory rate was determined by counting the respiration for 30 seconds in both respiratory scores (5).

Table1: Clinical signs and score of the Wang Respiratory Score(5)

Score	Respiratory Rate	Wheezing	Retraction	General Condition
0	<30	None	None	Normal
1	30–45	Terminal expiration or only with stethoscope	Intercostal recession	

Score	Respiratory Rate	Wheezing	Retraction	General Condition
2	46–60	Entire expiration or audible on expiration without stethoscope	Trachea-sternal recession	
3	>60	Inspiration and expiration without stethoscope	Severe with nasal flow	Irritable/lethargic/poor feeding

➤ Kristjansson Respiratory Score (KRS)

The Kristjansson Respiratory Score consists of five clinical signs ([Table 2](#)) with scores for each sign ranging from zero to two. The possible total scores ranged from 0–10. Whistling expiratory sounds heard with and without the stethoscope was considered as rhonchi and wheeze respectively (6).

Table2: Clinical signs and scores for the Kristjansson Respiratory Score(6)

Score	Respiratory Rate (<i>breaths/minute</i>)	Chest Recession	Breath Sound	Skin Colour	*General Condition
0	<40	None	Vesicular	Normal	Not affected
1	40–60	Moderate (<i>Costodia-phragmatic</i>)	Wheeze =/- rhonchi/rale	Pallor	Moderately affected
2	>60	Severe (<i>As in 1 plus rib & jugular retraction</i>)	Severe wheeze =/- rhonchi/rale	Cyanosis	Severely affected

* a) Not affected if activity and feeding is normal, b) moderately affected if activity and feeding is less than normal, c) severely affected if child looks ill and feeds poorly.

➤ Global Respiratory Severity Score (GRSS)

In 2017, the Global Respiratory Severity Score (GRSS) was developed as a specific scoring system to assess the requirement for hospitalization with RSV infection. The GRSS includes both systematic and respiratory parameters, including age-specific respiratory rates for infants aged less than 10 months, and grades the overall severity over the course of illness. The chronological severity score of the GRSS would be useful to guide decision-making regarding providing respiratory support(7).

➤ Table3: Parameters of **Global Respiratory Severity Score (GRSS)**

(8).

Global Respiratory Severity Score	
Age (months)	0–10
Oxygen saturation (%)	67–100
Respiratory rate (breaths/min)	30–123
General appearance	Well, mild, moderate, severe, NA
Wheezing present	Yes, no, NA
Rales/rhonchi present	Yes, no, NA
Retractions present	Yes, no, NA
Cyanosis present	Yes, no, NA
Lethargy present	Yes, no, NA

In the Global Respiratory Severity Score, “NA” is allowed to be selected for only one of the seven parameters where it is listed as an option.

NA, not applicable

✚ **Tal et al. severity score.**

The 4-item Tal et al. severity score consists of respiratory rate, wheeze, cyanosis, and accessory respiratory muscle utilization, with scores for each sign ranging from 0 to 3 (4). The score was in the range 0–12, with a higher score indicating more respiratory distress. Again, all measurements were taken when the child was awake and not crying (9).

Table4: Tal et al. severity score.

Score	Respiratory rate (breath/min)	Wheeze	Cyanosis	Accessory respiratory muscle utilization
0	<30	None	None	None (no chest in-drawing), i.e. absence of lower part of the chest moves in or retracts when inhalation occurs
1	30–45	Terminal expiratory only	Peri-oral on crying only	Presence of mild intercostal in-drawing (just visible), no head bobbing or tracheal tug

Score	Respiratory rate (breath/min)	Wheeze	Cyanosis	Accessory respiratory muscle utilization
2	46–60	Entire expiration and inspiration with stethoscope only	Perioral in rest	Moderate amount of intercostal in-drawing, no head bobbing or tracheal tug
3	>60	Entire expiration and inspiration without stethoscope only	Generalized in rest	Moderate or marked intercostal in-drawing with presence of head bobbing or tracheal tug

➤ **Modified -Tal score (mTS)**

Modified Tal score

Respiratory rate (breaths/min)					
Score	Age <6 months	Age ≥6 months	Wheezing/Crackles	O ₂ Saturation (room air)	Accessory respiratory muscle utilization
0	≤40	≤30	None	≥95	None (no chest in-drawing)
1	41-55	31-45	Expiration only	92-94	+ Presence of mild intercostal in-drawing
2	56-70	46-60	Expiration and inspiration with stethoscope only	90-91	++ Moderate amount of intercostal in-drawing
3	≥71	≥61	Expiration and inspiration without stethoscope	≤89	+++ Moderate or marked intercostal in-drawing, with present of head bobbing or tracheal tug

➤ **Respiratory Distress Assessment Instrument (RDAI)**

RDAI assesses retractions (max 9 points), wheeze (max 8 points) and changes in respiratory rate. A modified RDAI (m-RDAI) was developed to permit a single observation of respiratory rate and is described further in figure (10)

Variable	No. of Points					Maximum Points
	0	1	2	3	4	
Wheezing						
Expiration	None	End	1-2	3-4	All	4
Inspiration	None	Part	All	NA	NA	2
Location	None	Segmental $\leq 2-4$ lung fields	Diffuse $\geq 3-4$ lung fields	NA	NA	2
Retractions						
Supraclavicular	None	Mild	Moderate	Marked	NA	3
Intercostal	None	Mild	Moderate	Marked	NA	3
Subcostal	None	Mild	Moderate	Marked	NA	3

Abbreviation: NA, not applicable.

