

# Adolescent asthma: a developmental approach

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## Purpose of review

The purpose of this review is to update providers on how best to address asthma in adolescents.

## Recent findings

Asthma is a common chronic disease, with increased prevalence in minority populations, especially those living in poverty. Published treatment guidelines form the basis of modern asthma treatment, based on disease severity, frequency of symptoms, and lung function measured by spirometry. Written asthma action plans are recommended for patients with persistent asthma. Treating teens with asthma can be challenging, as they may deny disease, underreport symptoms, abandon medication regimens, and engage in risk-taking behaviors. Psychiatric comorbidities such as depression, anxiety, and even posttraumatic stress disorder can have profound effects on the adolescent with asthma, making the treatment much more challenging.

## Summary

Pediatricians should utilize a developmental approach, incorporating guideline-based therapies when developing treatment plans for teens with asthma. Resources such as school-based health centers, community health workers, mental health professionals, and possibly asthma specialists are all valuable aids to the physician in the medical home in providing care coordination for their teens with asthma.

## Keywords

adolescent medicine, asthma, medical home, school health transition

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## Introduction

Asthma is a leading chronic illness among children and adolescents in the United States. This review will discuss its epidemiology and evidence-based approaches to diagnosis and treatment. The roles that peers and family and the adolescent's psychosocial development have on asthma management will also be described. Specific tools for use in asthma management in the school and home will also be identified. Finally, the value of a well-functioning medical home and the challenges of transition to adult care will be discussed.

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## Epidemiology

The most recent report cited lifetime prevalence of asthma in children (birth to 17 years) to be 9.3%. The prevalence of current asthma (symptoms in the last 12 months) was higher among Puerto Rican Hispanics (18.4%), non-Hispanic blacks (14.6%), and the multiracial (13.6%) than among non-Hispanic whites (8.2%). Asthma prevalence was higher among boys (10.7%) than among girls (7.8%). Among poor children, Puerto Rican children, multiracial children, and non-Hispanic black children had higher asthma prevalence (23.3, 21.1, and 15.8%,

respectively) than poor non-Hispanic white children (10.1%) [1].

To examine self-reported asthma and asthma exacerbations among US high school students, the Center for Disease Control (CDC) analyzed data from the 2003 national Youth Risk Behavior Survey and found that 18.9% of high school students had been told by a doctor or nurse that they had asthma and 16.1% had current asthma. Of those with current asthma, 37.9% had experienced an episode of asthma during the 12 months preceding the survey [2]. Significantly, more teenage girls (44.5%) than teenage boys (31.1%) had current asthma. There is significant racial and ethnic disparity in the distribution of asthma prevalence. Fewer Hispanic (15.6%) than black (21.3%) or white (19.3%) students reported lifetime asthma and fewer Hispanic (12.9%) than black (16.8%;  $P < 0.01$ ) or white (17.0%;  $P < 0.01$ ) students reported current asthma. These findings underscore the need for healthcare providers, schools, families, and public health practitioners to be prepared to respond to asthma-related emergencies and to help students manage their asthma [2].

Adolescents with asthma are at higher risk of serious disease complications due to underappreciation and

denial of their disease severity, nonadherence with medications and trigger avoidance, and other risk-taking behaviors such as smoking tobacco or marijuana and using cocaine [3<sup>••</sup>,4<sup>•</sup>,5]. Adolescent asthma is an especially important issue as teens may have difficulties adhering to a medication plan. Patients in this age group may not appreciate the danger of poorly controlled asthma. They may deny having a chronic illness, or they may view the treatment plan as interfering with their emerging independence as they strive to reach adulthood [6,7].

