

Education and follow-up

Recommendations

1. Education is an essential component of asthma therapy and should be offered to all patients; educational interventions may be of particular benefit in patients with high asthma-related morbidity or severe asthma and at the time of emergency department visits and admissions to hospital (level I). Education programs should be evaluated (level III).
2. All patients should monitor their asthma using symptoms or peak expiratory flow (PEF) measurement (level I) and have written action plans for self-management that include medication adjustment in response to changes in severity or frequency of symptoms, the need for symptom relief medication or a change in PEF (level I).
3. Asthma control criteria should be assessed at each visit (level IV). Measurement of pulmonary function, preferably by spirometry, should be done regularly (level III) in adults and children 6 years of age and older.
4. Socioeconomic and cultural factors should be taken into account in designing asthma education programs (level II). Asthma education is an important component of asthma therapy,^{1,2} but it is difficult to make any definitive statements about the best approach to pediatric asthma education based on the research available. A literature review suggests that only about half of the studies in this area have been randomized controlled trials, and it is difficult to carry out a randomized controlled trial of patient education.

Many studies have used patients as their own controls. Variations exist between studies in terms of the identity of the learners and the educators, the intervention, the outcomes measured and the timeframe for measurement; some programs with positive outcomes also involved medical care, other services or some type of follow-up.³⁻¹⁰

Contents of an ideal education program for children

The Expert Panel Report of the National Heart, Lung and Blood Institute¹ recommended the following areas of focus for education:

- basic facts about asthma
- roles of medications
- skill in the use of inhaler, spacer and holding chamber; self-monitoring
- environmental control measures

- when and how to take rescue actions
- joint development of treatment goals with patient and family
- written daily self-management plan and an action plan for exacerbations
- encouraging adherence by promoting open communication; adapting, reviewing and adjusting plans as needed
- emphasis on goals and outcomes

The Canadian Asthma Consensus Report² also recommended that an asthma education program include:

- information about airway inflammation and bronchospasm
- figures to illustrate the concept, the rationale and methods for avoiding irritants and relevant allergens
- description of the rationale, correct use and side effects of preventive medications and bronchodilators
- demonstration of and practice in inhaler technique and monitoring using symptoms or PEF meters
- description of criteria for control and steps to take when control deteriorates
- discussion of the action plan and an attempt to improve both the patient's and the family's understanding and willingness to implement the plan when it is needed
- demonstration of techniques for successful communication with health care professionals
- emphasis on the need for regular follow-up
- discussion of intolerance to sulfites or acetylsalicylic acid
- specific information on food allergies
- discussion, when relevant, of conditions such as pregnancy.

Literature review

Three databases were searched for articles on the value of asthma education in children. The CINAHL database encompasses nursing and allied health articles. MEDLINE was used for medical articles. The ERIC database was used to search educational literature. Key words used for searching these databases were "pediatric," "asthma education," "self-management," "asthma training," "children," "pediatric asthma" and "asthma." In addition, personalized education bibliographies were examined for relevant articles. Years searched included 1991 to December 2004.

Current evidence

Meta-analyses in the literature

Three meta-analyses of the effects of asthma self-

management programs in children have been carried out. Wolf and colleagues¹¹ reported on a systematic review that included 3706 patients between the ages of 2 and 18 years. Various self-management programs were included for analysis. Primary outcome measures were lung function, days absent from school, self-efficacy and emergency department visits. A standardized weighted mean difference was used to estimate the pooled effect size. With self-management, there was moderate improvement in airflow and self-efficacy and a modest reduction in school absenteeism, days of restricted activities, emergency department visits and nights disturbed by asthma. The review contained no guidelines for assessing the magnitude of these differences. The authors concluded that "self-management education directed to the prevention and management of attacks should be incorporated into routine asthma care." There were no comparisons of the effectiveness of individual components of the education, making a recommendation on their effectiveness difficult.

Haby and coworkers¹² assessed studies in 1407 children between the ages of 1 and 18 years and reported on subsequent repeat visits to the emergency department after asthma education. The studies reviewed were heterogeneous and the analysis was inconclusive. Overall, there was no reduction in the number of repeat emergency department visits; however, some of the individual studies showed a significant decrease.

