

Evidence-Based Asthma Control Assessments in Pediatric Care

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Asthma is a chronic respiratory condition that affects people of all ages. Specifically, asthma is the most common chronic illness for children and affects children worldwide (Asher & Pearce, 2014). In the pediatric population, asthma contributes to significant illness and death (American Academy of Asthma Allergy & Immunology, 2016). In addition, asthma is cited as the most common cause of missed school days for children ages 5 to 17 years (Asthma and Allergy Foundation of America, 2015). Thus, children with asthma experience lower academic achievement, difficulty in adjusting to the educational environment, and more psychological and social stress (Hsu, Qin, Beavers, & Mirabelli, 2016). The Centers for Disease Control and Prevention (CDC) (2014) reported that pediatric asthma in Alabama was higher at 12% when compared to national pediatric asthma rates of approximately 9%. Moreover, asthma rates among minority children in Alabama were reported at 18% compared to the national minority rate of approximately 15.5% (CDC, 2014). Unfortunately, asthma rates between 2008 and 2010 were more prevalent among African-American children compared to other minority children (Moorman et al., 2012).

The Global Initiative for Asthma (GINA) (2016) updated clinical practice guidelines outline asthma management

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Harvey, M., Lennen, N., & Whitted, K. (2018). Evidence-based asthma control assessments in pediatric care. *Pediatric Nursing, 44*(4), 163-168, 181.

Asthma is the most common chronic illness for children and affects children worldwide. Non-compliance with clinical practice guidelines compromises pediatric asthma management. The two-fold purpose of this study was to implement clinical practice assessments outlined by the Global Initiative for Asthma and to examine the effect of the asthma control test and peak expiratory flow interventions on pulmonary referral and hospitalization rates of pediatric patients with asthma. The goal was to emphasize the significance of implementing clinical practice guidelines in caring for pediatric patients with asthma. A pre-intervention and post-intervention retrospective chart review was completed to assess the effectiveness of clinical practice guidelines in decreasing hospitalizations and pulmonary specialist referrals in a rural pediatric clinical setting. Outcomes revealed an increase in pulmonology referrals and hospitalizations. Use of clinical practice guidelines help to identify poorly controlled pediatric patients with asthma and the need for acute care intervention, revision of pharmacological therapy, or pulmonology referrals. Clinical practice guidelines are influential in managing pediatric asthma. Evidence-based practice must be used to promote optimal short- and long-term outcomes in all healthcare settings.

Key Words: Asthma, pediatric asthma management, asthma control test, peak expiratory flow, clinical practice guidelines.

for pediatric patients. Recommended guidelines include formulation of an asthma action plan, primary evaluation of asthma severity using peak expiratory flow (PEF), and reassessment of severity at a minimal interval of every 6 months. The guidelines also recommend utilization of both the asthma control test (ACT) and PEF during reassessment intervals, assessment of asthma triggers, and education regarding referral to a pulmonary specialist, usage of rescue and maintenance medications, and identification of risk factors for asthma fatality.

Purpose

The two-fold purpose of this study was to implement clinical practice assessments outlined by the GINA guidelines and to examine the effect of the ACT and PEF interventions on pulmonary referral and hospitalization rates of pediatric patients with

asthma. The clinical agency used for recruitment and data collection had no standardized method of pediatric asthma assessment based on the GINA guidelines prior to the study. The study implemented the use of an ACT checklist and PEF meter as outlined by GINA (2016) and compared the outcomes of pulmonary specialist referrals and hospitalizations post-intervention.

The goal of the project was to emphasize the significance of implementing clinical practice guidelines in caring for pediatric patients with asthma. The overall goal was to reinforce the importance of using standard guidelines of care for chronic illness, specifically in the care of the pediatric population. Evidence supports the use of clinical assessments along with objective tools to assess asthma control for asthma management in the primary care setting. The ACT and PEF assessments assist clinicians and par-

ents in identifying uncontrolled pediatric asthma and impending exacerbations. Based on objective and subjective assessments used in this study, pediatric patients with asthma in one pediatric clinic received acute care intervention, specialist referral, or additional pharmacological intervention.