### Guideline based approach

The National Heart Lung and Blood Institute issued updated asthma guidelines in 2007. These guidelines apply at every age, with specific sections about patients over 12 years of age, and adults. The guideline document gives practitioners a tool to assess initial severity, based upon domains of severity and risk, as well as spirometry to measure forced expiratory volume in 1 second (FEV1) and the FEV1/forced vital capacity (FVC) ratio. At subsequent visits, asthma control is assessed using similar domains, often with use of standardized questionnaires such as the Asthma Control Questionnaire, Asthma Control Scoring System, Asthma Control Test (<http://www.asthma-control.com/>), Asthma Therapy Assessment Questionnaire, and the Lara Asthma Symptom Scale [8<sup>•</sup>]. Well-controlled asthma requires all of the following: daytime symptoms less than twice a week, night time awakenings less than twice a month, no disturbance of exercise tolerance, and use of short-acting  $\beta$  agonists for symptoms less than twice a week. Spirometry results should show FEV1 greater than 80% predicted in well-controlled asthma. In addition, the 'risk' domain should show one or fewer emergency department (ED) visits for asthma, or courses of oral steroids for exacerbations, in the last 6 months. Strict adherence to the classification scheme is important, as adolescents will often say their asthma is controlled even with daily symptoms [9<sup>••</sup>].

The guidelines also recommend use of written asthma action plans to help adolescents and their families manage routine and sick day treatments. Two meta-analyses of action plans for children and adolescents confirm the efficacy of such plans in reducing the risk of exacerbations leading to acute care visits and suggest that symptom-based plans may be superior to peak-flow-based plans, possibly due to better and longer compliance with symptom-based plans [10,11]. The written asthma action plan should include the following information: instructions for handling exacerbations (including self-administration of medication); recommendations for long-term control medications and prevention of exercise-induced bronchospasm (EIB), if appropriate; and identification and avoidance of triggers. The adolescent should be involved in developing the action plan and should provide a copy to the school nurse [9<sup>••</sup>].

### Key points

- Asthma in adolescents is a common chronic disease that can be controlled by following published treatment guidelines, based on disease severity, frequency of symptoms, and lung function measured by spirometry.
- There is strong evidence for using behavior-based written asthma action plans for adolescents with persistent asthma.
- Teens with asthma may deny disease, underreport symptoms, abandon medication regimens, and engage in risk-taking behaviors.
- School-based health centers, community health workers, mental health professionals, and possibly asthma specialists are all valuable aids to the physician in the medical home in providing care coordination for their teens with asthma.
- Psychiatric comorbidities such as depression, anxiety, and even posttraumatic stress disorder can have profound effects on the adolescent with asthma.

### Vocal cord dysfunction

There may be some adolescents who do not respond to guideline-based asthma therapy. In such cases, alternate diagnoses should be considered. Vocal cord dysfunction, in which abnormal adduction of vocal cords with exertion or stress occurs, should be considered. Hyperventilation syndrome can also mimic asthma symptoms, especially in the setting of vigorous exertion or stress. Assessment of the 'stress level' of the adolescent patient may be helpful to elucidate these alternate diagnoses [12<sup>••</sup>]. Referral to a specialist is indicated for severe persistent asthma or if there is a diagnostic quandary.

### Exercise-induced bronchospasm

EIB, which can limit participation in normal activities if not treated, should be anticipated in all asthma patients. It is caused by a loss of heat, water, or both from the lung during exercise because of hyperventilation of air that is cooler and dryer than that of the lung. Some, but not all, studies suggest that release of inflammatory mediators is also involved in the cause of EIB. EIB usually occurs during or just after vigorous activity, reaches its peak 5–10 min after stopping the activity, and resolves in another 20–30 min. Some reports indicate that there is a refractory period of less than 1 h after EIB that allows an asthma-symptom-free interval after warm up exercises [9<sup>••</sup>].

### A developmental approach to asthma management for adolescents

Asthma is associated with a higher prevalence of psychiatric disorders, including anxiety and depression, as

well as high-risk behaviors. Anxiety can exacerbate asthma symptoms and depression can interfere with effective self-management in the adolescent. Providers should consider screening all children with asthma for depression, anxiety, and high-risk behaviors. It is also important to remember when assessing adolescents with asthma that significant mental health comorbidities such as depression, attention-deficit/hyperactivity disorder behavioral disorders, and learning disabilities can be present. Psychiatric comorbidity increases with increased asthma severity and poor control of the illness. Adolescents with life-threatening asthma have a high incidence of posttraumatic stress disorder. Increased risk taking in adolescents with asthma can include smoking tobacco or marijuana, driving without a seat belt, and unprotected sex. Children with asthma were also more likely to miss school and to be bullied when in school [13\*\*].