Bernard-Bonin and colleagues¹³ performed a meta-analysis of randomized clinical studies between 1979 and 1991 to address the effect of asthma education on morbidity. Twenty-three randomized clinical trials were initially assessed, but 12 of the studies were later excluded. In this analysis, self-management teaching did not reduce school absenteeism, asthma attacks, admissions to hospital, length of hospital stays or emergency department visits. Fewer than 5 studies could be included in the analysis for each outcome, and this small number may account for the apparent lack of impact of asthma education in this analysis.

Individual studies and outcomes

Knowledge

Asthma education improves asthma knowledge, as documented in several studies with large numbers of patients.^{5,14-21} Various programs have been described, but it has not been demonstrated that a change in knowledge results in changes in behaviour.

Coping and attitude change

Moe and coworkers²² followed 24 children, age 4-14 years, after participation in a modified "Open Airways" program. They reported an improvement in parent confidence immediately after the program and parents reported earlier intervention with medication when symptoms were

noticed, improved child adherence to medication, plus better communication among family, school and physician. Colland²³ studied the effect in 112 children, age 8-13 years, of 10 1-hour sessions on asthma management with a behavioural therapist. On follow-up at 1, 6 and 12 months after the intervention, the children showed improved coping and decreased anxiety related to their asthma. In a study by Hanson,²⁴ families of 303 patients between the ages of 6 months and 12 years were educated in groups. During the 2 years of follow-up, an increase in self-efficacy was reported. Persaud and colleagues²⁵ studied the effects of 8 individual 20-minute sessions held weekly for children aged 8-12 years. Immediately after the program, exacerbation anxiety decreased. In 13-16-year-old children with asthma ($n = 17$), after 6 hours of education in 4 categories of management, there was no difference in the self-efficacy scale immediately after the instruction, but there was improved confidence in some areas of management.²⁶ It is evident that programs were effective in decreasing anxiety and increasing patients' self-efficacy and confidence in managing the disease. As the delivery of each of these programs was different, comparisons between them are difficult.

Quality of life

Shah and colleagues²⁷ studied the effect of peer teaching on 251 youths between 12.5 and 15.5 years of age. Over the course of 8 months, activities and quality of life improved and there were fewer days absent from school. Other studies have reported significant improvement in measure of quality of life^{28,29} and improvements in "health belief"⁵ with an education intervention.

Asthma symptoms

With regard to symptoms, studies have shown decreased night waking, fewer restrictions on activities and fewer visits to physicians with education.²³ Bartholomew and colleagues³⁰ studied 133 children between the age of 6 and 17 years. Over a 4- to 15-month follow up there were better symptom scores and better self-management behaviours in the intervention group than in the control group. Deaves³ reported significant improvement in night symptoms (intervention 69 events, control 125 events) and activity restrictions (intervention 45 events, control 75 events; $p < 0.001$). Bonner and colleagues⁵ reported a decrease in symptom persistence with education and both these researchers and Guendelman and coworkers³¹ reported fewer activity restrictions. At study end in the education group, 65% of the children had no limitations of activity versus 53% of the control group (OR 0.52, 95% CI 0.29-0.94, $p = 0.03$).

Use of the health care system

The most important outcome of asthma education is the changes in the use of the health care system. Ronchetti and