Theoretical Framework

Advanced nursing practice requires clinicians to examine methods intended to improve patient outcomes using research. Middle-range theories derived from conceptual models focus on identifying concepts that can guide clinical practice (Fawcett & Garity, 2009). The symptom management theory was chosen to guide the research study, and the model for evidence-based practice change was selected to drive the process of implementing the study.

Symptom Management Theory

Middle-range theories are derived from conceptual models and are focused on identifying specific concepts that can be tested to guide clinical practice (Smith & Liehr, 2013). The University of California School of Nursing faculty applied symptom management theory (SMT) to clinical practice and revised the theory to explain the interrelatedness of constructs (Dodd et al., 2001). A modified version of the SMT was selected as a foundational theory to guide the study. Primary dimensions of the SMT are symptom experience, components of symptom management strategies, and outcomes. Symptom experience refers to physical and psychosocial changes the patient experiences that are associated with the disease process (Newcomb, 2010), and examines the patient's perceptions of frequency and severity of symptoms (Dodd et al., 2001).

For this study, an age-appropriate ACT and a PEF reading were used to evaluate symptom experiences for consenting participants. The dimension of symptom management strategies in the SMT can be defined as actions taken to relieve current symptoms and to improve long-term and short-term patient outcomes (Dodd et al., 2001; Newcomb, 2010). This study defined pharmacotherapy and behavior changes as asthma management strategies. The dimension of outcomes in the SMT refers to the consequences of management strate-

gies (Dodd et al., 2001; Newcomb, 2010) and was defined in this study as pulmonary referral and hospitalization rates based on ACT and PEF results. The purpose of SMT is to use subjective information to assess symptom experience, devise appropriate symptom management strategies, and attempt to improve patient outcomes. In addition, using clinical judgment concerning when and how to implement patient care is an important construct of the theory (Liehr, 2005). Clinicians are challenged to ask specific clinical questions to evaluate symptom experience and select appropriate intervention strategies. For this study, the ACT influenced communication between the patient, caregiver, and clinician by addressing specific questions about asthma symptom experience. As a result, clinicians evaluated symptom experience efficiently and created more effective treatment plans that resulted in improved outcomes.

Evidence-Based Practice Change Model

According to Larrabee (2004), evidence-based practice change integrates principles of leadership, such as quality improvement, teamwork, and conversion strategies, and was used to implement the study. Larrabee (2004) identified six phases for implementation of the evidence-based practice change model: measuring the need for change, finding the best evidence, investigating the evidence, planning practice change, implementing and assessing the change, and monitoring and maintaining the practice change. Each phase of the change model was followed to complete the study. Among pediatric patients with asthma, the model for evidence-based practice change was an appropriate model because it provided a systematic approach to solving the clinical problem.

Literature Review

A review of the literature revealed that adequate asthma control in children is dependent upon the use of appropriate objective and subjective diagnostic tools and clinical management. ACT and PEF assessments have been influential in decreasing hospitalizations and pulmonology referrals (Feldman et al., 2012), and are components of the recommended protocol for evaluating asthma control (GINA, 2016).

Asthma Control Test

The ACT is a subjective assessment tool used to evaluate asthma control in the pediatric population and is completed by the patient, parent, or clinical office staff. The tool is numerically scored to determine the effectiveness of asthma control based on patient or caregiver perception. GINA (2016) supports the use the ACT as a standardized survey for assessment of asthma severity in patients who have not established a long-term maintenance plan and as evaluation of the level of control in patients with established treatment strategies.

