



Letter

Acute Asthma Intensity Research Score: updated performance characteristics for prediction of hospitalization and lung function

The Acute Asthma Intensity Research Score (AAIRS) is a 7-component, 17-point (0–16 with 16 being the most severe) acute asthma exacerbation severity score. Components of the score include accessory muscle (suprasternal-sternocleidomastoid, intercostal, and subcostal) retractions, air entry, wheezing, oxygen saturation on room air ($\geq 95\%$, 0 points; $92\%–94\%$, 1 point; $<92\%$, 2 points), and expiratory phase prolongation.¹

We previously reported the performance of the AAIRS to measure baseline acute asthma exacerbation severity and responsiveness to change during treatment in a prospective cohort of 661 patients aged 5 to 17 years who were admitted to our tertiary children's hospital emergency department with acute exacerbations.¹ The criterion outcome measure for that analysis was the percentage of predicted forced expiratory volume in 1 second (FEV₁).

In this study, we sought to examine the performance of the AAIRS to predict hospital or pediatric intensive care unit (PICU) admission.² In addition, we examined the performance of the AAIRS to predict the percentage of predicted airway resistance by impulse oscillometry (IOS) and to confirm prior findings of the percentage of predicted FEV₁ after recruitment of the entire cohort of 933 participants.

For each participant studied during an acute exacerbation in our pediatric emergency department, we performed a comprehensive pulmonary examination and calculated the AAIRS before (baseline) and 2 hours after treatment. Participants attempted spirometry for percentage of predicted FEV₁ and measurement of percentage of predicted IOS using a CareFusion MasterScreen pulmonary function testing system (CareFusion, Yorba Linda, California) at each time point. The clinical team was not provided study data, including values for the AAIRS, and followed an asthma clinical practice guideline that used an unvalidated severity score. The study (protocol 080058) was approved by our institutional review board.

We assessed predictive validity with multivariable logistic regression models to examine whether the baseline AAIRS or 2-hour change of the AAIRS is associated with hospital or PICU admission, adjusted for age, sex, race, and, for the change of AAIRS analysis, baseline AAIRS.³ Construct validity was assessed as the

accuracy of the AAIRS to predict percentage of predicted FEV₁ and percentage of predicted IOS at baseline. For these analyses, we used multivariable linear regression with percentage of predicted FEV₁ or percentage of predicted IOS as the outcome variable and the AAIRS, age, sex, and race as predictor variables. Responsiveness was assessed as the ability of change of the AAIRS to predict change of percentage of predicted FEV₁ and percentage of predicted IOS after 2 hours of treatment.^{3–6} We used multivariable linear regression models to examine 2-hour change of percentage of predicted FEV₁ or percentage of predicted IOS with change of the AAIRS, adjusted for age, sex, race, baseline AAIRS, and baseline percentage of predicted FEV₁ or percentage of predicted IOS, respectively.

Of 806 unique participants among the cohort of 933 recruited participants, the median age was 8.9 years (interquartile range [IQR], 6.9–11.3 years), 61% were male, 58% were African American, and the AAIRS was 5 (IQR, 2–8) at baseline and 2 (IQR, 0–5) at 2 hours. One hundred forty-four (18%) were admitted to floor beds and 42 (5%) to the PICU. Percentage of predicted FEV₁ was 50 (IQR, 36–72; $n = 469$) at baseline and 61 (IQR, 43–77; $n = 351$) at 2 hours. Corresponding values for percentage of predicted IOS were 162 (IQR, 125–219; $n = 174$) at baseline and 125 (IQR, 103–159; $n = 133$) at 2 hours. The results of multivariable regression models used to assess the AAIRS are given in Table 1.

We found associations of the AAIRS with hospital or PICU admission. For example, a 1-point increase of the AAIRS at baseline was associated with 1.3 times the odds for hospital floor admission. Similarly, β -coefficients were clinically meaningful for the associations of the AAIRS with percentage of predicted FEV₁ and percentage of predicted IOS at baseline and in response to treatment. For example, a 1-point increase in the AAIRS score at baseline is associated with a decrease of percentage of predicted FEV₁ of approximately 5%.

In addition, our children's hospital now uses the AAIRS as part of an asthma clinical practice guideline according to 3 levels of severity: mild (AAIRS, 1–6), moderate (AAIRS, 7–11), and severe (AAIRS, 12–16). Hospitalization rates according to these severity levels for participants at baseline were as follows: mild, 72 (14%) of 517; moderate, 101 (38%) of 267; and severe, 13 (59%) of 22. Corresponding hospitalization rates for severity levels among participants remaining in the emergency department at 2 hours were as follows: mild, 111 (22%) of 493; moderate, 58 (73%) of 79; and severe, 1 (100%) of 1.

In summary, the AAIRS demonstrates predictive validity for hospitalization and PICU admission as well as construct validity and responsiveness to clinically meaningful changes of lung function. Expert guidelines recommend use of a

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Table 1

Performance of the AAIRS to Discriminate Baseline Severity and to Measure Responsiveness to Change of Outcome Measures in 806 Unique Children Aged 5 to 17 Years With Acute Asthma Exacerbations

Outcome	No. of patients	Effect size ^a (95% CI)
FEV ₁ , % predicted		
Baseline	469	–4.7 (–5.2 to –4.3)
2-Hour change ^b	298	–2.3 (–2.9 to –1.7)
IOS, % predicted		
Baseline	134	4.3 (0.8–7.8)
2-Hour change ^b	174	11.5 (7.8–15.1)
Hospital or PICU admission vs discharge to home		
Baseline	806	1.4 (1.3–1.4)
2-Hour change ^c	573	1.6 (1.5–1.8)
Hospital floor admission		
Baseline	764	1.3 (1.2–1.4)
2-Hour change ^c	535	1.5 (1.4–1.7)
PICU admission		
Baseline	806	1.5 (1.3–1.7)
2-Hour change ^c	573	1.7 (1.4–2.0)

Abbreviations: AAIRS, Acute Asthma Intensity Research Score; CI, confidence interval; FEV₁, forced expiratory volume in 1 second; IOS, airway resistance by impulse oscillometry; PICU, pediatric intensive care unit.

^aEffect size is the β -coefficient by multiple linear regression for percentage of predicted FEV₁ and percentage of predicted IOS. For hospital or PICU admission, it is the odds ratio by multiple logistic regression for a 1-point increase of the AAIRS at baseline or a failure to decrease by 1 point for 2-hour change. All analyses were adjusted for age, sex, and race.

^bThe 2-hour change of AAIRS to predict 2-hour change of percentage of predicted EV₁ or percentage of predicted IOS, adjusted for baseline AAIRS and baseline percentage of predicted FEV₁ or percentage of predicted IOS, respectively.

^cThe 2-hour change of AAIRS to predict hospitalization or PICU admission.

comprehensive exacerbation severity score to determine which patients should be admitted to the hospital to improve patient care and resource utilization.⁷ The AAIRS might also complement pediatric and adult clinical prediction rules for asthma hospitalization.^{8,9} Knowledge of the baseline AAIRS and change in response to treatment might inform clinical decision making at the bedside.

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