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Improved quality-of-life of caregivers of children with asthma through guideline-based management

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ABSTRACT

Objective: The quality of life (QOL) of caregivers of children with asthma may be related to children's responses to asthma management. *Aim:* To evaluate change in QOL over time of caregivers of children with asthma through guideline-based management. *Design:* This was a 3-year prospective cohort study of children with asthma referred to our pediatric asthma center. Families completed Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ), the Asthma Control Test™ (ACT), and reported the number of days/month of albuterol use and wheezing at each clinic visit. *Results:* We enrolled 143 children, ages 7–17 years (mean = 10.6 ± 2.9), 56.6% male, 70.6% Caucasian. Patients were managed by the same MD (n = 65,45.5%) or APN (n = 78,54.5%) over time. The mean total PACQLQ significantly increased over the 3-year period ($F = 67.418$, $p < .001$). Total scores at the first visit were 4.8 ± 1.6, which improved to 6.1 ± 1 at the 3-month follow-up visit. This improvement was sustained at the 1, 2, and 3-year clinic visits. PACQLQ emotional function ($F = 60.798$, $p < .001$) and activity limitation ($F = 41.517$, $p < .001$) domains significantly improved as well. PACQLQ scores were significantly associated with improved ACT scores ($r = .37$ to $.47$, $p < .05$), fewer days/month of albuterol use ($r = -.25$ to $-.36$., $p < .05$), and wheezing ($r = -.28$ to $-.33$, $p < .05$). There were no significant differences in PACQLQ, or asthma clinical outcome measures between MD and APN providers. *Conclusion:* Use of National Asthma Education and Prevention Program (NAEPP) guidelines significantly improved QOL of caregivers of children with asthma and in asthma-related symptoms. Improvements over time were independent of type of providers.

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Asthma; children; PACQLQ; quality of life

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Introduction

Asthma is the most common chronic disease in children and is associated with significant morbidity [1]. Prior studies demonstrated that asthma control is inadequate in primary care settings due to suboptimal adoption and adherence to guidelines from the National Asthma Education and Prevention Program (NAEPP) [1–4]. Asthma is a chronic condition that presents a burden for both children and their parents [5]. Missed school/work days and frequent unscheduled health care visits are well known morbidities associated with poorly controlled asthma [6,7]. Poor long term control of asthma can also affect sleep quality, impacting learning through decreased attentiveness during daytime and poor work performance for parents [8,9]. In addition, families may need to adopt restrictions inside their home or avoid certain activities which may adversely affect asthma [10]. The cost of missed work, prescription medications, and health care visits may create an economic burden for parents and negatively impact Quality of Life (QOL) [11]. The impact of poorly controlled asthma on parental QOL may also be affected by ethnomedical and cultural belief systems, thus adding another layer of complexity to disease burden [12–14].

Chronic diseases, especially if not well controlled, may have a negative impact on the QOL of patients and families [15,16]. Thus, caregivers of children with chronic disease often have decreased QOL [9,17–19]; therefore, it is useful to measure QOL of caregivers of children with asthma [17,20,21] as potential indicators of quality asthma management. QOL is an important outcome measure in patients with chronic diseases such as asthma [22]. Symptoms interfere with social functioning and normal activity, which subsequently impact QOL [23]. As symptoms differ in each disease, disease-specific QOL questionnaires add valuable information to providers about disease control [17,24].

The Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) is a useful measure to quantify the effect of caring for a child with asthma on the QOL of

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caregivers, e.g., parents and guardians [21]. Studies have shown that better control of symptoms can improve QOL among children with asthma and their families [21,25], but these studies are of short duration. It is not known if improvements last over several years. It is also not known if the type of health care provider, i.e. physician (MD) or Advance Practice Nurse (APN) makes a difference in the QOL of caregivers of children with asthma.

The main objective of this study was to measure the impact of following NAEPP (EPR-3) asthma guidelines on the QOL of caregivers of children with asthma over a 3-year study period. The secondary objectives were to a) evaluate the relationship between caregivers' QOL and asthma clinical outcome measures; and b) to compare caregivers' QOL and asthma clinical outcome measures between different types of health care providers (physician or advanced practice nurse) over time.