The ACT was developed by Nathan and colleagues (2004) to evaluate the effectiveness of asthma treatment and as a guideline to create an asthma action plan for patients with asthma. Reliability of the ACT has been reported at 0.77, and instrument validity was established by identifying a correlation between baseline provider assessment of asthma control, and ACT scores (Sekeral et al., 2012).

Patients ages 12 to 18 years can use the ACT, which is a short, 5-item questionnaire using Likert-like responses to examine the adolescent's perception of asthma control over the preceding 4 weeks. A different version, the child ACT (cACT) is used for children ages 4 to 11 years and is a short, 7-item questionnaire. Four pictorial items are presented for child selection and examine the child's perception of asthma symptoms. The three additional questions are answered by the parent or caregiver and examine adult perception of the child's symptom occurrence over the previous 4 weeks (Nathan et al., 2004).

Both ACT versions provide a quick 5- or 7-question assessment that can be completed over a short time frame. The healthcare provider could administer the survey after obtaining copyright permission for reprinting the instruments, or parents and/or patients can print a copy of the instrument obtained free online for later review with the primary care provider. The evidence supports the use of assessment tools to improve the management of asthma in pediatric patients (Bonagura, 2013; Celano, Holsey, & Kobrynski, 2012; Feldman et al., 2012; Tamblyn et al., 2015); however, there is an inherent potential for response bias that should be considered with the use of self-report questionnaires.

Peak Expiratory Flow

Recommended guidelines by GINA (2016) to improve asthma management in the pediatric population include assessment of asthma control using clinical assessment and PEF. PEF assessment is recommended at the following intervals: initial assessment after pharmacological treatment was initiated and symptoms are stabilized, and at least annually or biannually. A study conducted by Feldman and colleagues (2012) supported the use of PEF assessment and revealed that children who received PEF assessment as part of asthma self-management had better adherence to prescribed asthma control medications and decreased hospitalizations.

The PEF assessment is an objective method used to evaluate asthma control. To assess PEF, patients are instructed to exhale into a meter labeled in liters per minute (LPM) for airflow rates. If the patient's airflow rate is in the 400 to 500 LPM range, asthma is interpreted as well controlled, and the patient is considered to have good lung function. If the flow rate is in the 250 to 400 LPM range, asthma is interpreted as cautionary, and lung function may be compromised. This may also indicate the patient may require use of a rescue inhaler prior to physical activity. Finally, if the patient flow rate is in the 0 to 250 LPM range, asthma is interpreted as dangerous, representing impending asthma attack or poorly controlled asthma with diminished lung function. PEF is a recommended objective assessment to measure airflow obstruction in patients with asthma (Feldman, 2012; GINA, 2016).

The ACT and PEF were identified as valid and reliable tools that can be used as part of pediatric asthma treatment protocols. The addition of the PEF as an objective assessment is more useful than subjective assessment data gathered from patients or parents alone. Research supports the concomitant use of the ACT and PEF as assessments of asthma control and severity (Al Moamary, Al-Kordi, Al Ghobain, & Tamim 2012; Bonagura, 2013; Carroll, Wildhaber, & Brand, 2012; Feldman et al., 2012). Clinicians would benefit from using PEF and ACT, if presented in an easy, non-time-consuming method, to improve asthma management and decrease referrals and hospitalizations. Patients would benefit from receiving asthma care in the primary care setting while promoting continuity of care.

Methods

Study Design

A pretest-posttest research design was used for the study. Following agreement with the clinical agency and Institutional Review Board approval from the university, a retrospective chart review was conducted to collect demographic and pre-intervention data from August 2015 to November 2015. The intervention included implementation of age-appropriate ACT and PEF use on all patients with asthma who agreed to participate and met inclusion criteria from August 2016 to November 2016. A second retrospective chart review was conducted to collect demographic and post-intervention data from the consenting participants seen in the clinic between August 2016 and November 2016.

Sample

A convenience sample of 270 pediatric patients with asthma agreed to participate in the study. Children ages 5 to 18 years were included in the sample groups. Children ages 4 years and younger, children with developmental disabilities, and non-English-speaking participants were excluded from the study.

