Improving Outcomes for Underserved Adolescents With Asthma

abstract

BACKGROUND AND OBJECTIVE: Asthma is the most common chronic disease of childhood. Treatment adherence by adolescents is often poor, and their outcomes are worse than those of younger patients. We conducted a quality improvement initiative to improve asthma control and outcomes for high-risk adolescents treated in a primary care setting.

METHODS: Interventions were guided by the Chronic Care Model and focused on standardized and evidence-based care, care coordination and active outreach, self-management support, and community connections.

RESULTS: Patients with optimally well-controlled asthma increased from ~10% to 30%. Patients receiving the evidence-based care bundle (condition/severity characterized in chart and, for patients with persistent asthma, an action plan and controller medications at the most recent visit) increased from 38% to at or near 100%. Patients receiving the required self-management bundle (patient self-assessment, stage-of-readiness tool, and personal action plan) increased from 0% to ~90%. Patients and parents who were confident in their ability to manage their or their adolescent's asthma increased from 70% to ~85%. Patient satisfaction and the mean proportion of patients with asthma-related emergency department visits or hospitalizations remained stable at desirable levels.

CONCLUSIONS: Implementing interventions focused on standardized and evidence-based care, self-management support, care coordination and active outreach, linkage to community resources, and enhanced follow-up for patients with chronically not-well-controlled asthma resulted in sustained improvement in asthma control in adolescent patients. Additional interventions are likely needed for patients with chronically poor asthma control. Pediatrics 2014;133:e418–e427

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ABBREVIATIONS: CCHMC—Cincinnati Children’s Hospital Medical Center ED—emergency department

Drs Britto and Byczkowski conceptualized and designed the project, contributed to the acquisition of the data and analysis and interpretation of the results, and drafted the initial manuscript; Ms Vockell, Ms Munafo, Ms Wimberg, and Mr Pruett contributed to the conception and design the project, the acquisition of the data, and analysis and interpretation of the results; Ms Schoettker contributed to the analysis and interpretation of the results and drafted the initial manuscript; Dr Yi contributed to the conception and design of the project and helped to draft the initial manuscript; and all authors approved the final manuscript as submitted.

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Asthma is the most common chronic disease of childhood, affecting an estimated 7 million children in the United States, 9.4% of all children. The economic and public health costs related to asthma are enormous. It results in an estimated 10.5 million missed school days, 640,000 emergency department (ED) visits, and 157,000 hospitalizations for children each year. In 2007, there were 185 reported pediatric deaths from asthma. Asthma prevalence, morbidity, and mortality rates appear to be higher in adolescents than in younger children and higher in minority and inner-city adolescents. Adolescents with symptomatic asthma have more physical and emotional symptoms, more activity limitations, lower perceived well-being, more negative behaviors, and more acute recurrent and chronic comorbidities than adolescents without asthma.

The goals of asthma treatment are to achieve and maintain control of clinical manifestations of the disease for extended periods. When their asthma is controlled, patients are better able to prevent attacks, avoid symptoms, and maintain physical activity. However, despite the availability of clinical practice guidelines and efficacious treatment options, asthma is not well controlled for many patients, and poorer asthma control is associated with higher costs and increased resource use. In addition, large gaps still exist between the care recommended by guidelines and that actually provided, and there is an inadequate focus on self-management. A study from the Rand Corporation published in 2007 showed that adherence to 17 recommended ambulatory care indicators for children with asthma was only 46%. Using data from 2008, another study showed that, whereas 96% of children and their families were taught how to use an inhaler, 72% were taught to recognize early signs or symptoms of an episode of asthma, and 78% were taught how to respond to an episode, only 44% were given an asthma management plan, and 53% were advised to change things at home, school, or work to improve their asthma.

On average, adolescent outcomes are worse than those of younger patients. The poor outcomes observed for adolescents may be related to the intense emotional, psychological, developmental, and social changes teenagers characteristically undergo during these years. Many adolescents with asthma, particularly those with more severe disease, suffer from anxiety, depression, and low self-esteem. In addition, treatment adherence by adolescents is often poor, with rates of adherence to controller medications as low as 25%. In 2003, the Institute of Medicine designated quality improvement in asthma care as a priority area. To date, quality improvement initiatives designed to change the behavior of patients, their caretakers, or health care providers have shown varying degrees of success. A systematic review of controlled trials found that education interventions for asthma in children led to improvements in lung function and feelings of self-control and reduced school absences, days of restricted activity, and ED use. Educational interventions were not associated with reductions in hospitalizations. A recent systematic review of 79 quality improvement interventions for children with asthma found that several types of interventions improved process and outcomes of care, although the magnitude of improvement was often modest. Of the 6 studies that exclusively enrolled adolescent patients, none showed significant improvement in key asthma outcomes, such as medication use, asthma symptom control, or use of health services. In addition, these studies often did not quantitate the process improvements that were associated with improvement in outcomes. These results suggest the need for additional studies of quality improvement interventions for adolescents with asthma.