When teaching adolescents the asthma self-management techniques expected of adults, clinicians should address adolescent developmental issues, such as building positive self-image and confidence, increasing personal responsibility, and gaining problem-solving skills. To accomplish this approach, it is often helpful to see the adolescent initially without parents present and to involve the adolescent directly in setting goals for therapy, develop an appropriate asthma action plan, and review the effectiveness of the plan at subsequent visits. The parents can be brought in at the end of the visit to review the plan together and to emphasize the

parents' important role in supporting the adolescent's self-treatment efforts [9\*\*].

In order to properly care for adolescents with asthma, it is essential to understand the role that adolescent psychosocial development plays in self-management of their illness.

As adolescents grow, the delicate balance of the influence of the family, peers, school, and healthcare provider will fluctuate [14\*]. Table 1 [15–18] summarizes the stages of psychosocial development in adolescents as it pertains to asthma and links evidence-based strategies for asthma care and developmentally appropriate interventions.

**Family and cultural influence on asthma outcomes**

Low familial expectations of asthma control, worries about the safety of daily asthma medications, and competing family priorities can adversely influence asthma outcomes in poor populations [19,20]. Fears that daily medication use can make asthma relief medicine less effective or lead to substance abuse can be a barrier to giving daily controller medications [21]. Families can have a difficult time in negotiating how much responsibility the adolescent should take for self-management [22]. Familial knowledge gaps, misconceptions about asthma, and low expectations of care can act as barriers that affect healthcare access [23].

**Table 1 Evidence-based strategies in an adolescent developmental context**

	Early adolescence	Middle adolescence	Late adolescence
Cognitive thinking	Concrete thinking Denial of vulnerability	Early abstract thinking Inductive/deductive reasoning:	Adult ability to think abstractly 'Taking my controller medicine every day with a spacer will prevent me from getting sick. Having an action plan will keep me out of the hospital'
Role of family	'I don't need to take my medicine for my asthma' Progressive autonomy Starts to reject parental guidelines yet still underlying need to please adults. Parents may still have influence on adherence to asthma care plan. Rewards for good behavior still effective.	'My rescue medicine can help me when I am wheezing' Challenges necessity of parental recommendations for asthma	Reconnects with family
Role of peers	Peers' influence increases	Peers' influence at its highest	More willing to accept them as a source of support Able to reject peer pressure if not in self-interest
Evidence-based strategies	'I don't want my friends to know that I have asthma' Home-based CHW interventions  Action plan developed with parent School-based interventions  Open Airways asthma education [15]  <i>Teens Against Tobacco Use (TATU):</i> peer/mentor tobacco prevention [16]	'Why use peers to help explain asthma risk-taking behavior' Action plan developed with patient  School-based interventions Kickin asthma: asthma education [17]  Teens Against Tobacco Use/Not on Tobacco (TATU/N-O-T): peer/mentor tobacco prevention, tobacco cessation [16]	Will manage asthma regardless of peer influences Action plan developed with patient school-based asthma interventions Puff city asthma education [18] Not on Tobacco (N-O-T): tobacco cessation [16] Coordinated transition of care to adult settings: portable medical summaries, health media platforms

CHW, community health worker.

Community-based participatory education that incorporates culturally accepted remedies and addresses culturally specific myths in the intervention (with proper oversight by the medical community) can improve acceptance of treatment regimens by families [24]. The use of community health workers (CHWs), who can act as a bridge from the patients' medical home to the community, is being studied widely [25,26,27\*].

A systematic review of CHW-based environmental interventions for children with asthma showed improved outcomes, such as decreased activity limitations, asthma symptoms, and emergency/urgent care use. The conceptual model proposed in this article focused on the positive effect that the CHW had on providing emotional support, which leads to better coping with stressors and subsequent improved ability to avoid triggers, follow care plans, and access healthcare in a timely fashion [28\*\*].

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### Peers and families

Adolescents are often concerned that having asthma can adversely affect peer acceptance. Understanding how adolescents cope with this can help the practitioner develop a stronger therapeutic relationship. Four asthma management peer stress-related coping strategies have been described: cognitive justifying: justifying the asthma management behavior to oneself regardless of a nonsupportive peer-related environment; explaining: explaining asthma self-management behavior to peers; outsourcing: having a trusted friend explain asthma self-management behavior to the peer group, to buffer or influence a nonsupportive peer-related environment; undisclosed: hiding or lying about asthma self-management behavior to avoid peer attention [29\*].

