Examining causes of the urban (inner city) asthma epidemic: Implementing new management strategies

Stanley J. Szeffler, M.D.

ABSTRACT

Asthma in the inner city contributes to high morbidity and mortality, and, in school children, reduced school attendance and alteration in academic performance. There is a need to improve asthma care in the inner city by reducing asthma exacerbations. Methods are currently available to predict and prevent seasonal exacerbations of asthma. In addition, new medications are being developed that will be effective in improving pulmonary function and reducing asthma exacerbations. School-centered asthma programs can also be helpful to assist children and clinicians in applying asthma treatment plans and assuring optimal adherence to these plans.

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G.K. is a 12-year-old African American boy who you are seeing for the first time. He is accompanied by his mother who indicates that their pediatrician made the referral for evaluation of his asthma. You are seeing him in the spring time after recovery from an asthma exacerbation. He had an exacerbation in the previous fall season and has one or two prednisone courses each year. He is currently receiving low-dose inhaled corticosteroids, and montelukast was recently added to his treatment regimen. He takes albuterol for symptoms once or twice daily and awakens with shortness of breath about twice per month. He missed ~15 days of school in the past year. His mother indicates that he takes his medicines most days and is responsible for taking medications on his own because she starts work early in the morning. He has not been hospitalized for his asthma in the past year but was

seen in urgent care approximately three times in the past year.

G.K. lives in the inner city with his mother, older brother, and younger sister. His mother and brother smoke but they say only outside the home. Mother has a history of recurrent pneumonia as a child. G.K. is struggling in school to maintain grades, and he has not been able to participate in sports due to his asthma.

On physical examination, G.K. is slightly obese, and you detect end-expiratory wheezes on examination of the lungs, along with pale, moderately edematous nasal turbinates. You obtain spirometry and note a pre-bronchodilator forced expiratory volume in 1 second of 80% predicted; a forced expiratory volume in 1 second to forced vital capacity ratio of 0.57 with 12% bronchodilator reversibility of forced expiratory volume in 1 second to albuterol. Exhaled nitric oxide is 62 ppb (normal, ≤ 25 ppb). He has positive allergen skin test results to dust mites, *Aspergillus*, *Alternaria*, and cockroach. His chest radiograph shows moderate hyperinflation and bronchial wall thickening, with areas of atelectasis.

What will you do next? What is the anticipated outcome for this patient? How closely will you follow him? What unique role can you play in altering the course of his asthma? How will you prevent further exacerbations in this child?

You are concerned that he is at risk for further exacerbations, especially during the fall season. You suspect that his mother is trying hard to keep her job and that she relies on G.K. and his brother to attend to asthma medications. You have the option of increasing his asthma medications, *e.g.*, increasing his dose of inhaled corticosteroid or adding a long-acting β -agonist in the form of combination inhaled corticosteroid–long-acting β -agonist. You advise the mother regarding environmental control, but you

From the Pediatric Asthma Research Program, Breathing Institute, Section of Pediatric Pulmonary Medicine, Children's Hospital, Aurora, Colorado, and Department of Pediatrics, University of Colorado Denver School of Medicine, Aurora, Colorado

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Address correspondence to Stanley J. Szeffler, M.D., Pediatric Asthma Research Program, The Breathing Institute, Children's Hospital Colorado, 13123 East 16th Avenue, Box 395, Aurora, CO 80045

E-mail address: stanley.szeffler@childrenscolorado.org

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know that may be difficult. An option is omalizumab but you know it will require demonstration of inadequate response to conventional therapy and verification that he is adherent to his treatment schedule. Are there other steps that you might consider to support his asthma care?

Need to Improve Asthma Care

There continues to be a high burden of asthma among the African American population.¹ However, scientific discoveries continue to be made regarding the application of patient characteristics, biomarkers, and genetics to assist in individualizing care. New medications are being developed, but there are financial limits to their application.²

In managing asthma in the present times, we are focused on achieving asthma control through an effort to minimize asthma impairment and minimize risk for future asthma exacerbations, progression, and adverse effects to medications.^{3,4} Some key observations have been made to help design strategies for future asthma management. New medications have been developed that can improve pulmonary function, *e.g.*, tiotropium, a long-acting anticholinergic, and new immunomodulators that improve pulmonary function and prevent asthma exacerbations.^{2,5-7}