We report here on a quality improvement initiative, guided by the Chronic Care Model, to improve asthma control and outcomes for high-risk adolescents treated in a primary care setting.

METHODS

Setting

Cincinnati Children’s Hospital Medical Center (CCHMC) is a large, urban pediatric academic medical center. The Teen Health Center at CCHMC provides primary care to >8000, primarily underserved and African American, youths 12 to 22 years of age. Approximately 15% carry a diagnosis of asthma.

To accelerate our learning regarding asthma care improvement, in 2007 we instituted a Tuesday afternoon primary care clinic where all the patients have asthma. All Teen Health prospective patients requesting a new patient appointment are asked if they have asthma. If so, they are offered a slot in the Tuesday clinic. If they come to their new appointment, they are added to the denominator for the clinic (and for all measures included in this article). They remain in the target population, whether they come for follow-up visits with this special clinic session or not, until they age out of the Teen Health Center (typically at 22 years of age), inform us they are receiving care elsewhere, or make no visits to the Teen Health Center for 14 months. Bringing together an unselected group of patients with asthma allows us to more rapidly test and implement changes in asthma care. On average, ~200 patients are in the group at any time.
Outcomes of Interest

We developed a 3-level system of outcome measures. At the highest level, multifaceted outcome measures were developed to capture the overall aim of the team to improve clinical outcomes for adolescents with asthma. The primary outcome measure was the percentage of patients with optimally well-controlled asthma, defined as the best score (16) on our modified asthma control score questionnaire.47 Our score was based on the Asthma Control Test48 but was adapted to be consistent with the 2007 National Heart, Lung, and Blood Institute asthma guidelines.13 When CCHMC transitioned to an electronic health record, to be consistent across the medical center, we began using the top score of 25 on the original Asthma Control Test for our measure of optimally well-controlled and 20 for the usual Asthma Control Test cutoff for well controlled. Other measures were as follows: (1) the percentage of patients who were hospitalized and/or visited the ED, a measure of health care utilization, and (2) patient satisfaction with the clinic visit, measured by using a modified Consumer Assessment of Healthcare Providers and Systems question49 that measures overall satisfaction with the care patients received. For the satisfaction measure, patients were asked to fill out an anonymous, 11-point Likert scale survey at the end of their visit. The team monitors the proportion of patients giving their care the highest rating.

Within the second level of measures, which were specific to the interventions, the delivery of standardized and evidence-based care was evaluated by using the proportion of patients receiving a bundle of care elements: a written asthma action plan, severity classified, and controller medications prescribed for patients with persistent asthma. The overall outcome measure for self-management support was the percentage of patients who were confident in their ability to manage their asthma, measured during each clinic visit by using a Likert scale question developed and validated by Lorig et al50 for patients with arthritis.

The third level of measures were developed to measure the success of the numerous and targeted Plan-Do-Study-Act cycles51 used in the testing and implementation of the interventions. For example, while conducting tests to improve mental health access, we developed a process measure of the proportion of patients each week needing a mental health referral who received the new standard referral process.

Interventions

The Chronic Care Model42–46 was used as the evidence-based framework to guide changes in care delivery. During the planning phase, suggestions and feedback on proposed changes were obtained from patients and families through questionnaires and involvement of the Teen Asthma Advisory Board; an adolescent focus group, and during clinic visits. The interventions implemented included delivery system redesign to provide standardized and evidence-based care, productive interactions between informed patients and prepared clinicians, self-management support, community linkages, clinical information systems, and decision support (Table 1). A quality improvement consultant coached the team in quality improvement methods and a data specialist guided the data collection process and assisted with the data analysis.

Standardized, Evidence-Based Care

In 2007 we began administering the asthma control questionnaires to teenagers and their parents at each visit and, using our modified asthma control score, assessed teenagers’ symptoms, medication use, and confidence to manage their asthma. Decision-support tools and frequent feedback encouraged providers to implement evidence-based practices, such as classifying severity, developing a written asthma management plan, and prescribing controller medications for persistent asthma. In 2008 we developed and implemented a more detailed asthma assessment and treatment algorithm (see Supplemental Fig 5)52–55 based on the National Heart, Lung, and Blood Institute asthma guidelines.13

Care Coordination and Active Outreach

In May 2007, the parent of a child with a chronic illness was hired to coordinate data tracking, family outreach, appointment scheduling, and preclinic reminders and assessments. Two widely available electronic databases (DocSite clinical registry and Care Management Plus) were used to maintain clinical and demographic information about the patients. These databases also served as the primary data source for our process and outcomes measures. Patients in need of follow-up were tracked. Follow-up was performed by different team members depending on the specific need. For example, the parent coordinator would help patients with appointment scheduling or linking to community resources. The nurse practitioner would do clinical reassessment by phone and adjust the treatment plan as needed.