Two sequential cross-sectional studies of urban and suburban adolescents describe how families and peers can influence adolescent coping mechanisms to overcome barriers to effective self-management, with subsequent improvement in overall quality of life. In the initial study, three main barriers identified were the adolescents' unwillingness to give up 'the things the doctors say I have to give up,' difficulty in remembering to take care of their asthma, and 'trying to forget' that they have asthma. Psychosocial factors that influenced these barriers included: negativity toward providers ('I don't always trust the doctors and nurses') and the medication regimen ('my medication has side effects that I don't like'), cognitive challenges ('when there are changes in my regimen I get confused'), social barriers ('I don't want my friends to know about my illness'), and denial ('nothing bad would happen to me if I don't follow my regimen'). Self-efficacy was found to be the most influential factor to decrease all four barriers independent of the levels of asthma control and socio-demographic characteristics [30\*\*].

In the follow-up study, validated instruments [31,32,33\*,34] were used to measure perceived family support, barriers to adherence, asthma control, and asthma quality of life. Family support of self-efficacy appeared to reduce barriers concerning adolescents' negative attitudes toward medication and healthcare providers, which in turn improved asthma control, quality of life, symptoms, emotional functioning, and activity domains. Similarly, family support significantly influenced adolescents' cognitive and social barriers but without affecting asthma control [35\*].

### Schools

A recent systematic review of stand-alone school-based asthma education programs demonstrated improved knowledge of asthma and self-efficacy and self-management behaviors. Health outcomes were not improved among students who did not have adequate access to medical care or who were exposed to high levels of exposure to environmental irritants [36\*].

There are four essential components of effective school-based asthma programs:

- (1) Case identification: age-specific tools have been developed that can be administered to students and parents that can effectively identify students with asthma.
- (2) Faculty/personnel education: school personnel (nurses, teachers, and coaches) need to learn to address asthma episodes in students. It is important to have good systems of communications between the school, parents, and the medical home with clear plans of action to avoid delays in care.
- (3) Access to high-quality healthcare: linkage to the students' medical home can be facilitated by school-based health clinics and written asthma action plans.
- (4) Student self-management: adolescent self-management skills can be taught by school-based curriculums that are tailored to the age of the student [37\*\*].

Evidence-based programs have been developed for different age groups that utilize these concepts. Open Airways for Schools Program is an interactive asthma curriculum taught to small groups of children with asthma in the third, fourth, and fifth grades [15]. Kickin Asthma is a case identification and education-based program developed for 6–10th grade [17]. Puff City is a web-based program for urban high school students linked to a health coordinator to facilitate community-based referrals [18].

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### Tobacco prevention

Addressing the issue of smoking tobacco is an essential component of asthma care in the adolescent patient.

### School-based

Evidence-based school programs and office-based counseling are available to address the high prevalence of smoking in this group. Not On Tobacco (N-O-T) is a state-of-the-science, school-based program that provides assistance to teens who wish to quit smoking. The program covers the entire quitting process, including the prevention of relapses. A second program, Teens Against Tobacco Use (TATU), is a peer-led program that allows students aged 14–17 to mentor younger middle school students about the dangers of smoking and reinforces their decisions to remain smoke free [16].

### Office-based

A potentially useful office-based intervention is the United States Public Health service 'Five A's' brief intervention (Ask about tobacco, Advise quitting, Assess willingness to quit, Assist with treatment and referrals, and Arrange follow-up) [38]. In a meta-analysis of this tool, pediatricians were able to significantly increase the abstinence rate in adolescents [15].

### Importance of medical home

There is ample evidence to suggest that a strong connection to a medical home has a positive influence on the quality of care that is received by patients with asthma [39\*\*]. An examination of data from the 2005–2006 National Survey of Children with Special Healthcare Needs was performed to assess the relationship among children with asthma receiving care in a medical home and ED use. Care delivered in a medical home was associated with significantly fewer asthma-related ED visits [40\*]. A high-functioning medical home that delivers well-coordinated asthma care can result in decreased severity of disease with concomitant reductions in healthcare utilization, and a return on investment as high as 11 dollars for every dollar spent [41\*].