Methods

Design

This was a 3-year prospective cohort study the caregivers of children with asthma who received care from either MDs or APNs according to NAEPP Guidelines.

Participants

After hospital Institutional Review Board (IRB) approval, (IRB11-00174) children with the diagnosis of uncontrolled asthma referred by local primary care practices between January 2011 and December 2014 were enrolled in our pediatric asthma center. Inclusion criteria were children ages 7 to 17 years who returned to the clinic for follow-up appointments, and their primary caregivers who could communicate in English ($n = 143$). Written consent and child assent was waived by the IRB.

Intervention

At the initial visit, patients were randomly assigned to either a pulmonologist (MD) or to an Advance Practice Nurse (APN) and were followed by the same provider throughout the study period. The APN worked in close collaboration with the pulmonologist as a team, and discussed all difficult cases before developing a management plan. The pulmonologist was also available as resource for the APN throughout the study. All patients received assessment of asthma control, as well as recommended treatment according to NAEPP asthma guidelines. At each visit, patients and caregivers received asthma education, including discussion of their individualized asthma action plan, discussion of asthma control, information about asthma medications, including detailed demonstration and dispensing of appropriate spacer devices, and self-management strategies. Follow up appointments were scheduled at the end of each visit. Families were asked to complete PACQLQ questionnaire at each visit, Asthma clinical outcome measures were also recorded at each visit.

Instruments

QOL Outcome Measure:

The PACQLQ [17, 21] (Table 1) is a 13-item self-administered, validated questionnaire for caregivers of 7–17-year-old children with asthma that inquire how often parents experienced negative feelings because of their children's asthma symptoms (9 items), and how worried caregivers are about their children because of asthma (4 items). Responses are given on 7-point ordinal scales where 1 = *all the time* and 7 = *none of the time*, or 1 = *very, very worried* and 7 = *not at all worried*. The questionnaire includes two domains of the impact of asthma on caregivers: Activity Limitation (4 items, #2, 4, 6, 8), and Emotional Function (9 items; #1, 3, 5, 7, 9, 10-13), during the previous week. Individual items are weighted equally. Mean scores for each of the two domains and for the total PACQLQ were calculated by summing the items and dividing by the number of items, yielding potential cores from 1 to 7 [21].

Asthma clinical outcome measures

The Asthma Control Test™ (ACT) [26] was completed by caregivers or older patients to evaluate asthma control over the past 4 weeks. Five items (amount of time asthma interfered with getting things done, frequency of shortness of breath, nighttime symptoms, and use of nebulizers, and level of asthma control) were scored on an ordinal scale of 1 to 5 and summed for a total ACT score. Low scores indicate poor asthma control. Caregivers or patients were also asked to document, at each visit, the number of days/month the children required albuterol for acute asthma symptoms and experienced daytime wheezing.

Analysis plan

Data were collected at the first clinic visit, the 3-month follow-up visit, and at subsequent follow-up visits as determined by the provider. The latest data from the 6-, 9- or 12-month visits were categorized as "1-year" follow-up, 18- or 24-month data were categorized as "2-year" follow-up, and 30-month or 36-month data were categorized as "3-year" follow-up. SPSS v.23 (IBM Analytics, Armonk, NY) was used for all analyses. Missing data values were not imputed. The distribution of scores was measured by mean ± standard deviation, median, and interquartile

Table 1. Pediatric Asthma Caregiver Quality of Life Questionnaire PACQLQ.

Please complete all questions by circling the number that best describes
How you have been during the last ONE week as a result of your child's asthma.