coworkers³² studied 209 children, average age 9 years. After 1 year, the group participating in the "Living with Asthma" or the "Open Airways" program had significantly fewer emergency department visits in the previous 2 months compared with the control group who did not participate in an education program (0.07 v. 0.23, $p = 0.04$). Volsko⁹ reported on 27 1- to 18-year-olds who participated in 3 outpatient education sessions; over 7 months, their visits to the emergency department decreased from 2.1 to 0.1 per patient ($p < 0.0001$), admissions to hospital decreased from 0.4 to 0.04 per patient ($p = 0.0095$), cost of care decreased from \$1690 to \$146 and compliance improved (from 50% to 25% no-shows). Detwiler and colleagues¹⁴ reported fewer emergency department visits (0.42 ± 1.16 v. 0.97 ± 3.24 , $p < 0.01$), admissions to hospital (0.10 ± 0.330 v. 0.42 ± 0.73), number of days in hospital (0.30 ± 1.14 v. 1.50 ± 2.68) and sick visits to the physician (2.43 ± 2.97 v. 4.26 ± 3.24) after asthma education. Kelly and coworkers³³ also reported decreases in the number of emergency department visits, admissions to hospital and average health care costs. Bonner and colleagues⁷ showed increased prescribed control medications after asthma education (54%–70% for ICSs and 26%–24% for cromolyn after asthma education v. 44%–38% for ICSs and 36% for cromolyn among the control group). Maslennikova and coworkers⁶ followed 110 children, aged 4–14 years, who participated in either "Open Airways" or "Air Power" programs. A year after the baseline date, there were significant increases in the use of anti-inflammatory drugs among the program participants (46% increase v. 8% increase in the control group, $p < 0.05$) and a reduction in physician visits (1.1 ± 0.36 fewer visits per subject in the control group v. a reduction of 2.3 ± 0.59 visits per subject in the intervention group). Wesseldine and colleagues³⁴ followed 160 children, age 2–16 years, after asthma education was delivered while they were in hospital for asthma treatment. During the next 6 months, hospital readmissions in the education group were much lower than in the control group (15% v. 37% of patients, $p = 0.001$).

Peak expiratory flow rates

Physiologic outcomes have also been investigated. In 134 children, 8–16 years old, using an interactive web site, PEF readings were monitored and immediate feedback was provided.³¹ Over 6 and 12 weeks, fewer patients who monitored their PEF were in the yellow or red zones (40% v. 58%, $p = 0.01$). Maslennikova and colleagues⁶ reported significant improvement in PEFs (54.8 ± 8.1 L/minute v. 32.7 ± 6.01 L/minute) and decreased variability after asthma education.

Computer-based education

Four studies reported on the use of computer-based software as an educational intervention. In a study of 137 children, aged 3–12 years, patients and parents used an "asthma

game" during 3 visits.³⁵ Follow-up was by monthly telephone contact. The group who used the game showed improved knowledge, but there were no differences in number of emergency department visits, unscheduled visits to physicians, asthma severity or impact of asthma on parents' time. Bartholomew and colleagues³⁰ used computer-based education software in 133 children, aged 6–17 years. Children played the game before physician visits and received printouts at the end of the visit. They also received an asthma action plan. On follow-up, there were fewer admissions to hospital compared with 1 year prior to the study (0.7 ± 1.1 per child in the year before decreased to 0.4 ± 0.8 in the year after in the intervention group v. 0.6 ± 1.0 before and 0.5 ± 1.1 in the year after in the control group), better symptom scores, increased functional status and better self-management behaviour among the children who played the game. Shegog and coworkers³⁶ used computer-assisted education in 9–13 year olds ($n = 76$). At 3 weeks follow-up, there were no differences in knowledge, but the intervention group had higher scores for self-regulation (3.3 ± 1.3 v. 0.06 ± 0.3), prevention strategies (2.7 ± 1.1 v. 1.8 ± 1.0) and treatment strategies (2.7 ± 1.1 v. 1.5 ± 0.8). Guendelman and coworkers³¹ used a combination of interventions: an interactive Internet site, daily questions, PEF readings and immediate feedback via the Internet. As reported above, fewer patients who participated in the education program had PEF in the yellow or red zone. There were no differences between intervention and control groups in use of health care services, but the intervention group made fewer urgent calls for advice (OR 0.43, $p = 0.005$). Children in the intervention group were more likely to use their medications without reminding (74% v. 50%, $p = 0.04$).

Discussion

Target learners

Specific recommendations on the most appropriate target learners based on existing evidence are impossible. However, we offer the following comments.

