

## Behavioral and Educational Interventions to Improve Asthma Outcomes in Children: A Systematic Review

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### ABSTRACT

**Background:** Asthma, being a chronic inflammatory disease requires not only medical treatment but also complimentary healthcare, self-management strategies and interventions for the appropriate management and possible prevention of attack as well as reduction of school absences and days of restricted activity and decrease emergency room utilization.

**Methods:** Randomized clinical trial (RCT) data reviewed for outcomes and processes associated with asthma educational and behavioral interventions provided by different types of health professionals. The study group has synthesized studies that identified barriers and interventions to improve asthma symptoms and management in children through searching in MEDLINE, Cochrane EMBASE, TOXLine and CINAHL considering papers starting from 1999.

**Results:** Physician-led interventions were most successful for outcomes related to the use of health care. Multidisciplinary teams were best in achieving symptom reduction and quality of life. Lay persons were best in achieving self-management/self-efficacy outcomes. Components most frequently employed in successful programs are skills to improve patient-clinician communication and education to enhance patient self-management. Fifty percent of interventions achieved reduction in the use of health care and one-third in symptom control. A combination approach including self-management and patient-clinician communication involving multidisciplinary team members may have the greatest effect on most outcomes.

**Conclusion:** strong evidences suggest that the development of self-management and clinician-patient communication skills are essentially required and considered as critical factors for Asthma patients particularly children symptoms alleviation and outcomes improvement in the long term. This can be achieved by appropriate self-care, awareness programs through effective educational and behavioral intervention which are crucial components associated with success across outcomes and providers.

**Keywords:** asthma, Health education, interventions.

### INTRODUCTION

Asthma is the third-ranking cause of hospitalization children<sup>1</sup>. Adolescents are at particularly high risk for poor asthma outcomes, with asthma death rates twice as high for 11–17 year olds than 0–10 year olds<sup>2</sup>. As asthma continues to be one of the costliest long-term disorders of childhood. Among chronic pediatric conditions, it accounts for the highest number of pediatric emergency department (ED) visits and hospitalizations and the highest number of missed school days for children and missed work for parents. The resulting financial costs are considerable<sup>3</sup>. There have been dramatic advances in the therapeutics of asthma, specifically the availability of anti-inflammatory, combination, and long-acting

drugs, and we know more about the pathophysiology and

treatment of asthma than ever before. However, prevalence and problems associated with the disease (e.g., health care use, family disruption, costs) have not dramatically decreased in kind. This may in part be due to patients and families not following the recommendations of their clinicians and effectively managing their disease. Studies have shown rates of adherence to the medical regimen to be less than 50%<sup>4</sup>.

An increasing amount of attention has been paid to the roles of the patient and family in the day-to-day management of asthma. This has, in part, evolved from recognition in the medical community of the need for partnership with patients in the effective control of chronic

conditions<sup>5</sup>. Today experiences of the patient coupled with the clinical expertise of the physician are thought to be equally as important in reducing the effects of the disease. To further control asthma and its effects on individuals, families, and communities, a range of interventions have been evaluated. Most national guidelines recommend that patients should be offered education in self-management and written asthma action plans that focus on individual need<sup>6</sup>.

Self-management educational programs for children with asthma have been developed in recent years in recognition of the need to improve health care practices, reduce morbidity, and lower costs of care<sup>7</sup>. To be successful, programs must be based on a sound theoretical understanding of behavior change and employ self-management strategies designed to improve knowledge, skills, and feelings of self-control<sup>8</sup>. A number of educational programs have been the subject of rigorous evaluations<sup>9</sup>. These programs incorporate a variety of educational strategies, are designed for different clinical settings, and are targeted to different patient groups. While it has become increasingly clear that limited asthma education involving only information transfer is ineffective<sup>10</sup>, the effectiveness of self-management education programs in children with asthma is unclear. In adults with asthma, the use of a self-management education program that includes self-monitoring, regular medical review, and an asthma action plan does appear to improve measures of morbidity and reduce health care utilization<sup>11</sup>. In children, however, a published meta-analysis of 11 self-management teaching programs concluded that asthma self-management programs do not reduce morbidity or decrease health care utilization<sup>12</sup>.

In this review, we present an overview of educational interventions to assist children with asthma that focus on the social, behavioral, and clinical aspects of managing the condition, behavioral and educational interventions role in the self-management, symptoms alleviation and outcomes improvement.