*Within each variable the subscores are summed to give a total score. The maximum total points for wheezing is 8, and for retractions is 9. Reproduced with permission from Lowell et al.⁸

➤ Modified Wood's Clinical Asthma Score

The modified Wood's Clinical Asthma Score (mWCAS), generated with oxygen saturation level, presence of expiratory wheezing, inspiratory breath sounds, use of accessory muscles, and cerebral function/status (**Table 5**), is used to assess the severity of respiratory distress in children with bronchiolitis. An mWCAS greater than 3 is an indication of moderate-to-severe respiratory distress (11)

The 5-item M-WCAS is a clinical scoring system that considers oxygen saturation, inspiratory breath sounds, expiratory wheezing, accessory muscle usage, and mental status, with scores for each sign ranging from 0 to 2. A score of 0 to 3, 4 to 6, and >6 represents mild, moderate, and severe illness, respectively (12).

Table5: Modified Wood's Clinical Asthma Score Five-Item Scoring(11)

Item	0	0.5	1	2
SpO ₂	SpO ₂ $\geq 95\%$ in room air	95% $>$ SpO ₂ $>$ 90% in room air	SpO ₂ $\geq 90\%$ with FIO ₂ $>$ 21%	SpO ₂ $<$ 90% with FIO ₂ $>$ 21%
Expiratory wheezing	None	Mild (+)	Moderate (++)	Marked (+++)
Inspiratory breath sounds	Normal	Slightly decreased	Decreased	Absent
Use of accessories muscles	None	Mild (+)	Moderate (++)	Maximal (+++)

Item	0	0.5	1	2
Cerebral status	Normal	Agitated when disturbed	Depressed/agitated	Markedly depressed/coma

➤ **Acute Bronchiolitis Severity Score (ABSS)**

The assessment of wheezing was graduated from 0 to 4 points, ranging from none to wheezing at the end of expiration, during the whole expiration, in both inspiration and expiration phases, and finally hypoventilation and decreased airflow without wheezing. Crackles were graduated from 0 to 4, adding a point for each of the anterior and posterior fields of each hemithorax with persistent crackles at every breath on auscultation. Effort was graduated from 0 to 3 points, ranging from no effort to mild subcostal and lower intercostal retractions, the latter plus nasal flaring or suprasternal retractions, and finally retractions in all fields. The inspiration/expiration (*I:E*) ratio was graduated from 0 to 2: normal, symmetrical or inverted (13).

Table6: Items and scoring of the acute bronchiolitis severity scale(13)

Age	Sex	GA			
Wheezing/crackles-effort- <i>I:E</i> ratio					
Score	0	1	2	3	4
Wheezing	No	Wheezing at end of expiration	Wheezing throughout expiration	Ins-expiratory wheezing	Hypoventilation
Crackles	No	Crackles in one field	Crackles in 2 fields	Crackles in 3 fields	Crackles in 4 fields
Effort	No effort	Subcostal or lower intracostal retractions	+suprasternal retractions or nasal flaring	+nasal flaring and suprasternal (universal)	
<i>I:E</i> ratio	Normal	Symmetrical	Inverted		
Respiratory rate	0 Point	1 Point	2 Points		
<i>Age (months)</i>					
<2m	<57	57–66	>66		
2–6m	<53	53–62	>62		
6–12m	<47	47–55	>55		
Heart rate	0 points	1 point	2 points		
<i>Age</i>					
7 days–2 months	125–152	153–180	>180		
2–12 months	120–140	140–160	>160		

The validation of severity scores (and other outcome measures)

The validation of severity scores (and other outcome measures) is an essential process for assessing their measurement properties to ensure that they measure what it is intended to be measured. This validation process should include assessment of reliability (internal consistency, test–retest reliability, and inter-rater agreement), validity (face validity, construct validity, and criterion validity), responsiveness, and usability. However, despite the undoubted importance of this validation process and the widespread use of severity scores in bronchiolitis not only for clinical purposes but also in a research context, many of them have not been formally validated or have been only partially validated. The validation process of those that have been validated have often been limited to assessing the inter-rater agreement (9)

Criteria to hospitalize infants with bronchiolitis are hypoxia, moderate to severe respiratory distress, dehydration, or apnea; other criteria to be considered are comorbidities (such as prematurity, bronchopulmonary dysplasia, or congenital heart diseases) and unfavorable social and environmental factors (4)

In a study evaluating infants with moderate to severe bronchiolitis, the saturation level on admission was the most critical predictor of hospitalization and the only one correlated with a longer hospital stay (14)

Rodriguez-Martinez et al., (15) systematically evaluated 32 instruments to evaluate the severity of bronchiolitis in different clinical settings: upon analyzing their content, respiratory rate turned out to be the most frequently used item (in 26/32, 81.3% of the instruments), followed by wheezing (in 25/32, 78.1% of the tools). They concluded that there is an urgent need to develop new instruments and better validate them. Furthermore, previous studies enrolled infants up to 24 months of life, where we know that patients younger than three months are at particular risk for severe bronchiolitis and frequently require prolonged hospitalization and intensive care. Therefore the need for a tool to help clinicians in the assessment of a neonate or infant with bronchiolitis, on admission and during hospitalization and to guide the respiratory support escalation is very high.

In the study by De Rose et al., (4), All three scores were significantly correlated with the length of stay. As expected, the length of stay was longer for those patients receiving respiratory support, the same who presented with higher scores on admission. Neonates and infants with RSV-bronchiolitis have a more severe clinical picture documented by significantly higher WBSS and KRS scores rather than patients infected with other viruses.

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