- School-age children — According to some studies^{25,30,36} it might be useful to provide asthma education to school-aged children without specific inclusion of parents. However, no randomized controlled trial comparing education of children alone v. parents and children was identified. Children need support; intuitively, it would seem parents also need education.
- Preschool education for children — One study involved provision of asthma education to children 3.5–5 years old and reported positive results³⁷; however, the number of participants was small and it was not a randomized controlled trial. Working with this age group and their parents requires additional educator resources, and a cost-benefit analysis was not included in the study.
- Adolescents — This is a difficult group and ensuring attendance is challenging.⁴ Innovative programs and en-

gaging venues²⁶ are required, and peer teaching should be considered.²⁷

The ideal education program

It is not possible to recommend an ideal program for any specific target learner.

- Both group and individual interventions resulted in positive outcomes, but only 1 study comparing group with individual education was identified and both methods were associated with some positive outcomes.³⁸
- The number of education contacts varied; consideration must be given to program length and attrition rate.
- Education plus medical care and follow-up appear to have value,^{3,5,7} but the relative importance of these interventions to outcome has not been assessed.

Site of intervention

Education was delivered at a variety of sites (e.g., hospitals, camps, schools), but no 1 site appears to be most effective.

- Positive outcomes have resulted from providing education during admission.^{7,20,33} This venue might provide 2 advantages: the child and (likely) the parents are already on site; and awareness of the child's asthma is heightened.
- None of the identified studies evaluated the delivery of asthma education in the emergency department.
- Although camps provide an interesting venue, the studies evaluating camp education programs did not result in impressive outcomes.
- Evaluation of asthma education in schools showed mixed results, but children in the school system are readily accessible for education.

Delivery of asthma education must not only be effective, but also practical in the real world. Barriers to attendance and completion of education interventions that might exist for the pediatric group must be recognized and counteracted. Some difficulties for families include time commitment, transportation, babysitting, illness and denial.

Implications for research

1. Although the randomized controlled approach to education research is difficult, efforts should be made to carry out this type of study to ensure that results are not due to unexplained variables.
2. Education research should employ a variety of outcome measures. Positive changes in beliefs, attitude and knowledge are important, but it is also necessary to show that these outcomes translate into behaviour change, improved quality of life, improved lung function and decreased requirement for urgent care.
3. Evaluations should be performed for periods longer than immediately post-intervention.
4. Further research is needed to determine whether edu-

cation interventions are effective and practical for parents, children and adolescents.

5. Further research is needed to determine whether there are ideal sites for an education intervention for specific target groups.
6. Although a certified asthma educator might be assumed to be the most appropriate person to facilitate effective asthma education, this has as yet not been evaluated.
7. Although some studies suggest that cost benefits are associated with education,^{9-10,39} more research is needed related to this outcome.