## METHODS

Systematic searches were carried out in the databases: MEDLINE and EMBASE, TOXLINE and CINAHL.

- **Search terms:** asthma randomized controlled trials, asthma outcomes, asthma interventions, behavioral medicine, asthma management, asthma self-management, asthma behavior, asthma education, and asthma

patient education. The search terms were used in combinations and together with the Boolean operators OR and AND.

- **Limitations:** Studies must be in English language from 1990 and 2016 and accessible in full-text versions.

### *Inclusion criteria*

Randomized clinical trial (RCT) discussing and concluding on the educational or behavioral intervention for asthma; and evidence of statistical assessment of asthma-related outcomes on at least one variable including asthma symptoms, pulmonary function, medicine use, psychosocial factors, days absent from work or school, days of restricted activity due to asthma, self-management, self-efficacy, quality of life, emergency department use, hospital in-patient stays, and office visits.

Studies failing to meet all of these criteria were excluded.

### *Data Extraction*

We ensured that Personnel included were with both clinical and methodological expertise.

Primary and secondary reviewers were assigned, a primary reviewer abstracted the data, while a second reviewer checked the primary reviewer's data abstraction for completeness and accuracy by reading the article and reviewing the primary reviewer's data abstraction form. Differences of opinion were resolved by discussion between the reviewers through consensus adjudication by the entire research team. For all articles, reviewers extracted information on general study characteristics, participant characteristics, and types of barriers identified.

We ensured a direct link between the studies outcomes and outcomes of interest is established especially in the pain management interventions, for example, duration of hospitalization, costs, or emergency department "treat and release rates", and descriptive comments from patients (without an explicit analysis of those comments) to be a form of indirect evidence, and most chart abstracted measures of pain management quality (e.g., rates of patient-controlled analgesia or use of pain consults) and patient ratings of their experience to be a form of direct evidence. For each intervention study, we also determined by discussion if there was improvement, potential improvement, no improvement, or a detrimental effect. We categorized intervention studies as "improvement" if any measure of direct evidence showed statistically significant improvement and no outcomes (direct or indirect) worsened.

We categorized intervention studies as “potential improvement” if:

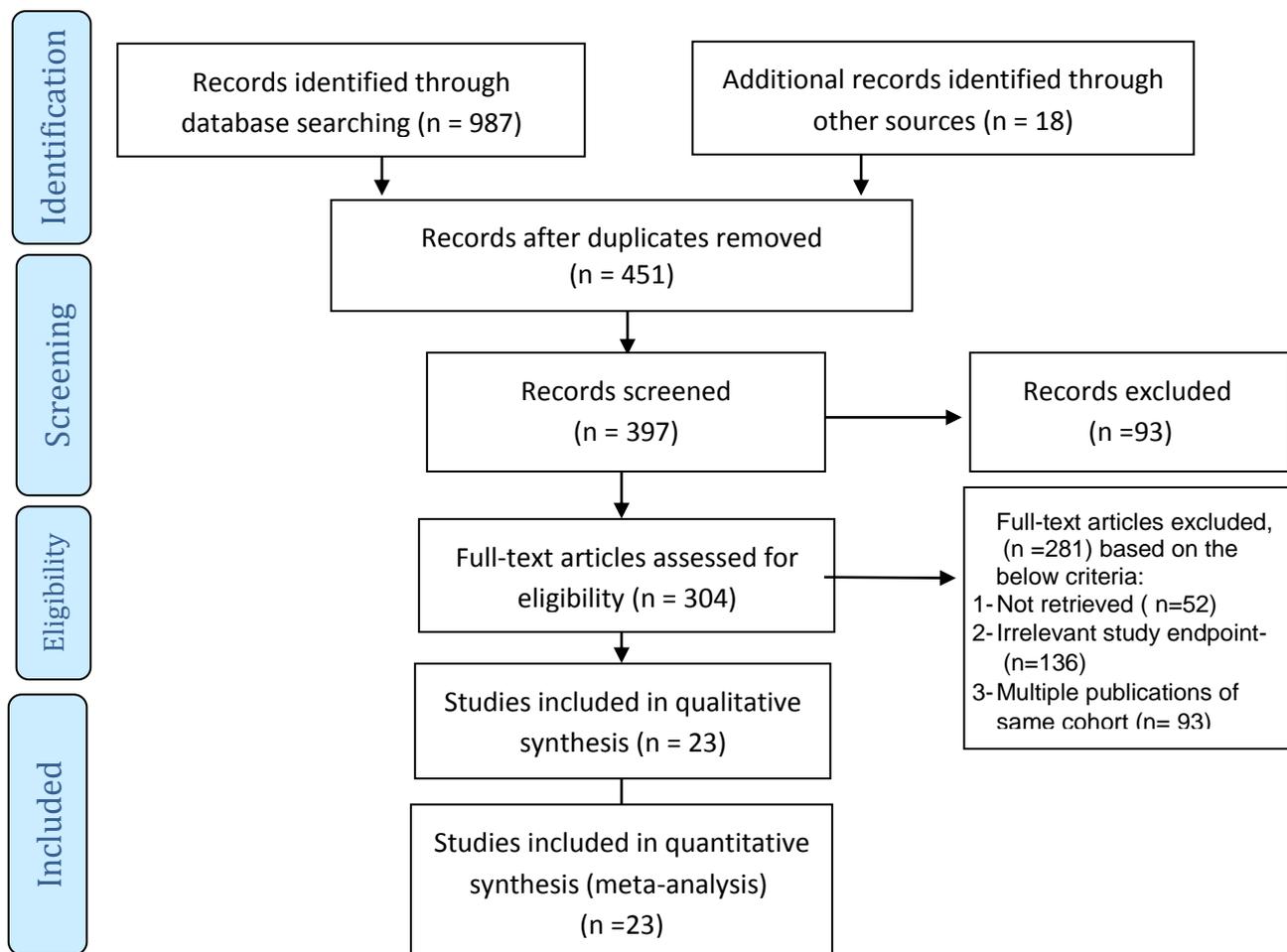
1. Improvements in direct outcomes with no statistical evidence.
  2. One outcome measure at least (direct or indirect) improved and one outcome measure worsened.
  3. Only indirect outcomes measures showed improvement.
  4. The design of the study was through multivariate statistical techniques or standard epidemiological (risk of bias was not minimized) as with, health services, or qualitative designbased techniques. We categorized intervention studies as “no improvement” if there was no improvement in any outcome and no outcomes worsened. We categorized intervention studies as “detrimental” if any measured outcomes worsened and no outcomes improved.
- We did not attempt to quantitatively pool the data for any of the outcomes using the methods of a formal statistical meta-analysis because of the substantial heterogeneity among the studies in terms of their target populations of interest, study designs, and outcome measures.

## RESULTS

### Data Synthesis

Searches identified 987 publications in addition to another 18 publications that were found through manual research. After removal of duplicates, abstracts and titles 451 publications were assessed as identified from title and abstract, and 281 papers were excluded. 52 papers full text could not be retrieved and another 93 papers with the same cohort. There were also 136 papers excluded because they did not discuss the same endpoint (Impact of educational and behavioral intervention on the improvement of Asthma outcomes). We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines in reporting the results.

**Finally, 23 publications were carefully selected -in line with the inclusion criteria – and included in the present systematic review.**



**Figure 1: Selection criteria of assessed the studies ,see PRISMA flow diagram**

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7)

The included publications suggested different Intervention activities most used by different types of program providers such as Physician-directed programs which emphasized one-on-one counseling, self-monitoring, and use of diaries/action plans. The second program providers were nurses who used individual, group, and telephone learning sessions and

employed activities to elicit patient participation such as role plays and problem-solving exercises. They also engaged in home visiting. Teams used a range of these activities and, in addition, case managers. Lay people-led programs involved individual, group, and home visit sessions and use of peer educators. Pharmacists used one-on-one counseling.