Setting

An established pediatric primary care clinic located in Alabama was chosen to implement the study. The practice had two pediatricians, an office manager, an office administrator, and four medical assistants. The practice had an average of 450 patient visits per month from August to November. The percentage of patients with asthma is unknown. A large, onsite conference room was used for staff education and training.

Procedures

The primary investigator received training for the electronic health record (EHR) that would be used to complete data collection forms of the pre- and post-intervention data. Clinical staff training regarding how to administer and score the appropriate ACT and PEF was provided. Clinical staff implemented the cACT, ACT, and PEF on patients meeting all inclusion criteria for the study on August 1, 2016. After patients were brought to the triage area, a clinical staff member presented a script that explained the study. Following obtaining informed parental consent and

child assent, the cACT or ACT and the PEF were assessed on the patient and documented in the EHR. Clinical staff followed this procedure on all patients with asthma until November 30, 2016. Post-intervention assessment of pulmonary referrals, hospitalizations, and demographic data was conducted and compared to pre-intervention data. It is unknown how many eligible patients elected not to participate in the study.

Demographics. The evidence has identified correlations between demographic characteristics related to asthma in children, such as ethnicity (Akinbami et al., 2012; CDC, 2015), family history of asthma (Paaso, Jaakkola, Lajunen, Hugg, & Jaakkola, 2013), insurance (CDC, 2013, 2015; Zahran, Bailey, & Garbe, 2011), and exposure to smoke (Burke et al., 2012). Based on the evidence, the following demographics were collected: sex; height; weight; ethnicity; family history of asthma; presence, absence, and type of insurance coverage; and presence of a smoker in the home.

Instruments

Asthma control test. The cACT and the ACT were used to assess asthma control. A score of 19 or lower was interpreted as poorly controlled asthma. Conversely, a score of 20 to 27 was interpreted as well-controlled asthma. For this study, the cACT or the ACT was administered to children ages 5 to 18 years. Survey scores were added, and the overall score was placed in the history of present illness section of the EHR for quick access by clinicians in assessment of asthma control.

Peak expiratory flow. The following recommendations were made based on patients' scores on the PEF meter. Patients who scored 200 LPM or below were administered nebulizer treatments if clinical presentation warranted. For patients who scored 201 to 300 LPM, providers accessed medication adherence, reeducated patients on the appropriate medication usage, and reevaluated the asthma action plan. For patients who scored 301 to 450 LPM, providers continued the current treatment plan and reinforced patient teaching.

Results

Data were collected from 270 charts for pre-intervention ($n=174$, 64.5%) and post-intervention ($n=96$, 35.5%)

periods. Demographic information is presented in Table 1. There were more males than females in both groups, and African-American children were represented more than any other race. A higher percentage of participants reported a familial history of asthma in the post-intervention sample ($n=60$, 62.5%) compared to the pre-intervention sample ($n=71$, 40.8%). The post-intervention sample had a higher percentage of smoking in the home ($n=35$, 36.5%) compared to the pre-intervention sample ($n=52$, 29.9%). Medicaid was reported as the largest insurance provider between both samples, representing 82.2% ($n=143$) of the pre-intervention group and 85.4% ($n=82$) of the post-intervention group. Some variation was noted between samples for age, height, and weight.

The mean, standard deviation, and range of PEF, ACT, and cACT totals were calculated for the post-intervention sample. Overall results of the PEF total scores demonstrated the post-intervention group had moderate lung function ($M=2.14$, $SD=91.231$). Individual PEF results indicated that nearly 48% ($n=46$) of the children required immediate medical attention, and 36.5% ($n=35$) were instructed to take precautions with physical activity. Results from the cACT total ($M=16.96$, $SD=4.98$) indicated that the post-intervention sample ages 5 to 11 years had poorly controlled asthma, and the ACT total ($M=19.38$, $SD=2.83$) indicated the post-intervention sample ages 12 to 18 years also had poorly controlled asthma. Almost 67% ($n=48$) of children ages 5 to 11 years indicated poorly control based on the cACT, and 54.2% ($n=13$) of children ages 12 to 18 years indicated poorly control on the ACT.