From July 2010 through June 2011, we focused improvement efforts on a group of 58 chronically not-well-controlled patients: those with a median score of 9 to 13 over the previous year on our modified56 asthma control score. It was discovered through this effort that these patients were less likely to come to clinic. Therefore, interventions for this group focused on improving patient contact and follow-up.
They were called and texted at every known telephone number. Their schools were also contacted. If these patients could be reached, their asthma was assessed over the telephone. An in-depth chart review was performed to assess what gaps in their care could be addressed (ie, learning needs, comorbidities, referrals, triggers, barriers to care, tobacco exposure). When patients returned to clinic, these gaps were addressed. This targeted intervention was evaluated by the proportion of patients in the cohort whose score on our modified asthma control questionnaire improved by at least 2 points. A study consisting primarily of adults reported a 1.88-point change in the 25-point Asthma Control Test to be clinically important.\(^{57}\) Self-management Support

At the inception of the clinic, it was determined that self-management support was integral to success. Initial testing and refinement of the parent coordinator role began in 2007. In 2008 all clinical staff and the parent coordinator received training in motivational interviewing and behavior change counseling.\(^{58–60}\) In 2008 we designated a team member as

<table>
<thead>
<tr>
<th>TABLE 1 Interventions</th>
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<tbody>
<tr>
<td><strong>Health systems</strong></td>
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<tr>
<td>- Delivery system design</td>
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<tr>
<td>- Staff tracker: a paper matrix used by staff to track each patient's steps through a clinic visit to ensure they received the care they needed during that visit</td>
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<tr>
<td>- Staff coordinator: the parent of a chronically ill child coordinated data tracking, appointment scheduling, and preclinic reminders and assessments</td>
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<td>- Preclinic planning</td>
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<td>- Standardized educational brochures, Web sites, knowledge quiz, and checklists developed with patients</td>
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<tr>
<td>- Symptom tracker: a paper form used by patients to record their asthma symptoms, triggers, and medication use and reviewed at clinic visits</td>
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<td>- Individual patient asthma control data plotted on run charts and discussed with patients/families during visits</td>
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<td>- Contact information updated every 60 days during the clinic visit and numbers and methods prioritized according to patient preference; enabled us to obtain information that patients sometimes are reluctant to give to registration personnel</td>
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<tr>
<td>- Active follow-up between visits</td>
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<td><strong>Decision support</strong></td>
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<tr>
<td>- Evidence-based algorithms for asthma, allergic rhinitis, smoking cessation, and gastroesophageal reflux disease were created to standardize care</td>
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<tr>
<td>- Prompts and templates developed to guide care decisions and standardize information attained during clinic visit (initially paper, later embedded in electronic health record)</td>
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<tr>
<td>- Standardized previsit planning forms</td>
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<tr>
<td><strong>Clinical information systems</strong></td>
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<tr>
<td>- Clinic tracker: information on completion of patient-entered data, self-management support, patient community resource needs, and patient feedback on initiatives stored in a spreadsheet database and used during clinic visits</td>
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<tr>
<td>- DocSite Registry: a database of all patients and their outcomes used for previsit planning, follow-up, and monitoring population results (used before implementation of electronic health record)</td>
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<tr>
<td>- Care-Managment Plus(^{52,53,55}) database: patient demographic database used to generate reminder lists of patients needing follow-up (used before implementation of electronic health record)</td>
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<td>- Online, confidential patient satisfaction questionnaire: satisfaction measured on a scale of 0 to 10, with an opportunity for free text comments</td>
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<td><strong>Self-management support</strong></td>
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<td>- Self-management support through tailored mailings and patient brochures based on stage of readiness</td>
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<td>- Staff trained to address patient needs and confidence in behavior change counseling</td>
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<td>- Self-management tools (patient self-assessment, stage-of-readiness progress checklist, and personal action plan) reviewed and documented in medical record at each clinic visit</td>
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<td>- Reminders for influenza immunization, upcoming appointments, and need to make a follow-up appointment were sent as text messages</td>
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<td>- Patient illness management questionnaire to identify barriers to self-management(^{41})</td>
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<tr>
<td>- Administration of the State/Trait Anxiety Inventory for Children(^{54}) to patients whose asthma was not well controlled after (\geq 3 ) months in clinic; patients exceeding the tool's threshold and possibly anxious or worried were referred to mental health services</td>
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<tr>
<td>- New patients received a letter providing contact information and describing the Teen Health Center and Asthma Innovation Laboratory and what to expect during a visit</td>
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<tr>
<td><strong>Community</strong></td>
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<tr>
<td>- Teen Asthma Advisory Board: teenagers with asthma who attended the Teen Health Center helped to shape decisions around use of and implementation of Web sites and documents</td>
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<td>- Asthma camp: a weekend camp for children with asthma to promote friendship, asthma education, and fun</td>
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<td>- Facilitated mental health referrals</td>
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<td>- Emergency prescriptions: patients/families without insurance could receive a 1-month supply of medications from the pharmacy at Cincinnati Children's and be billed later</td>
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<td>- Facilitated referrals to financial counseling services to obtain assistance with health care–related financial needs</td>
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<tr>
<td>- Transportation services to and from clinic visits for publicly insured patients</td>
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<tr>
<td>- Cincinnati Health Department conducted evaluations of rental properties for asthma triggers (mold, cockroaches, etc) and sent letters to landlords</td>
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<tr>
<td>- School nurses administered the Asthma Control Test to patients with not-well-controlled asthma who were unresponsive to contact at home or did not attend clinic appointments</td>
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a self-management coach to conduct self-assessments, set goals, and develop action plans. The coach also contacted patients between visits to assess progress. We tested and eventually began using 3 self-management tools: a patient self-assessment, a stage-of-readiness tool, and a personal action plan. The training tools were based on an evidence-based guideline previously developed at CCHMC. Starting in 2009, an evidence-based guideline previously plan. The training tools were based on an evidence-based guideline previously developed at CCHMC. Starting in 2009, resident physicians rotating in the clinic began receiving training in the use of the self-management tools and behavior change counseling using motivational interviewing skills.