**Table 1: Teaching/learning approaches most used by provider**

Physicians	Teams of providers	Nurses	Lay person
Individualized sessions with patients one-on-one	Groups and individual pt educational sessions face-to-face	Group and individual patient education sessions face-to-face	Groups and individual patient educations sessions
Self-monitoring/regulation	Information for patient physician	Role plays	Home visits for environmental control and pt education
Patient diaries/action plans	Peer educators  Telephone consultation  Web-based team discussion Telephone advice line Case managers Home visits for environmental control and pt education	Problem solving  Home visits for environment control and pt education Patient diaries  Telephone counseling	Peer educators

The studies included shed light on 4 main interventions that targeted educational awareness and behavioral modulation to alleviate Asthma symptoms and efficiently manage the common outcomes which included: healthcare use, quality of life, self-management self-efficacy and symptoms relief, among which healthcare use was the prevalently reported as the most frequent reported. Data summary for the number of interventions undertaken by type of provider as well as the success rate achieving health care use reductions was consolidated in table 2, where physicians scored a success rate of 86% (the percent of times positive health care reduction

outcomes were reported given the number of studies by that type of provider), on the other hand, multidisciplinary teams reported 50% success while nurses reported success in 72% of their undertakings, and lay people 29% success. For reports of symptom reduction, reported success for physicians was 30%, multidisciplinary teams 51%, nurses 33%, and lay people 12%. Multidisciplinary teams reported achieving quality of life outcomes in 26% of the studied programs and lay persons' self-management and/or self-efficacy outcomes in 31% of programs.

**Table 2 provides the outcomes achieved in programs by provider type.**

	Success in symptom reduction	Success in health care use	Success in self-management/self-efficacy	Success in quality of life
Physician-led programs (n = 3)	30% (n = 2)	86% (n = 5)	–	–

Multidisciplinary Teams (n=9)	55% (n = 5)	52% (n = 4)	15% (n = 2)	26% (n = 3)
Nurse (n = 6)	33% (n = 4)	72% (n = 8)	–	20% (n = 2)
Lay person (n =5)	12% (n = 1)	29% (n = 3)	31% (n = 2)	3% (n = 2)

Program approaches varied from enhancing patient–clinician interactions including emphasis on communication, for example, Clark et al<sup>15</sup>, to providing highly specific asthma information along with specialist consultations, for example,

Levy et al<sup>16</sup>, to paying indirect attention to asthma in literacy education, for example, Bolton et al.<sup>19</sup> Table 3 presents the components and processes of the interventions by provider type and outcome.

**Table 3: major outcomes per provider and focus of intervention**

Provider	Outcome	Investigator	Focus of intervention	Method of intervention
Physicians (n=3)	<b>Symptom reduction</b>	Glasgow et al <sup>13</sup>	Education of MD	<ul style="list-style-type: none"> <li>• Psychological component</li> <li>• Pt interviewing</li> <li>• PEF review</li> </ul>
	<b>Health care use</b>	Glasgow et al <sup>13</sup>	Patient and family one session group management skills	–
		Moudgil et al <sup>14</sup>	Emphasis on treatment plan PFM Individualized management plan	–
		Clark et al <sup>15</sup>	Education of MD • MD self-regulation  • 10 MD communication behaviors • 10 Pt education message	<ul style="list-style-type: none"> <li>• Psychosocial considerations</li> <li>• Focus on inflammation reduction</li> </ul>
Nurses (n= 6)	<b>Symptom reduction</b>	Levy et al <sup>16</sup>	<ul style="list-style-type: none"> <li>• Asthma specialist consultation</li> <li>• Telephone follow-up</li> <li>• Encasement of mattresses</li> <li>• Instructions for bed washing</li> <li>• Current attacks as a model for management of future attacks</li> </ul>	<ul style="list-style-type: none"> <li>• Step up medications</li> <li>• PFM and SX monitoring</li> <li>• Benzyl benzoate application</li> <li>• Pt counseling retriggers</li> </ul>
		-		
	Madge et al <sup>17</sup>	<ul style="list-style-type: none"> <li>• Telephone advice regarding individual management plans</li> <li>• Written management information</li> </ul>	–	
<b>Health care use</b>	Choy et al <sup>12</sup>	<ul style="list-style-type: none"> <li>• Pathophysiology of asthma</li> <li>• Triggers</li> <li>• Use of medications/devices</li> <li>• Discharge education</li> </ul>	<ul style="list-style-type: none"> <li>• Self-management skills</li> <li>• Pt self-rating of asthma</li> </ul>	
	Levy et al <sup>16</sup>		<ul style="list-style-type: none"> <li>• Nature of asthma and risk factors</li> </ul>	