When comparing groups, hospitalization rates increased from 12.6% ($n=22$) in the pre-intervention group to 22.9% ($n=22$) in the post-intervention group. This increase may be related to results demonstrating that nearly 48% of participants had PEF scores lower than 200 LPM. Additionally, a slight increase in pulmonary referrals occurred from the pre-intervention group (31%, $n=54$) to the post-intervention group (31.3%, $n=30$) (see Table 2).

Multiple regression was used to determine which independent variables predicted PEF total. The model summary and the analysis of variance (ANOVA) summary indicate that the overall model of the total ACT score and someone smoking in the home predicted the PEF

Table 1.
Characteristics of Pre- and Post-Intervention Samples
(N = 270)

Characteristics	Post-Intervention Sample (n=96)		Post-Intervention Sample (n=96)	
	n	(%)	n	(%)
Sex				
Male	105	(60.3)	61	(63.5)
Female	69	(39.7)	35	(36.5)
Ethnicity				
Black	150	(86.2)	89	(92.7)
White	19	(10.9)	5	(5.2)
Hispanic	1	(0.6)	0	(0.0)
Asian	2	(1.1)	0	(0.0)
Other	2	(1.1)	2	(2.1)

Table 2.
Comparison of Referral Rates and Hospitalization Among Both
Samples (N = 270)

Frequency	Pre-Intervention Sample (n=174)		Post-Intervention Sample (n=96)	
	n	(%)	n	(%)
Referral				
Yes	54	(31.0)	30	(31.3)
No	120	(69.0)	66	(68.8)
Hospitalization				
Yes	22	(12.6)	22	(22.9)
No	152	(87.4)	74	(77.1)

Table 3.
ANOVAs of PEF Total and Child, Caregiver, and Teen Perception
of Asthma Control

Variable	F	p
Child asthma perception	1.868	0.143
Teen asthma perception	5.822	0.005
Caregiver asthma perception	4.607	0.001

($R^2=0.389$, $R^{2adj}=0.371$, $F_{[2, 69]}=21.963$, $p<0.001$). Review of beta weights indicated that both smoking in the home ($\beta=43.337$, $t=2.726$, $p<0.01$) and the child ACT total ($\beta=9.571$, $t=6.149$, $p<0.001$) significantly contributed to the model. One way ANOVA identified an increase in PEF totals when individual perception of asthma control increased ($F_{[3, 19]}=5.822$, $p<0.01$). As patient or parent perception of asthma control increased, PEF totals increased. Adolescents who perceived

their asthma as 'poorly controlled' had a lower PEF total ($M=173.33$) than those who rated their asthma as 'somewhat controlled' ($M=202.50$), 'well-controlled' ($M=293.08$), or 'completely controlled' ($M=386.67$). Additionally, a statistically significant difference in PEF total and the caregiver's perception of how many days per month the child had asthma symptoms was also identified using one way ANOVA ($F_{[5, 66]}=4.607$, $p<0.01$). As the caregiver's perception of the number of

days per month with asthma symptoms decreased, the PEF total increased (see Table 3).

Discussion

Results from the study demonstrated that the use of ACT and PEF assessments was helpful in evaluating asthma severity and control among the study participants. Quality of care at the clinic was improved with the implementation of the ACT and PEF assessments. Despite these findings, providers verbalized disinterest in continuing the use of the ACT as a measure of asthma control because it requires permission due to copyright law. Use of the PEF to assess lung function will be sustained at the clinic. Current GINA (2016) guidelines support the use of the PEF in asthma management in primary care settings. Clinical staff reported that the PEF was a quick assessment and that patients and caregivers were receptive to its use.