To assess general health, concerns/worries, disease and treatment knowledge, social stressors, and readiness to make a behavior change, the patient self-management assessment was administered at the beginning of the visit to every patient who had not been assessed within the previous 30 days. The stage-of-readiness tool was used to document the patient's current stage of readiness to change and the focus of the behavior change counseling at the end of the visit. A personal action plan was completed if the patient was ready to make a behavior change (all tools available on request). Follow-up was conducted by phone, e-mail, or text, according to the teenager's preference.

**Community Connections**

Because many teenagers were failing to achieve optimal asthma control with our evidence-based care, self-management, and care coordination interventions, in 2011 we investigated major barriers to achieving good control. We interviewed patients, parents, and hospital social workers and determined that the major, potentially modifiable barriers were lack of transportation to appointments, lack of insurance coverage for medications, and untreated mental health comorbidities. Working with families, social services, and community agencies, we developed and tested interventions to address each of these problems (Table 1).

**Data Collection**

The data to generate the measures and monthly reports were collected during clinic or telephone encounters and entered into an electronic patient registry (later, the electronic health record) or extracted from hospital administrative databases from the start of interventions through June 2011, which was the end of the fiscal year in which we transitioned to an electronic health record.

**Analysis**

Statistical process control methods were used to monitor changes in care processes and health outcomes. Specifically, annotated control or run charts were developed and updated monthly. Standard industry criteria were used to determine if observed changes in measures were chance random variation (common cause variation) or due to a specific assignable cause, in this case the intervention (special cause variation).

Some measures were based on the total population and used the most recent data point for each patient. Standard statistical process control criteria were not used for these cumulative measures due to the large degree of autocorrelation caused by carrying over patients’ values from the previous data point if a new visit did not occur since the data were collected.

**Human Subjects Protection**

This initiative fell within the CCHMC Institutional Review Board's guidance for quality improvement projects that did not constitute human subjects research.

**RESULTS**

**Overall Innovation Laboratory Measures**

From June 1, 2007, through June 30, 2011, 322 unique patients with asthma were seen in the new clinic. The proportion of patients with optimally well-controlled asthma (ie, highest possible score on our modified asthma control score) was ~10% at baseline and gradually increased to 20% by June 2008 after implementation of standardized, evidence-based care and outreach by a parent coordinator (Fig 1). In August 2009, after the implementation of reliable self-management support, the proportion of optimally well-controlled patients exceeded our goal of 30% and was maintained.

