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Variability of the Acute Asthma Intensity Research Score (AAIRS) in the Pediatric Emergency Department

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Asthma is the most common chronic disease of childhood, and acute asthma exacerbations utilize a significant amount of pediatric emergency department resources.^{1–3} The ability to quickly and accurately evaluate acute asthma exacerbation severity is essential for providing appropriate, quality care in an efficient manner. Furthermore, in increasingly busy emergency departments in which multiple health care providers may take care of a single patient, there needs to be low inter-rater variability of asthma severity assessment among providers so that exacerbation severity can be efficiently communicated.

The clinical team in our tertiary, urban, academic children's hospital emergency department (PED) manages approximately 3,100 acute asthma exacerbation per year. We previously reported higher than expected treatment variability of asthma exacerbations in the PED.⁴ At that time, we were using the 15-point pediatric asthma score (PAS) to evaluate our asthma exacerbations.⁵

As part of a quality improvement initiative, a multidisciplinary asthma steering committee created a hospital-wide clinical pathway guideline (CPG) for asthma exacerbation assessment and management, and implemented the CPG in May, 2014. The Acute Asthma Intensity Research Score (AAIRS) was incorporated in the CPG to guide clinical assessment and management of exacerbations, but no formal training in the use of the AAIRS was provided before the start of the CPG.

The AAIRS is a 7-component bedside severity score with a 17-point range of possible score values (0 – 16, with 16 most severe). The components of the score include the evaluation of

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the presence of three groups of accessory muscle usage, a room air oxygen saturation value, and severity measures of air entry, wheezing, and expiratory phase prolongation. The AAIRS has demonstrated discrimination and responsiveness to predict the criterion standard %-predicted forced expiratory volume in 1-second (%FEV₁).⁶ However, to our knowledge the inter-rater reliability of AAIRS has yet to be reported. The objective of this study was to evaluate the inter-rater agreement of the individual AAIRS components as well as the total AAIRS amongst providers (MDs or nurse practitioners (NP)), nurses (RN), and respiratory therapists (RT).

In July 2014, clinical team members were recruited for study participation. Participants were asked to assess individual AAIRS components in tandem with at least one other clinical team member for children ages 3 – 17 years with acute asthma exacerbations. The only patient inclusion criteria was doctor diagnosed asthma. Participants did not receive any formal training in the use of the AAIRS for the duration of the study and no participants had any previous experience using it in clinical practice.

Clinical team members were recruited from individuals who routinely worked in the PED. Participants included providers (MD or NP), nurses (RN), and respiratory therapists (RT). All participants who completed AAIRS scoring sheets for this research signed informed consent; the AAIRS was also in routine clinical use after the establishment of the CPG in May 2014.

Evaluations were completed on paper score sheets by circling the individual components of AAIRS, and evaluations were completed both at the time of asthma presentation and after 1 hour of treatment. Clinical team members completed the evaluations independently and placed the score sheets in a locked mailbox in the PED work-room. Participants were asked to not share or discuss their assessments with one another. The research score sheets were not used to guide clinical care. All participants signed informed consent and the study was approved by our Institutional Review Board.

We calculated interobserver agreement for all three clinical team member groups (RT vs. RN, RT vs. provider, RN vs. provider). For analysis of the individual components of AAIRS, we used Kappa statistics. For the analysis of the total AAIRS, we used the intraclass correlation coefficient. All analyses were performed using the R statistical package.⁷

During the study period July 1 2014 to November 27, 2014 AAIRS research score sheets were completed on patients with 144 individual asthma exacerbations. The presence of an asthma exacerbation was determined by the treating physician. All evaluated patients had doctor diagnosed asthma, median age 5 years (IQR 3.3 years, 8 years), and 33% were female. For each asthma exacerbation, all three clinical team member groups had the opportunity to complete an AAIRS evaluation. In total, 22 different RTs, 50 different nurses, and 48 different providers completed AAIRS research score sheets. RT vs. provider had the best total AAIRS intraclass correlation coefficient for both before- and after-treatment [0.77 and 0.66 respectively, Table]. The after-treatment assessment for RN vs. provider of the sternocleidomastoid muscle usage had the highest kappa statistic, 0.81, and in general the

evaluation of accessory muscle usage had greater kappa statistics than other AAIRS components. The lowest kappa statistic was seen for RN vs. provider for the assessment of before-treatment expiratory phase.

Our study results indicate that while there is good inter-rater reliability for the overall AAIRS evaluation, there were several components of the score that have poor inter-rater reliability. Specifically, the evaluation of air entry, wheezing, and the expiratory phase have particularly poor inter-rater reliability before and after treatment. We believe this might relate to the lack of formal training in the AAIRS during the study period. Despite these observations, the AAIRS has been shown to predict PED disposition.⁸

The evaluation of asthma severity involves clinical assessment as well as spirometry when possible. However, there is evidence that concordance between spirometry and asthma symptoms can be low with a significant proportion of children demonstrating greater severity of asthma on spirometry than would be predicted by clinical symptoms alone.⁹ Therefore, there is a need for clinical tools that help to better predict asthma severity and that are available at the bedside.

There are a number of pediatric asthma exacerbation scores available for clinical use, but few have been sufficiently validated.¹⁰ The AAIRS has been validated against %FEV₁ and has demonstrated similar discrimination and responsiveness to another score, the Pediatric Respiratory Assessment Measure (PRAM).⁶ A next step is to implement an educational video that teaches correct severity assessment of pediatric asthma exacerbations using the AAIRS. After implementation of this teaching tool, we plan to re-evaluate the inter-rater reliability of the AAIRS.

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Measures of inter-rater agreement for Acute Asthma Intensity Research Score (AAIRS) amongst clinical team members caring for children with acute asthma exacerbations

Table 1

Kappa Statistics and Intraclass Correlation Coefficient									
Component	RT vs RN		RT vs Provider		RN vs Provider		Overall		
	Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx	Before Tx	After Tx	
SCM ^a	0.51	0.63	0.49	0.70	0.35	0.81	0.40	0.36	
Intercostal ^a	0.76	0.63	0.53	0.53	0.27	0.42	0.43	0.23	
Subcostal ^a	0.71	0.64	0.67	0.48	0.64	0.42	0.60	0.37	
Air entry ^a	0.22	0.14	0.30	0.29	0.24	0.25	0.19	0.18	
Wheezing	0.35	0.34	0.46	0.25	0.16	0.32	0.25	0.21	
SpO ₂ ^a	0.62	0.69	0.60	0.36	0.40	0.49	0.40	0.41	
Expiratory phase ^a	0.21	0.35	0.26	0.34	0.06	0.35	0.12	0.28	
Total Score ^b	0.74	0.64	0.77	0.66	0.61	0.53	0.65	0.49	

Abbreviations: RT, respiratory therapist; RN, registered nurse; SCM sternocleidomastoid muscle; SpO₂, transcutaneous pulse oximetry

^a Kappa statistic (categorical variable)

^b Intraclass correlation coefficient (continuous variable)