		<ul style="list-style-type: none"> <li>• Guided self-management plan</li> <li>• Nurse review of self-monitoring and self-management</li> <li>• Patient priority questions addressed</li> </ul>	<ul style="list-style-type: none"> <li>• Medications/devices</li> <li>–</li> <li>–</li> </ul>
		<ul style="list-style-type: none"> <li>• Medication</li> <li>• Attack prevention and control</li> </ul>	<ul style="list-style-type: none"> <li>–</li> <li>• Relaxation exercises</li> <li>• Smoking cessation</li> </ul>
	<b>Quality of life</b>	–	<ul style="list-style-type: none"> <li>• Patient teaching techniques</li> <li>• Communication skills</li> </ul>
		Abdulwadud et al <sup>20</sup>	<ul style="list-style-type: none"> <li>• Education of nurses</li> <li>–</li> </ul>
	<b>Self-management/self-efficacy</b>	Abdulwadud et al <sup>20</sup>	<ul style="list-style-type: none"> <li>• Asthma group counseling skills</li> <li>• Self-management skills</li> <li>• Meds and side effects</li> </ul>
			<ul style="list-style-type: none"> <li>• Triggers</li> <li>• Importance of compliance</li> </ul>
<b>Multidisciplinary Teams of providers (n=9)</b>	<b>Symptom reduction</b>	MeGhan et al <sup>21</sup>	<ul style="list-style-type: none"> <li>• Parent teacher asthma awareness event at school</li> <li>• Information letter for doctors with suggested actions plan</li> </ul>
		Sullivan et al <sup>22</sup>	<ul style="list-style-type: none"> <li>• Physician education regarding guidelines at practice site</li> <li>• Asthma nurse</li> <li>• Standard assessments</li> </ul>
		Clark et al <sup>23</sup>	<ul style="list-style-type: none"> <li>• Care planning</li> <li>• Education for all school personnel</li> <li>• Education for students with asthma</li> </ul>
		Garrett et al <sup>24</sup>	<ul style="list-style-type: none"> <li>• Community health worker instruction</li> <li>• Trigger avoidance</li> <li>• Medications</li> </ul>
		Zeiger et al <sup>25</sup>	<ul style="list-style-type: none"> <li>• Written asthma instructions for:</li> <li>• PFM and spacer</li> </ul>
	<b>Health care use</b>	Butz et al <sup>26</sup>	<ul style="list-style-type: none"> <li>• Group session with nurse and physiotherapist Pt brochure</li> </ul>
		Robinson et al <sup>27</sup>	<ul style="list-style-type: none"> <li>• Literacy training</li> <li>• Oral reading</li> </ul>
		Walders et al <sup>28</sup>	<ul style="list-style-type: none"> <li>• Asthma management plans</li> <li>–</li> <li>• Risk profile</li> </ul>

		Splett et al <sup>29</sup>	<ul style="list-style-type: none"> <li>• PFM</li> <li>• Medications/devices</li> <li>• Provided medication</li> <li>• Action plans</li> </ul>	<ul style="list-style-type: none"> <li>• Problem solving</li> <li>–</li> <li>• Communication between parents and school</li> <li>• Clinic activities regarding asthma guidelines</li> </ul>
		-	<ul style="list-style-type: none"> <li>• PFM</li> <li>• PT educations</li> <li>• Individualized education reinforcement of leadership</li> </ul>	–
	<b>• Case management</b>	Lahdensuo et al <sup>30</sup>	Education	• PFM
	<b>Quality of life Self-management/self-efficacy</b>	Shames et al <sup>31</sup>	<ul style="list-style-type: none"> <li>• Medication use</li> <li>• Case manager</li> <li>• Self-management educations</li> <li>• Follow-up</li> </ul>	<ul style="list-style-type: none"> <li>–</li> <li>• Video game</li> <li>• Visits with allergists</li> <li>• Hotline</li> </ul>
<b>Lay person (=5)</b>	<b>Symptom reduction</b>		Family education regarding self-management	–
	<b>Health care use</b>	Bryant-Stephens and Li <sup>32</sup>	Home visitors for environmental control: bedding, pest reduction, self-management Classes, symptom diaries Monthly contacts to assess	–
		Partridge et al <sup>33</sup>	<ul style="list-style-type: none"> <li>• Morbidity outcomes</li> <li>• Consultation</li> <li>• Telephone follow-up</li> <li>• Self-management counseling</li> </ul>	<ul style="list-style-type: none"> <li>• Self-management plans</li> <li>• Patient education</li> <li>• Medications/devices</li> <li>• Pt history guides</li> <li>• Counseling</li> </ul>
	<b>Quality of life</b>	Henry et al <sup>34</sup>	Three-lesson package of asthma education Peer leaders in schools provide asthma education	–
	<b>Self-management/self-efficacy</b>	Bonner et al <sup>35</sup>	• Lay person facilitated interaction between pt and doctor	
		Turner et al <sup>36</sup>	<ul style="list-style-type: none"> <li>• Family education</li> <li>• Diaries</li> <li>• Problem solving</li> <li>• Asthma management skills</li> </ul>	<ul style="list-style-type: none"> <li>• PFM</li> <li>–</li> <li>• Management plan</li> <li>• PFM</li> </ul>