Figure 1 also shows when we converted to the electronic health record and began to use the standard Asthma Control Test as our outcome measure. We found that a similar proportion of patients had a maximal score of 25 on the Asthma Control Test as had a maximal score on our modified asthma score. The mean proportion of patients with asthma-related ED visits or hospitalizations was stable at 1.6% (Fig 2). Patient satisfaction also remained stable at 75% (Fig 3).

**Results of Specific Interventions**

In September 2006, only 38% of patients received the 3 following elements of evidence-based care: (1) condition/severity characterized in chart; and, for patients with persistent asthma, (2) an action plan; and (3) controller medications at the most recent visit. The value increased rapidly and, starting in June 2007, was ≥94%. Between December 2010 and June 2011, 100% of patients with asthma received the evidence-based care bundle.

After the implementation of self-management interventions in September 2007, the proportion of patients and their parents who were confident in their ability to manage their or their adolescent's asthma (rating of ≥7 of 10) increased from a low of 70% to ~80%. This proportion increased again to ~85% after the team began to increase...
FIGURE 1
Percentage of patients with asthma whose condition was well controlled. EPIC, our electronic health record; FY, fiscal year.

FIGURE 2
Percentage of patients with asthma with asthma-related ED visits and/or hospitalizations.
its skill in providing self-management support and planned specific interventions for each adolescent with a low score in February 2009.

Between July 2008 and August 2009, the proportion of patients receiving the required self-management components (a patient self-assessment, a stage-of-readiness tool, and a personal action plan, if in action) rapidly increased from 0% to 86% and then remained steady at slightly less than 90%. These results coincided with the large increase in well-controlled patients beginning in June 2008 (Fig 1).

Cohort of Chronically Not-Well-Controlled Patients

Of the 50 chronically not-well-controlled patients who remained in the practice (8 left the practice or moved away), 60% had a $\geq 2$-point improvement in their median modified asthma control score in the intervention year compared with the previous year (Fig 4).

Community Connections

Community connections were measured by identifying patients who needed community services and tracking the proportion of patients who were either referred or provided with information during a clinic visit. By June 2011, we achieved $\geq 90\%$ reliability in our processes to address major family concerns.

DISCUSSION

Our quality improvement initiative is among the first to show sustained improvement in asthma control in adolescent patients. By using the outcome of optimal asthma symptom control, we tripled the proportion of patients who achieved that level of control over the course of our initiative. In accordance with the Chronic Care Model, our multiple interventions focused on standardized and evidence-based care, self-management support, care coordination and active outreach, linkage to community resources, and enhanced follow-up for patients with chronically not-well-controlled asthma.

We used a high bar to define asthma control, the highest possible score on our modified asthma control score. We originally chose to modify the Asthma Control Test developed by Nathan et al because it was not consistent with the most recent asthma guidelines from the National Heart, Lung, and Blood Institute. After our transition to use of an
electronic health record in March 2011, we switched to using the Asthma Control Test to be consistent with other departments in our medical center. Initial results after the transition suggested that our modified score functioned similar to the original Asthma Control Test. Several of our interventions focused on improving teenager and family engagement in their asthma care. The 3 self-management tools (a patient self-assessment, a stage-of-readiness tool, and a personal action plan) were designed to promote self-management assessment and help providers talk comfortably and productively with patients and families about making changes necessary to improve their health. The role of the parent coordinator served as a relatively low-cost innovation that allowed someone familiar with the needs and struggles of families dealing with a chronic illness to help other families navigate the care system. This valuable person, working closely with clinicians, was often able to obtain patient information that clinicians alone could not get. We suspect that the parent coordinator, herself the parent of a child with a chronic condition, could converse with parents as a peer rather than as a medical professional.

We continue to work with patients who struggle to control their asthma. We are currently testing interventions that use technology to promote active outreach and population management. We are also developing new algorithms to drive comanagement approaches with our specialist colleagues in Pulmonary Medicine and Psychology.

This small group of patients with chronically poor control may also represent a group with intrinsically difficult-to-control asthma. They are now the focus of research efforts among our pulmonary colleagues. In addition, we are spreading our successful interventions to other areas of the medical center that treat patients with chronic disease. For example, the self-management tools have been adapted for use with our electronic health record and brochures describing the 5 stages of change readiness are widely used.

CONCLUSIONS

Implementing interventions focused on standardized and evidence-based care, self-management support, care coordination and active outreach, linkage to community resources, and enhanced follow-up for patients with chronically not-well-controlled asthma resulted in sustained improvement in asthma control in adolescent patients. Additional interventions are likely needed for patients with chronically poor asthma control.

FIGURE 4
Cumulative percentage of chronically not-well-controlled patients (median score of 9 to 13 on our modified asthma control score) whose score improved by 2 points.
REFERENCES


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