	During the past one week, how often	All of the time	Most of the time	Quite often	Some of the time	Once in a while	Hardly any of the time	None of the time
1	did you feel helpless or frightened when your child experienced cough, wheeze, or breathlessness?	1	2	3	4	5	6	7
2	did your family need to change plans because of your child's asthma?	1	2	3	4	5	6	7
3	did you feel frustrated or impatient because your child was irritable due to asthma?	1	2	3	4	5	6	7
4	did your child's asthma interfere with your job or work around the house?	1	2	3	4	5	6	7
5	did you feel upset because of your child's cough, wheeze, or breathlessness?	1	2	3	4	5	6	7
6	did you have sleepless nights because of your child's asthma?	1	2	3	4	5	6	7
7	how often were you bothered because your child's asthma interfered with family relationships?	1	2	3	4	5	6	7
8	how often were you awakened during the night because of your child's asthma?	1	2	3	4	5	6	7
9	did you feel angry that your child has asthma?	1	2	3	4	5	6	7

How much worried or concerned have you been during the last ONE week as a result of your child's asthma?

		Very, very	Very	Fairly	Somewhat	Little	Hardly	Not at all
10	about your child's performance of normal daily activities?	1	2	3	4	5	6	7
11	about your child's asthma medications and side effects?	1	2	3	4	5	6	7
12	about being overprotective of your child?	1	2	3	4	5	6	7
13	about your child being able to lead a normal life?	1	2	3	4	5	6	7

Emotion Scale = items #1, 3, 5, 7, 9, 10–13.
Activity Scale = items 2, 4, 6, 8.

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range as appropriate. Overall changes in PACQLQ and ACT scores were evaluated by linear mixed model analysis with fixed effects. Pearson or Spearman correlations were used to evaluate the strength and direction of the relationship between variables. Differences in PACQLQ measures between MD and APN providers were evaluated by mixed linear model analysis with *provider* as a covariate. The alpha level of significance for all analyses was ≤ 0.05.

Results

Demographics

The initial sample included 143 children, ages 7 to 17 years (mean = 10.6 ± 2.9). Males comprised 56.6% of the sample (Table 2). The majority of participants were Caucasian ($n = 101$, 70.6%) and 35 (24.5%) children were African Americans. Patients were managed either by an MD ($n = 65$, 45.5%) or an APN ($n = 78$, 54.5%) and maintained consistent follow-up with the same provider at each visit. A summary of all data collected for all variables at each clinic visit are reported in Table 3.

Change over time in pediatric asthma caregiver quality of life scores

A linear mixed model analysis indicated that Total PACQLQ scores significantly increased over the 3-year period ($F = 67.418$, $p < .001$). There were no missing data in the PACQLQ items. The mean total score at the first visit was 4.7 ± 1.7, which improved to 6.1 ± 1.0 at 3 months (Table 4). Average scores continued to increase at 1-year (6.4 ± 0.6, $n = 56$), 2-year (6.7 ± .05, $n = 38$), and 3-year visits (6.8 ± 0.3, n = 20). Over the 3-year period, significant improvement was noted for the Emotional Function ($F = 60.798$, $p < .001$) and Activity Limitation

Table 2. Demographic and clinical characteristics of the sample of children with asthma ($N = 143$).

	Mean ± SD
Age (years)	10.6 ± 2.9
Duration of symptoms	5.6 ± 3.5
Age at diagnosis	10.6 ± 2.9
	n (%)
Male	81 (56.6)
Female	62 (43.4)
Ethnicity	
Caucasian	101 (70.6)
African American	35 (24.5)
Hispanic	7 (4.9)
Provider	
Physician	65 (45.5)
Nurse Practitioner	78 (54.5)
Asthma Severity	
Mild persistent	22 (15.4)
Moderate persistent	98 (68.5)
Severe persistent	11 (7.7)

($F = 41.517$, $p < .001$) domains of the PACQLQ (Table 4) (Figure 1).