### Transition to adult world

Analysis of the National Health Interview Survey data from 2000 to 2005 demonstrated that young adults with asthma have unanticipated financial barriers that significantly exceeded those of adolescents, resulting in delayed care and unmet needs. Even though young adults with asthma were more likely to lack health insurance or a usual source of primary care, aging into adulthood was an independent risk factor for poor asthma control [42,43].

Qualitative differences between adult and pediatric care may account for some of these delays in care and unmet needs experienced by young adults with asthma. Internists express difficulty in meeting the psychosocial needs of young adults, especially those living with chronic illnesses, and report difficulty in broadening the doctor–patient relationship to include parents [44\*].

A survey of both pediatricians and internists cited a lack of time and adequate reimbursement as major barriers in providing primary care to transitioning patients. Conversely, when office systems for coordinating patient care were in place, providers believed that the quality of the patient care improved [45]. Healthcare information technology is evolving and can now combine information in a common platform gathered from home computers, mobile phones, and other devices to help teens communicate better amongst themselves and their providers to assist in the transition process [46\*\*].

### Conclusion

Asthma can be well controlled in adolescents by following the recommended National Heart, Blood and Lung Institute (NHBLI) guidelines described above. Effective implementation of these guidelines requires an understanding of family, school, and peer influences on adolescent behavior. Evidence-based interventions that are tailored to adolescent developmental needs can be useful when coordinated with the patient's medical home. It is important to design self-management plans that support adolescent autonomy and lead to successful transitions to adulthood.

### Acknowledgement

The authors have no conflicts of interest to declare.

### References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 492–493).

- 1 MMWR. CDC Health Disparities and Inequalities Report: United States 2011. Current Asthma Prevalence: United States, 2006–2008; 60:84–87. [http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a18.htm?s\\_cid=su6001a18\\_w](http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a18.htm?s_cid=su6001a18_w). [Accessed 12 October 2011]
- 2 MMWR. Self-reported asthma among high school students: United States, 2003. 2005; 54:76567. <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5431a1.htm>. [Accessed 12 June 2010]
- 3 Towns SJ, van Asperen PP. Diagnosis and management of asthma in adolescents. *Clin Respir J* 2009; 3:69–76. This publication explores asthma diagnosis and other potential causes of respiratory symptoms in adolescents, and discusses developmental approaches to treatment, as well as transition to adult care.
- 4 Guo SE, Ratner PA, Johnson JL, *et al*. Correlates of smoking among adolescents with asthma. *J Clin Nurs* 2010; 19 (5–6):701–711. This article describes comorbidity in asthmatics who smoke.
- 5 Bender BG. Depression symptoms and substance abuse in adolescents with asthma. *Ann Allergy Asthma Immunol* 2007; 99:319–324.
- 6 Strunk RC, Mrazek DA, Fuhrmann GS, LaBrecque JF. Physiologic and psychological characteristics associated with deaths due to asthma in childhood. A case-controlled study. *JAMA* 1985; 254:1193–1198.
- 7 Burns JJ, Sadof M, Kamat D. The adolescent with a chronic illness or condition. *Ann Pediatr* 2006; 35:207–213.
- 8 Halbert RJ, Tinkelman DG, Globe DR, Lin SL. Measuring asthma control is the first step to patient management: a literature review. *J Asthma* 2009; 46:659–664. This review identified five validated instruments designed to measure asthma control. All instruments were short and easily administered, easy to interpret, and all had evidence to support their use in clinical decision making.

9 www.nhlbi.nih.gov/guidelines/asthma. [Accessed 24 December 2010]

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The 2007 NHLBI guidelines compose an essential reference for all practitioners who care for people with asthma, with details of classification of severity and control, step up and step down therapy diagnosis and monitoring all conveniently available in this document.

10 Ducharme FM, Bhogal SK. The role of written action plans in childhood asthma. *Curr Opin Allergy Clin Immunol* 2008; 8:177–188.

11 Zemek RL, Bhogal SK, Ducharme MD. Systematic review of randomized controlled trials examining written action plans in children. *Arch Pediatr Adolesc Med* 2008; 162:157–163.