After the Institute of Medicine's (2001) critical report of medical shortfalls responsible for thousands of preventable patient injuries and deaths, evidence-based practice became pivotal to transforming health care. Evidence-based practice must be used to improve short- and long-term asthma management. Healthcare delivery has continued to shift from tertiary prevention to primary and secondary prevention models focused on health promotion, illness prevention, and disease progressing interference strategies (Institute for Work and Health, 2015; Stevens, 2013); healthcare providers are ethically obligated to ensure best practices are used when providing care.

Study Limitations

Approximately half the number of patients with asthma were included in the study compared to 2015 based on the retrospective chart reviews and this is thought to be related to unseasonably warm weather. Studies have found asthma exacerbations in the United States typically occur during the spring and fall seasons, and generally affect individuals younger than age 15 years. Some evidence suggests exposure to rhinovirus and other allergens is most likely to occur among pediatric patients during the fall when children return to school and may be impacted by colder weather when children are in closer proximity (Gerhardsson de Verdier,

Gustafson, McCrae, Edsbäcker, & Johnston, 2017; Wisniewski et al., 2016). Due to unseasonably warm weather, the number of patients with asthma who met the post-intervention criteria for the study decreased from the previous year. Students were less likely to be confined indoors, which may have lessened exposure among pediatric patients with asthma, and thus, influenced the post-intervention sample size.

Another limitation of the study was difficulty in locating the PEF and ACT scores due to lack of documentation in the appropriate area of the EHR. Although weekly visits to the clinical site were made, some scores were found written on the actual ACT or cACT assessment documents instead of in the EHR as previously arranged. Additionally, the lack of consistency in documentation prevented assessment of the total number of patients with asthma seen in the clinic during the post-intervention period. There is no estimation on the number of patients eligible for participation who did not consent.

Recommendations/ Implications for Practice

To improve health care, evidence-based practice must be the foundation of healthcare delivery. Nursing literature emphasizes that evidence-based practice leads to better patient outcomes and promoted quality nursing care. Clinical practice guidelines are based on the integration of clinical expertise, research, and collaboration among the patient, family, and caregivers that optimize health. Empirical data from this study revealed that following clinical practice guidelines by implementing the ACT and PEF to manage pediatric patients with asthma resulted in acute care intervention, revision of pharmacological treatments, or specialist referral, all of which improved quality care. Results validate the need for the advanced practice nurse to insure clinical practice guidelines are used in primary care settings.

Future Research

Additional research is necessary to adequately assess the effect of ACT and PEF on pediatric asthma outcomes. This project was limited to 4 months from the end of summer, through fall, and ended prior to win-

ter. Perhaps a longitudinal study that examines a 12-month timeframe over a period of 1 to 3 years would reveal more information of the ability of the ACT and PEF to influence asthma control and management. In addition, a clinic that serves a more culturally diverse population may provide more insight into disparities related to pediatric asthma.

Consistent use of clinically validated assessments to manage pediatric asthma is essential in the primary care setting. Evidence-based assessment tools can promote better patient outcomes and quality of life for pediatric patients with asthma. This study demonstrated that using the assessments helped to identify children with poorly controlled asthma and the need for treatment plan intervention. Using evidence-based clinical practice guidelines could be useful in dispelling disparities of pediatric asthma in the African-American community. ■

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Learning Outcome

After completing this continuing nursing education activity, the learner will be able to describe the importance of using a clinically validated assessment and clinical practice guidelines to manage pediatric patients with asthma for optimal outcomes.

Learning Engagement Activity

Learn more about asthma and the CDC's National Asthma Control Program by visiting <https://www.cdc.gov/asthma/default.htm>

The author(s), editor, editorial board, content reviewers, and education director reported no actual or potential conflict of interest in relation to this continuing nursing education article.

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