Change over time in asthma clinical indicators

ACT scores significantly improved over the 3-year period ($F = 36.189$, $p < .001$). Scores improved from 16 ± 5.6 at baseline to 20.4 ± 4.6 at the 3-month visit, and at 1-year: (21.6 ± 3.5) (Table 4). ACT scores remained at this level or higher at the 2-year and 3-year visits. The number of days of albuterol use decreased significantly over the 3-year period ($F = 73.705$, $p < .001$). The largest change was from the first visit (median = 9.5, IQR 4,20) to the 3-month visit (median = 1, IQR 1,3)) (Table 4). The median remained at a median of 1 day/month at all subsequent visits. Similarly, the number of days of wheezing decreased significantly between the baseline visit and 3-year visit ($F = 50.731$, $p < .001$). The most dramatic decrease was from the baseline (median = 7 [IQR 3,15]) to 3-month visits (median = 1 (IQR 0,2), and remained at that level at subsequent visits (Table 4).

Relationships among PACQLQ Scores and Asthma Clinical Indicators

ACT scores were positively correlated with PACQLQ total scores at the first visit ($r = .47$, $p < .001$), at 3 months ($r = .39$, $p = .002$), 1 year ($r = .34$, $p = .004$), and 2 years ($r = .43$, $p = .005$) (Table 5). Similar significant correlations were observed between ACT scores and PACQLQ Emotional Function and Activity Limitation scores at the first and 3-month visits (Table 5). The number of days/month of albuterol use and wheezing were significantly negatively correlated with all PACQLQ scores at the first and 3-month visits as shown in Table 5.

Mixed linear modeling indicated that PACQLQ total scores were not significantly different over time among the three groups of asthma severity ($F = .854$, $p = .426$): mild persistent (mean = 6.06 ± 1.36), moderate persistent (mean = 5.84 ± 1.34), severe (mean = 5.89 ± 1.3). There was no significant main effect for total scores with respect to age at diagnosis (<1 to 16 years; $F = 3.232$, $p = .073$, duration of symptoms (<1 to 15 years; $F = .965$, $p = .326$), or age of child at the first office visit (7 to 17 years; $F = .062$, $p = .804$). A similar pattern was noted for the Emotional Function and Activity Limitation domains of the PACQLQ, with one exception. There was a significant main effect for age at diagnosis in PACQLQ Activity Limitation scores, with lower scores at younger age at diagnosis ($F = 5.593$, $p = .018$).

Physician (MD) vs. Advance Practitioner Nurse (APN) providers

Linear mixed model analysis indicated significant decreases in PACQLQ total, Emotional Function, and

Table 3. Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) total, emotional and activity scores and asthma clinical outcomes over a 3-year period in a cohort of 143 parents of children with asthma.

	First Visit *n*	3-month visit *n*	1-year visit *n*	2-year visit *n*	3-year visit *N*
PACQLQ Scores	143	81	102	55	27
			Mean ± Standard Deviation		
Total	4.8 ± 1.6	6.1 ± 1.0	6.5 ± 0.6	6.5 ± 0.7	6.8 ± 0.3
Emotional Function	4.8 ± 1.6	6.1 ± 1.0	6.4 ± 0.6	6.5 ± 0.7	6.8 ± 0.3
Activity Limitations	4.8 ± 1.9	6.2 ± 1.1	6.3 ± 0.9	6.6 ± 0.7	6.7 ± 0.5
Asthma Outcomes					
			Mean ± Standard Deviation		
Asthma Control Test	*n* = 135	*n* = 104	*n* = 80	*n* = 51	*n* = 27
	16 ± 5.6	20.4 ± 4.6	21.1 ± 3.8	21 ± 4.0	23.6 ± 3.3
			Median (Interquartile Range)		
# days/month:	*n* = 143	*n* = 139	*n* = 103	*n* = 72	*n* = 34
Albuterol use	7 (4,20)	1 (1,3)	1 (1,3)	1 (1,2)	1 (1,4)
Wheezing	7 (3,15)	1 (0,2)	1 (0,1.25)	1 (0,2)	1 (.75,1)