There is emerging concern regarding the potential for poorly controlled asthma to lead to chronic obstructive pulmonary disease, including the “asthma–chronic obstructive pulmonary disease overlap syndrome.”³ There is also growing emphasis to address the special needs of children, and, therefore, asthma management must be viewed across the ages, including strategies to prevent asthma.⁸⁻¹⁰

New Strategies to Predict and Prevent Asthma Exacerbations

In the United States, we are gradually moving from a system of managed care to one of more collaborative care, which includes directing patients with more-severe asthma to specialty care when needed. The next step is integrating the specialist into the system and creating what is called a “medical neighborhood.”¹¹ For asthma care, specialty areas include allergy and immunology, and also pulmonary medicine. The specialist or, preferably, a multidisciplinary team, would monitor the care of all patients with asthma within their own medical system, including those seen personally. This requires careful analysis of data regarding patient visits, medical costs, and urgent care utilization within a system, a population health perspective.¹²

For example, Teach *et al.*¹³ recently reported risk factors for seasonal exacerbations, especially those that occur in the fall season. In general, the lower

the pulmonary function, the higher the risk of an asthma exacerbation at any time during the year. A high exhaled nitric oxide or high serum immunoglobulin E (IgE) level is associated with a higher risk for a fall exacerbation. A seasonal asthma predictive index, composed of a number of patient characteristics, pulmonary function, and laboratory tests, was also presented, which could be used to identify patients at risk for a seasonal exacerbation, especially in the fall season. Some lessons learned are that obtaining a measure of exhaled nitric oxide, blood eosinophils, serum IgE, and pulmonary function, along with a history of an exacerbation can be useful in predicting a seasonal exacerbation, especially the fall season.

For the past 15 years, only one new medication has been introduced for asthma therapy, *viz.* anti-IgE and, specifically, omalizumab. On the horizon is the imminent approval of a set of new medications that are directed toward blocking key cytokines related to asthma.² Of interest, biomarkers have been identified that are linked to a high level of response to these medications.^{2,8-10} These observations brought attention to the use of biomarkers to predict response to asthma therapy. An additional potential benefit is that perhaps one of these medications when used early in treatment may actually alter the course of the disease. In the interim, it, therefore, will be important to maximize the use of available medications before considering these more-expensive alternatives, including improved methods to enhance adherence to conventional therapy.²

Potential Support Systems for Inner City Children with Asthma

School-centered asthma programs can support the medical system in monitoring asthma control, enhancing education of children with asthma, and communicating with clinicians related to the children’s medical care.^{14,15} We must take steps to standardize communication, especially the school asthma treatment plan. It would also be useful for the school, particularly the school nurse, to see the full medical treatment plan.¹⁶ This would allow the school nurse to support the appropriate medication inhaler technique, contribute to asthma education, and assist in monitoring adherence to the management plan.

It would be useful if electronic medical record systems could alert clinicians to potential risk factors for loss of control, especially seasonal exacerbations.¹³ The electronic medical record system can also be used to harmonize asthma care. For example, the Easy Breathing program (Connecticut Children’s Medical Center, Hartford, CT) is a cost-effective, evidence-based, asthma management program for health care provid-

Table 1 Key factors in asthma management for inner city children

Asthma deaths and hospitalizations are decreasing but the African American/black population still bears a heavier burden of the disease
It is important to standardize and harmonize asthma care; there is also a need for collaboration to address health disparities in asthma care
Asthma care must be focused on achieving asthma control by preventing asthma exacerbations, progression, and adverse effects to medications
Response to new medications has been linked to specific biomarkers, <i>e.g.</i> , sputum or blood eosinophil count with anti-interleukin-5 therapy
It is possible that poorly controlled asthma may lead to chronic obstructive lung disease, such as the “asthma–chronic obstructive pulmonary disease overlap syndrome”

ers that includes training and tools to improve the recognition and management of childhood asthma.^{17,18} The program has led to reduced hospitalizations, outpatient visits, and asthma-specific emergency department visits.¹⁸

It is important for the asthma specialist to encourage harmonization of asthma care by applying an evidence-based guidelines approach. This will lead to consistency across the community and less confusion. There is also a need for ongoing collaboration and coordination in managing asthma among schools, health care providers, and families. A concerted effort should result in better asthma control with reduced costs due to urgent care utilization.¹⁶

Indeed, communication and collaboration among key stakeholders are essential for providing students with the necessary assistance in managing their asthma in the school setting. Here school attendance is essential for academic performance, and physical activity is encouraged in wellness efforts for reducing the health risks of obesity. This may also require changes in health care policy in various settings, such as schools and day care settings.¹⁹