12 Weinberger M, Abu-Hasan M. Exercise-induced dyspnea in children and adolescents: if not asthma then what? *Ann Allergy Asthma Immunol* 2005; 94:366–371.

This paper should be reviewed by everyone who treats adolescent asthma and should result in a higher suspicion for alternate diagnoses.

13 Peters TE, Fritz GK. Psychological considerations of the child with asthma. *Child Adolesc Psychiatr Clin N Am* 2010; 19:319–333.

This article reviews much about the symptoms and treatment of asthma, as well as reviewing the literature on the psychiatric disorders which can have effects on the adolescent with asthma.

14 Fonseca H. Helping adolescents develop resilience: steps a pediatrician can take in the office. *Adolesc Med State Art Rev* 2010; 21:138–151.

This offers a practical developmental approach to the adolescent with chronic illness.

15 Fiore MC, Jaén CR, Baker TB, *et al.* Treating Tobacco Use and Dependence: 2008 Update. Clinical Practice Guideline. Rockville, MD: US Department of Health and Human Services. Public Health Service. May 2008.

16 Teens Against Tobacco Use (TATU). <http://www.lungusa.org/associations/states/minnesota/events-programs/teens-against-tobacco-use.html>. [Accessed 13 January 2011]

17 Davis A, Savage Brown A, Edelstein J, Tager IB. Identification and education of adolescents with asthma in an urban school district: results from a large-scale asthma intervention. *J Urban Health* 2008; 85:361–374. <http://www.lungusa.org/associations/states/california/programs/asthma-programs/>. [Accessed 1 December 2011]

18 Joseph CL, Peterson E, Havstad S, *et al.*; Asthma in Adolescents Research Team. A web-based, tailored asthma management program for urban African-American high school students. *Am J Respir Crit Care Med* 2007; 175:888–895.

19 Smith LA, Bokhour B, Hohman KH, *et al.* Modifiable risk factors for suboptimal control and controller medication underuse among children with asthma. *Pediatrics* 2008; 122:760–769.

20 Wu AC, Smith LA, Bokhour B, *et al.* Racial/ethnic variation in parent perceptions of asthma. *Ambul Pediatr* 2008; 8:89–97.

21 Mansour ME, Lanphear BP, DeWitt TG. Barriers to asthma care in urban children: parent perspectives. *Pediatrics* 2000; 106:512–519.

22 Martin M, Beebe J, Lopez L, Faux S. Qualitative exploration of asthma self-management beliefs and practices in Puerto Rican families. *J Healthcare Poor Underserved* 2010; 21: 464–474.

23 Seid M. Barriers to care and primary care for vulnerable children with asthma. *Pediatrics* 2008; 122:994–1002.

24 Martin CG, Andrade AA, Vila D, *et al.* The development of a community-based family asthma management intervention for Puerto Rican children. *Prog Community Health Partnersh* 2010; 4:315–324.

25 Krieger JW, Takaro TK, Song L, Weaver M. The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. *Am J Public Health* 2005; 95:652–659.

26 Levy JI, Brugge D, Peters JL, *et al.* A community-based participatory research study of multifaceted in-home environmental interventions for pediatric asthmatics in public housing. *Soc Sci Med* 2006; 63:2191–2203.

27 Krieger J, Takaro TK, Song L, *et al.* A randomized controlled trial of asthma self-management support comparing clinic-based nurses and in-home community health workers: The Seattle-King County Healthy Homes II Project. *Arch Pediatr Adolesc Med* 2009; 163:141–149.

A report of one of the largest comprehensive environmental justice-based interventions utilizing CHWs to help families with asthma.

28 Postma J, Karr C, Kieckhefer G. Community health workers and environmental interventions for children with asthma: a systematic review. *J Asthma* 2009; 46:564–576.

This review proposes a practical framework for looking at asthma outcomes and helps to define how CHWs influence asthma outcomes.

29 Yang TU, Lunt I, Sylva K. Peer stress-related coping activities in young adolescents' asthma management. *J Asthma* 2009; 46:613–617.

This describes several patterns of coping skills used in asthmatic adolescents using open-ended interviews.

30 Rhee H, Belyea MJ, Ciurzynski S, Brasch J. Barriers to asthma self-management in adolescents: relationships to psychosocial factors. *Pediatr Pulmonol* 2009; 44:183–191.