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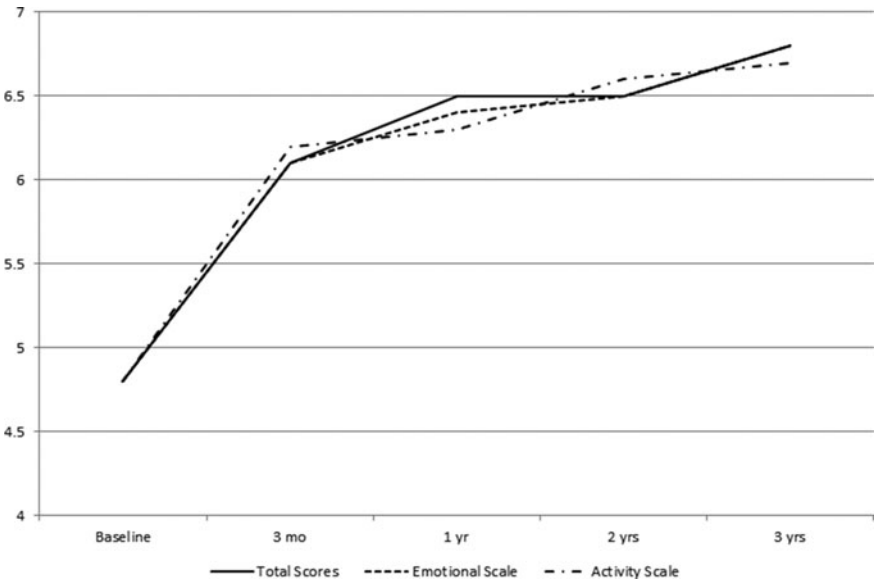

Figure 1. changes in mean PACQLQ scores over time.

Table 4. Changes between clinic visits in Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) Total, Emotion and Activity scores and children's Asthma Clinical Outcomes over a 3-year period.

	PACQLQ Total	PACQLQ Emotional Function	PACQLQ Activity Limitations	Asthma Control Test	Albuterol Use	Wheezing
	Mean ± Standard Deviation				Median (Interquartile Range)	
		$n = 81$		$n = 102$	$n = 136$	$n = 139$
First visit vs. 3-month visit	4.7 ± 1.7 6.1 ± 1.0	4.7 ± 1.7 6.1 ± 1.1	4.7 ± 2.0 6.2 ± 1.1	16 ± 5.6 20.4 ± 4.6	9.5 (4,20) 1 (1,3)	7 (3,15) 1 (0,2)
		$n = 56$		$n = 61$	$n = 98$	$n = 98$
3-month visit vs. 1-year visit	6.4 ± 1.0 6.5 ± 0.6	6.0 ± 1.2 6.3 ±0.7	6.1 ± 1.2 6.2 ± 0.9	20.3 ± 4.2 21.6 ±3.5	1 (1,4) 1 (1,3.25)	1 (0,3) 1 (0,2)
		$n = 38$		$n = 36$	$n = 71$	$n = 69$
1-year visit vs. 2-year visit	6.4 ± 0.6 6.7 ± 0.5	6.4 ± 0.6 6.6 ± 0.6	6.4 ± 0.9 6.7 ± 0.6	20.9 ± 3.8 21.3 ± 3.9	1 (1,3) 1 (1,2)	1 (0,2) 1 (0,2)
		$n = 20$		$n = 18$	$n = 33$	$n = 32$
2-year visit vs. 3-year visit	6.7 ± 0.4 6.8 ± 0.3	6.7 ± 0.4 6.8 ± 0.3	6.6 ± 0.7 6.7 ± 0.5	21.9 ± 4.4 23.6 ± 2.8	1 (1,2) 1 (1,2.5)	1 (.25,1) 1 (.5,1)

Table 5. Correlations among Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) Total, Emotional Function and Activity Limitation scores and Asthma Clinical Outcomes over a 3-year period.

	First visit	3-month visit	1-year visit	2-year visit	3-year visit
			r		
			PACQLQ Total Scores		
ACT scores	.47*	.39*	.34*	.43*	.17
Albuterol	− .33*	− .25*	.07	− .05	− .04
Wheezing	− .30*	− .28*	− .02	− .32*	.20
			PACQLQ Emotional Function Scores		
ACT scores	.43*	.37*	− .05	.42*	.03
Albuterol	− .31*	− .25*	.16	− .07	− .05
Wheezing	− .28*	− .26*	− .01	− .33*	− .10
			PACQLQ Activity Limitations Scores		
ACT scores	.49*	.37*	.31*	.41*	.20
Albuterol	− .36*	− .28*	− .08	− .05	− .20
Wheezing	− .30*	− .33*	− .03	− .37*	.08

*Alpha level of significance ≤ .05.
*Significant at alpha ≤ 0.05.

