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### ORIGINAL ARTICLE

# A comparison of two clinical scores for bronchiolitis. A multicentre and prospective study conducted in hospitalised infants

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#### KEYWORDS

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#### Abstract

**Background:** There are a number of clinical scores for bronchiolitis but none of them are firmly recommended in the guidelines.

**Method:** We designed a study to compare two scales of bronchiolitis (ESBA and Wood Downes Ferrés) and determine which of them better predicts the severity. A multicentre prospective study with patients <12 months with acute bronchiolitis was conducted. Each patient was assessed with the two scales when admission was decided. We created a new variable "severe condition" to determine whether one scale afforded better discrimination of severity. A diagnostic test analysis of sensitivity and specificity was made, with a comparison of the AUC. Based on the optimum cut-off points of the ROC curves for classifying bronchiolitis as severe we calculated new Se, Sp, LR+ and LR- for each scale in our sample.

**Results:** 201 patients were included, 66.7% males and median age 2.3 months (IQR = 1.3–4.4). Thirteen patients suffered bronchiolitis considered to be severe, according to the variable severe condition. ESBA showed a Se = 3.6%, Sp = 98.1%, and WDF showed Se = 46.2% and Sp = 91.5%. The difference between the two AUC for each scale was 0.02 (95%CI: 0.01–0.15),  $p = 0.72$ . With new cut-off points we could increase Se and Sp for ESBA: Se = 84.6%, Sp = 78.7%, and WDF showed Se = 92.3% and Sp = 54.8%; with higher LR.

**Abbreviations:** ESBA, Escala para la Severidad de la Bronquiolitis Aguda; WDF, Wood Downes Ferrés scale; AUC, area under curve; ROC, receiver operating characteristic; Se, sensitivity; Sp, specificity; LR+, likelihood ratio positive; LR-, likelihood ratio negative; ICU, Intensive Care Unit.

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*Conclusions:* None of the scales studied was considered optimum for assessing our patients. With new cut-off points, the scales increased the ability to classify severe infants. New validation studies are needed to prove these new cut-off points.

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## Introduction

Acute bronchiolitis (AB) is the most common lower airway infection in infants, with an annual incidence of 10% in infants under 12 months of age and a hospital admission rate in Spain of between 2 and 5% of all affected patients.<sup>1,2</sup> During the epidemic periods, AB constitutes an important healthcare burden in both the primary care and hospital settings.<sup>3</sup> Overall, AB is estimated to be the most frequent cause of admission in infants less than one year of age.<sup>4</sup> During the 1980s and 1990s, hospital admissions due to AB increased 2.4-fold in the United States,<sup>5</sup> with no evidence of increased mortality. At that time, it was suggested that some of these admissions might be unnecessary and could be attributable to other factors.<sup>6</sup> Later, in the period between 2000 and 2009, admissions due to AB in infants under 12 months of age began to decrease slightly, although the hospitalisation costs increased by 34%, at the expense of the more serious cases requiring admission to intensive care and mechanical ventilation.<sup>4</sup>

Adequate assessment of the clinical condition of a patient with AB is of great importance for the paediatrician, since it constitutes the basis of the decision-making process. Severity scales, applied objectively and with rigour, should prove useful in evaluating the clinical course of the patients and the efficacy of the prescribed treatments. While such scales are routinely used, they are supported by observational studies with limitations; as a result, no concrete scale is recommended in the clinical practice guides.<sup>7-9</sup>

One of the most widely-used scales in our setting, the Wood-Downes-Ferrés score (WDF), was designed to assess respiratory failure in patients with severe asthma.<sup>10,11</sup> However, a Spanish group has recently proposed a new scale, known as the Acute Bronchiolitis Severity Scale (*Escala de Severidad de la Bronquiolitis Aguda*, ESBA), based on different clinical parameters specific of AB and which has been evaluated in infants under one year of age, with good inter-observer agreement.<sup>12</sup>

The main objective of this study is to determine whether the ESBA shows a better correlation to the severity of AB than the WDF. As secondary objectives, an analysis is made of the mean stay due to bronchiolitis, admission to the Intensive Care Unit (ICU), the need for ventilation, and the incidence of respiratory acidosis.

## Material and methods

### Study design

A prospective observational study was carried out, involving the consecutive inclusion of all patients  $\leq 12$  months of age admitted due to acute bronchiolitis (McConnochie criteria modified by age) between October 2014 and April 2015 to

five second-level hospitals (according to the classification of the World Health Organisation)<sup>13</sup> in La Comunidad Valenciana and Castilla la Mancha, in Spain. All the patients in the paediatric ward were visited on a daily basis, with application of the admission and discharge criteria contemplated by the AB clinical practice guide of the Spanish Ministry of Health. None of the five hospitals had an ICU of their own; the most seriously ill patients therefore could be transferred to another centre at some point during the clinical course of the disease. Patients with background diseases such as cystic fibrosis, bronchopulmonary dysplasia or congenital heart disease with haemodynamic alterations were excluded, as were infants with hypotonus (Down syndrome, neuromuscular disorders, Prader-Willi syndrome), patients admitted for reasons other than AB, premature infants (<35 weeks of gestation, representing the limit of preventive treatment with palivizumab in our setting), or bacterial superinfection suspected from the clinical or laboratory test findings.

### Data collection

The investigators conducted a structured interview of the parents or legal tutors to collect information referred to the demographic parameters, environmental characteristics, duration of the symptoms and details of the acute disease. A comprehensive review was made to establish the parameters defining increased severity of bronchiolitis, and these were used as the study variables. In addition, the vital signs were recorded, including respiratory frequency and heart rate, as well as oxygen saturation, and a physical examination was carried out with special attention to signs of breathing difficulty and respiratory auscultation. At the time of patient admission, we assessed severity using the two study scales (ESBA and WDF). These instruments regard bronchiolitis as severe when the score exceeds 9 and 7 for the ESBA and WDF, respectively (*Annex 1*). Scoring was performed by a paediatrician with experience in AB, with the patient naked, awake, calm, without crying or fever, and at least two hours after having received any kind of inhaled medication. The diagnostic and therapeutic procedures during admission (need for intravenous fluid therapy, oxygen therapy, catheter feeding, blood tests, chest X-rays and other complementary tests) were recorded. The scales were applied again in the event of clinical worsening requiring major changes in patient management. Such major changes were defined as transfer to the ICU, the need for mechanical or non-invasive ventilation, parenteral or enteral (tube) nutrition, and the need for oxygen therapy (if not previously required). In such situations, the highest measure recorded was considered for the study.

In order to determine whether a given scale afforded better discrimination of the seriously ill patients, we established a new variable ("severe condition") that was taken to

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