This qualitative study provides an excellent description of barriers that adolescents experience when managing asthma.

31 Procidano ME, Heller K. Measures of perceived support from friends and from family: three validation studies. *Am J Community Psychol* 1996; 5:35–46.

32 Logan D, Zelikovsky N, Labay L, Spergel J. The illness management survey: identifying adolescents' perception of barriers to adherence. *J Pediatric Psychol* 2003; 28:383–392.

33 Juniper EF, Guyatt GH, Feeny DH, *et al.* Measuring asthma quality of life in children with asthma. *Qual Life Res* 1996; 5:35–46.

This is a classic article for measuring asthma quality of life. A recent update has developed a scale for adolescents [34].

34 Juniper EF, Svensson K, Mörk AC, Ståhl E. Modification of the asthma quality of life questionnaire (standardized) for patients 12 years and older. *Health Qual Life Outcomes* 2005; 5:58.

35 Rhee H, Belyea MJ, Brasch J. Family support and asthma outcomes in adolescents: barriers to adherence as a mediator. *Adolesc Health* 2010; 47:472–478.

This well-designed study describes the interrelated influences that peers and family have on adolescents and asthma outcomes.

36 Coffman JM, Cabana MD, Yelin EH. Do school-based asthma education programs improve self-management and health outcomes? *Pediatrics* 2009; 124:729–742.

This article demonstrates how school-based educational programs can improve knowledge but not necessarily asthma outcomes.

37 Bruzzese JM, Evans D, Kattan M. School-based asthma programs. *J Allergy Clin Immunol* 2009; 124:195–200.

This review puts together data from a number of school-based health programs and ties together the influences of the school, family, peers, and medical home to develop a cohesive strategy for success.

38 Fiore MC, Bailey WC, Cohen SJ, *et al.* Treating Tobacco Use and Dependence. Clinical Practice Guidelines. Rockville, MD: US Department of Health and Human Services, Public Health Service; 2000.

39 Lyon M, Rossier A, Rosenbaum S. The Affordable Care Act, Medical Homes, and Childhood Asthma: A Key Opportunity for Progress. The Merck Childhood Asthma Network, Inc. (MCAN), The George Washington University School of Public and Health Services (GWU) and the RCHN Community Health Foundation. <http://www.rchnfoundation.org/images/FE/chain207site-Type8/site176/client/MedicalHomesBrief.pdf>. [Accessed 10 January 2010]

This is a blueprint for asthma care and health reform in the United States.

40 Diedhiou A, Probst JC, Hardin JW, *et al.* Relationship between presence of a reported medical home and emergency department use among children with asthma. *Med Care Res Rev* 2010; 67:450–475.

This demonstrated a decrease in emergency room usage in children with a medical home.

41 Grant R, Bowen SK, Neidell M, *et al.* Healthcare savings attributable to integrating guidelines-based asthma care in the pediatric medical home. *J Healthcare Poor Underserved* 2010; 21 (2 Suppl):82–92.

Eleven dollars saved for every dollar spent in this study of asthma patients participating in an inner city medical home.

42 Scal P, Davern M, Ireland M, Park K. Transition to adulthood: delays and unmet needs among adolescents and young adults with asthma. *J Pediatr* 2008; 152:471–475.

43 Houtrow AJ, Newacheck PW. Understanding transition issues: asthma as an example. *J Pediatr* 2008; 152:453–455.

44 Peter N, Forke C, Ginsburg K, Schwarz D. Transition from pediatric to adult care: internists' perspective. *Pediatrics* 2009; 123:417–423.

Intrinsic differences in the approaches to adult-oriented and child-oriented care affect physicians' ability and willingness to accept young adult patients with chronic illness.

45 Okumura MJ, Kerr EA, Cabana MD, *et al.* Physician views on barriers to primary care for young adults with childhood-onset chronic disease. *Pediatrics* 2010; 125:e748–e754.

46 Chira P, Nugent L, Miller K, *et al.* Health media platform for teens with SHCN. *J Biomed Inform* 2010; 43:S9–S12.

This study helps us see what can be possible in the not so distant future and how technology is emerging that links healthcare portals and social media to improve patient education and access to care.