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Table 6. Comparison of Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) Total, Emotional Function, and Activity Limitation scores between Medical Doctor (MD) and Advanced Practice Nurse (APN) providers over a 3-year period.

	First visit		3-month visit		1-year visit		2-year visit		3 year visit	
	n and Mean ± Standard Deviation									
PACQLQ Total Scores										
MD vs.	63	4.9 ± 1.5	41	6.0 ± 1.2	47	6.5 ± 0.7	23	6.5 ± 0.7	13	6.7 ± 0.3
APN	78	4.7 ± 1.7	48	6.2 ± 0.8	55	6.5 ± 0.6	32	6.5 ± 0.7	14	6.8 ± 0.3
p		.384		.342		.796		.864		.386
PACQLQ Emotional Function scores										
MD vs.	64	4.9 ± 1.7	41	5.9 ± 1.2	36	6.4 ± 0.7	23	6.5 ± 0.8	13	6.7 ± 0.3
APN	78	4.6 ± 2.0	40	6.3 ± 0.8	47	6.5 ± 0.6	33	6.5 ± 0.7	15	6.9 ± 0.3
p		.456		.191		.605		.805		.212
PACQLQ Activity Limitation scores										
MD vs.	64	5.0 ± 1.7	41	6.2 ± 1.2	36	6.2 ± 1.0	24	6.6 ± 0.7	14	6.7 ± 0.5
APN	78	4.6 ± 2.0	41	6.2 ± 1.0	47	6.4 ± 0.9	33	6.5 ± 0.8	16	6.7 ± 0.4
p		.251		.981		.263		.831		.824

Activity Limitation scores over the 3-year time period (all $p < .001$), but no significant differences between MD and APN providers with respect to overall PACQLQ total ($F = .045$, $p = .832$), Emotional Function ($F = .018$, $p = .894$), or Activity Limitation scores($F = .432$, $p = .511$) (Table 6).

Discussion

This is the first study to evaluate changes in the QOL of parents of children with asthma in the context of their children's level of asthma control over a 3-year period, and to study on-going patterns of correlation between parental QOL and their children's clinical asthma outcomes. This study is also the first to compare parental QOL between MD and APN providers who followed NAEPP asthma guidelines. The results of this study suggest that following asthma guidelines and providing asthma care that includes an appropriate level of therapy based upon severity/control, action plans, and asthma control information, improves the QOL in caregivers of children with asthma, in as soon as the first 3-month follow up. This study also demonstrates that as children's asthma clinical symptoms improve, caregivers' PACQLQ scores also improve. These improvements were sustained long-term and were not influenced by the choice of health care provider.

Current NAEPP guidelines [27] recommend use of a validated instrument to assess and monitor asthma control at every visit. However, these instruments focus on symptoms and medication use and do not take either the children's or their parents' QOL into consideration [28–30]. This study supports previous research findings and expands knowledge about the usefulness of monitoring QOL in caregivers of children as an indicator of disease burden for caregivers and of asthma control in their children [31].

Sources of low caregiver QOL may be identified by a review of low-scoring items in the PACQLQ with the family. Careful questioning may identify needs that are not being addressed elsewhere, and help to better align treatment goals between families and providers. In addition, quality of life may be a useful predictor of adherence to therapy and health care utilization [32]. Parental decision making in regards to their children's asthma management may be affected by their QOL, thus another important reason to include assessment of QOL information as part of the clinical evaluation [5]. In a systematic review of condition-specific QOL questionnaires for caregivers of children with pediatric conditions, the PACQLQ was found to be sensitive to changes in the children's disease severity [19].