## DISCUSSION

The findings of this study suggest that clinician–patient communication and patient self-management may be the most promising to

include in efforts to change health care use and reduce asthma symptoms as these elements have been included in all programs to date reporting such outcomes.

Several limitations to this description of interventions are apparent. The number of studies in each provider category was uneven and often very small. For example, many trials involving teams have been conducted, while only four concern pharmacists. Exclusion of studies of fewer than 100 subjects may have worked against some studies where sample size recalculation would indicate smaller numbers could ascertain differences. Studies of teams of providers did not describe fully the relative roles of team members or assess which provider had the most influence on success. No multifactorial research designs were used in the studies included here to uncover which element or combination of elements in the intervention produced the outcome. Reports of only five negative studies could be located. The publication of negative studies in the literature is quite rare. Thus, our findings may be subject to publication bias. In one study, for example, Griffiths et al.<sup>37</sup> not all patients had asthma and the whole may not reflect subgroup differences. A few studies focused on specific ethnic/racial groups (e.g., African-American, Chinese, South Asian), but no comparison between approaches for differing ethnicities was available. As components of interventions may have differing effects on subgroups of the population, comparative effective studies appear needed. Further, investigations in this review comprise those targeted at children, at adults, and sometimes both. The relative advantages of approaches identified here for younger and older patients were not clear in the available data and deserve attention in future studies.

How, by necessity, we have looked at the extant studies that also reflect weaknesses in the field more generally. For example, measures used to assess asthma outcomes are not standard and/or are not applied in a standard way. The rationale and/or theory underlying the components of an intervention were not described in study reports inhibiting theoretical conclusions regarding why an intervention may or may not have worked. Descriptions of the organizational context for program delivery, or success in institutionalizing an effective intervention, were not presented, so characteristics of sustainability or longevity of programs cannot be assessed. Nonetheless, the findings from this review are instructive concerning the current situation regarding the type of providers and components of interventions apparently associated with specific asthma outcomes.

A number of recommendations are evident in the results of this review. One, as noted, is the need for standard asthma outcome measures and uniform application of them. New efforts by the US National Heart, Lung, and Blood Institute and a joint Committee of the European Respiratory Association and American Thoracic Society to identify and assess the validity and reliability of asthma outcome measures should help in this regard<sup>38</sup>. Another is to consider health care use and symptom reduction as the gold standards of intervention success. If programs do not, at minimum, achieve these results, their added value and a strong rationale for their association with clinical or quality of life improvements would appear to be needed. Also needed as part of standard practice in program planning is a clearer rationale for selection of a) intended outcomes b) program provider selected to pursue the outcomes, and c) the program components included to achieve it.

Although some plateauing of asthma prevalence was noted in the recent data from the Centers for Disease Control and Prevention, 2 factors are important to note<sup>39</sup>. First, asthma is still at an unacceptable level of prevalence. Second, the plateauing has not occurred in the low-income and minority communities that experience the greatest burden of disease. After a decade-long effort to control the condition with better therapies, we seem to be experiencing a type of "asthma fatigue." Our efforts at reducing the prevalence and burden of this disease must become more sophisticated in the ways described in this article, including targeting of the social, behavioral, and policy-linked factors that have received less attention in research. To achieve better control over a disease that continues to affect far too many children, we need to reinvigorate our efforts as practitioners and researchers.

## CONCLUSION

Evidences suggest that the development of self-management and clinician-patient communication skills are essentially required and considered as critical factors for Asthma patients particularly children symptoms alleviation and outcomes improvement in the long term. This can be achieved by appropriate self-care, awareness programs through effective educational and behavioral intervention which are crucial components associated with success across outcomes and providers.

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