Our collaborative program in Denver, Colorado, and Hartford, Connecticut, entitled “Building Bridges for Asthma Care,” is a program designed to improve communication between schools and medical care providers. This school-centered asthma program includes case management according to the asthma risk level for the individual student; use of school asthma care plans; onsite quick relief inhalers; asthma education for students, families, and school staff; and the buildout and optimization of existing information technology platforms in the schools.¹⁴ This program makes a significant contribution because it combines a multifaceted school-centered program and a multifaceted asthma care provider program while identifying barriers to overcome. Models of asthma care that place schools at the center and coordinate evidence-based asthma care are applicable nationwide and may serve as a model for managing other chronic illnesses.

It is also important to conduct an environmental assessment in the home as well as in the school and to implement environmental control measures in the presence of allergen sensitization and clinically significant allergen exposure. We must take a broad view of asthma disparities to develop the research and public health measures that are most likely to be effective in preventing and managing asthma.²⁰ It appears that factors that contribute to asthma may not be limited to urban location but more to the poverty level. There is also an unmet need for rigorous and comprehensive school-based environmental interventions with clinical outcome studies.²¹

Our Building Bridges program seeks to use school nurses to identify students with asthma based on parent history; assess their level of severity based on a key set of questions; monitor their school absence, physical activity, and ongoing asthma control as well as school performance; and communicate this information to the student’s parents and health care provider. Communication between the provider and the school may also help to support the overall school and home asthma care plan. In certain situations, directly observed therapy is needed to assure adherence to the treatment schedule.¹⁵ An important feature of all school-centered asthma programs is an effort to sustain such programs, *e.g.*, through reorganization of school staffing or some unique mechanisms of payment to supplement schools. It is our hope that national medical and nursing societies will support these efforts and make them ongoing features of their continuing education and maintenance of certification programs as community engagement and quality improvement efforts.

Reducing Asthma Mortality, Morbidity, and Asthma Prevalence in the Inner City

We now have very effective treatments that not only relieve but also prevent symptoms, including exacerbations. However, we still need medications that prevent disease progression and the onset of the dis-

ease.^{2,8,12} There are reasons for optimism that our overall management of asthma will continue to improve. There are devices that can effectively measure adherence to asthma therapy and also send reminders when medication administration is delayed.^{22,23} Telemedicine is also being developed to facilitate communication between clinicians and also for patients from the home or school setting to their clinician. In addition, monitoring devices are now being developed to assess airway inflammation, *e.g.*, home monitoring of exhaled nitric oxide, as well as personalized environmental monitoring that could be useful in tailoring asthma management strategies.

A systems biology approach is being developed to understand better ways to predict response to medications and also to monitor disease activity.¹² The benefits and risks of such an approach, including an assessment of the costs of implementation will need to be carefully assessed in terms of lifetime benefits. It is hoped that this new form of treatment for childhood asthma coupled with preventative measures, such as environmental control measures, including but not limited to reduction in tobacco smoke exposure and smoking avoidance, will lead to an improved quality of life and reduced risk of chronic obstructive airway disease as children reach adulthood. This effort should have a marked impact on reducing the prevalence of lung disease in the future and the consequent burden of respiratory illness on society.

Summary

To improve asthma care for this 12-year-old boy, it will be important to make some major changes in our health care system by establishing methods to prevent asthma exacerbations and support medical care (Table 1). There are now methods to use medical history, such as a recent asthma exacerbation and low pulmonary function, and biomarkers, such as blood eosinophil count and exhaled nitric oxide, to predict seasonal risk for an asthma exacerbation.¹³ In this patient with a history of recent exacerbations, low pulmonary function, and high blood eosinophils and exhaled nitric oxide, there is a high risk for a fall asthma exacerbation. Therefore, steps should be taken to avoid discontinuation of medications during the summer season.

In addition, symptoms should be monitored, perhaps with the support of the school system, to identify early signs of an exacerbation to institute systemic steroid therapy sooner than later.^{14,15} The school system can also be supportive in reinforcing key messages in the medical treatment plan and in notifying the asthma care provider if poor adherence to the treatment plan is noted. Overall, a population health approach could also be useful to identify overuse of

urgent care settings for periodic treatment. These children could then be redirected to receive regular asthma care and close follow-up, including an asthma specialist.

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