Several studies have demonstrated the relationship between asthma control and QOL but all are of shorter duration. To the author's knowledge, our study is the first to follow children for three years and to document correlations between parental QOL and child's asthma control during this extended period of time. Fleming et al. [33] followed 148 school age children as part of the U-BIOPRED cohort for up to two years and demonstrated significant correlation of asthma control with QOL. They identified poor asthma control as inversely associated with QOL. Cano-Garcinuno et al. [34] followed 452 children for 16 weeks and identified correlation of parental QOL with short-term asthma control in their children. A shorter, 9-week, study by Stelmach et al. [35] also identified correlation with parental QOL and level of their child's asthma control. These cumulative data all support a strong and lasting correlation between parental QOL and their child's asthma control, and as an aggregate, support the importance of evaluating caregiver QOL at each office visit.

Despite being widely publicized and accessible, NAEPP asthma guidelines [16] are slow to be adopted by

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primary care clinicians [36,37]. There are multiple barriers to implementation of clinical guidelines, including lack of time to read, understand, and apply into practice by busy clinicians [38]. However, when specific elements of the asthma guidelines are implemented, namely adjusting and prescribing appropriate level of therapy based upon assessment of control, then outcomes improve [39]. The latest NAEPP guidelines recommend assessing severity at initiation of therapy and level of control to adjust therapy [16].

There are specific parameters to assess control, which are easy to incorporate into the office setting, and can help determine whether asthma therapy needs to be adjusted. Use of these guidelines does not require specialty care and can occur through primary care offices, which will have a much greater reach and impact on a population level [40,41]. Asthma currently affects roughly 8–9% of all children in the United States [42]. The majority of these children will be seen only by their primary care providers without need for, or access to, a specialist. Primary care providers can implement basic elements of guideline based care with successful outcomes for their patients [43]. APNs have been shown to be valuable in caring for pediatric asthma related hospital admissions, offering comparable care to that of resident teams, and at a lower cost [44,45].

Although data are lacking regarding use of this model in the outpatient care setting for asthma, we provide evidence of the usefulness of APNs in this role. On a wider scale, there is disagreement regarding expanding the role of APNs in primary care, most notably from physicians [46]. However, with implementation of the Patient Protection and Affordable Care Act, millions of new patients will have access to primary care and require services that the current supply of primary care physicians will be challenged to meet [47–49]. In a recent study, we have shown that in-office training of non-physician asthma providers (APN or RN) improved the quality of asthma care in pediatric primary care practices, as measured by documentation of many quality indicators based on NAEPP guidelines [50]. Nurses are uniquely positioned to address the many facets of chronic disease management, in particular the repetitive teaching needs and incorporation of evolving psychosocial needs [51].

Recent systematic reviews have identified that use of clinical nurse specialists in outpatient management is cost-effective and offers comparable quality of care compared with physicians [52–54]. With proper training regarding use of evidence-based clinical guidelines, increased use of APNs under supervision of physicians in the primary care setting can offer a cost-effective strategy to provide quality care to patients with asthma. Additional studies are warranted to evaluate asthma specific parameters of care, including acute care need such as asthma related hospital admissions and/or emergency room visits and exacerbations when care is directed by APNs.

A limitation of this study is the use of self-reported data regarding children's asthma symptoms. Future studies should also include clinical indicators of asthma control as they relate to caregivers' quality of life. The sample size decreased over the 3-year period, which is to be expected as children's asthma control improves. Other data that would have contributed to the study of caregivers' QOL include demographic factors such as parental education level and socioeconomic status. Strengths of our study were the long term follow-up period, assessment of multiple data points over time, and consistency in relationships between parental QOL assessment and their children's level of asthma control.

Conclusion

This study demonstrated statistically and clinically significant evidence that quality of life in caregivers of children with asthma improved concurrently with improvement in children's levels of asthma control. These relationships were sustained over a 3-year period. NAEPP guidelines were followed throughout the study such that all children and families received the same quality of care. Improvement was not dependent on type of health care provider, indicating that APNs provide an important role in the management of persistent asthma in children

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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