References

1. National Institutes of Health/National Heart, Lung and Blood Institute. *Expert panel report 2: guidelines for diagnosis and management of asthma*. Bethesda: NIH; 1997. Publ. 97-4051.
2. Boulet L-P, Becker A, Bérubé D, Beveridge R, Ernst P. Canadian asthma consensus report, 1999. *CMAJ* 1999;161(11 suppl):S1-S62.
3. Gebert N, Hümmelink R, Könnig J, Staab D, Schmidt S, Szczepanski R, et al. Efficacy of a self-management program for childhood asthma — a prospective controlled study. *Patient Educ Couns* 1998;35(3):213-20.
4. Cowie RL, Underwood MF, Little CB, Mitchell I, Spier S, Ford GT. Asthma in adolescents: a randomized, controlled trial of an asthma program for adolescents and young adults with severe asthma. *Can Respir J* 2002;9(4):253-9.
5. Bonner S, Zimmerman BJ, Evans D, Irigoyen M, Resnick D, Mellins RB. An individualized intervention to improve asthma management among urban Latino and African-American families. *J Asthma* 2002;39(2):167-79.
6. Maslennikova GYa, Morosova ME, Salman NV, Kulikov SM, Oganov RG. Asthma education programme in Russia: educating patients. *Patient Educ Couns* 1998;33(2):113-27.
7. Madge P, McColl J, Patton J. Impact of a nurse-led home management training programme in children admitted to hospital with acute asthma: a randomized controlled study. *Thorax* 1997;52(3):223-8.
8. Harish Z, Bregante AC, Morgan C, Fann CS, Callaghan CM, Witt MA, et al. A comprehensive inner-city asthma program reduces hospital and emergency room utilization. *Ann Allergy Asthma Immunol* 2001;86(2):185-9.
9. Voloko TA. A pediatric asthma clinic pilot program reduces emergency department visits, hospitalizations and cost of care. *Respir Care* 1998;43:107-13.
10. Greineder DK, Loane KC, Parks P. A randomized controlled trial of a pediatric asthma outreach program. *J Allergy Clin Immunol* 1999;103(3 pt 1):436-40.
11. Wolf FM, Guevara JP, Grum CM, Clark NM, Cates CJ. Educational interventions for asthma in children (Cochrane Review). In: *The Cochrane Library*; Issue 1, 2003. Oxford: Update Software.
12. Haby MM, Waters E, Robertson CF, Gibson PG, Ducharme FM. Interventions for educating children who have attended the emergency room for asthma (Cochrane Review). In: *The Cochrane Library*; Issue 3, 2002. Oxford: Update Software.
13. Bernard-Bonnin AC, Stachenko S, Bonin D, Charette C, Rousseau E. Self-management teaching programs and morbidity of pediatric asthma: a meta-analysis. *J Allergy Clin Immunol* 1995;95(1 pt 1):34-41.
14. Detwiler DA, Boston LM, Verhulst SJ. Evaluation of an educational program for asthmatic children ages 4-8 and their parents. *Respir Care* 1994;39(3):204-12.
15. Horner SD. Using the Open Airways curriculum to improve self-care for third grade children with asthma. *J Sch Health* 1998;68(8):329-33.
16. McCarthy MJ, Herbert R, Brimacombe M, Hansen J, Wong D, Zelman M. Empowering parents through asthma education. *Pediatr Nurs* 2002;28(5):465-73.
17. Collins J. A programme to reinforce understanding. An educational programme for hospitalised children with asthma. *Prof Nurse* 1994;9(4):225-8.
18. Deaves DM. An assessment of the value of health education in the prevention of childhood asthma. *J Adv Nurs* 1993;18(3):354-63.
19. Lord A, St. Leger LH, Ridge DT, Elisha D. The value of asthma camps for young people in Victoria. *Contemp Nurse* 2001;11(2-3):133-41.
20. Taggart VS, Zuckerman AE, Sly RM, Steinmueller C, Newman G, O'Brien RW, et al. You Can Control Asthma: evaluation of an asthma education program for hospitalized inner-city children. *Patient Educ Couns* 1991;17(1):35-47.
21. Pérez MG, Feldman L, Caballero F. Effects of a self-management educational program for the control of childhood asthma. *Patient Educ Couns* 1999;36(1):47-55.
22. Moe EL, Eisenberg JD, Vollmer WM, Wall MA, Stevens VJ, Hollis JF. Implementation of "Open Airways" as an educational intervention for children with asthma in an HMO. *J Pediatr Health Care* 1992;6(5 pt 1):251-5.
23. Collard V. Learning to cope with asthma: a behavioural self-management program for children. *Patient Educ Couns* 1993;22(3):141-52.
24. Hanson J. Parental self-efficacy and asthma self-management skills. *J Soc Pe-*

diatr Nurs 1998;3(4):146-54.

15. Persaud DI, Barnett SE, Weller SC, Baldwin CD, Niebuhr V, McCormick DP. An asthma self-management program for children, including instruction in peak flow monitoring by school nurses. *J Asthma* 1996;33(1):37-43.
16. Alaniz KL, Nordstrand J. Camp Super teens: an asthma education program for adolescents. *MCN Am J Matern Child Nurs* 1999;24(3):133-7.
17. Shah S, Peat JK, Mazurski EJ, Wang H, Sindhusake D, Bruce C, et al. Effect of a peer led programme for asthma education in adolescents: cluster randomized controlled trial. *BMJ* 2001;32(7286):2:583-5.
18. Forshee JD, Whalen EB, Hackel R, Butt LT, Smeltzer PA, Martin J, et al. The effectiveness of one-on-one nurse education on the outcomes of high-risk adult and pediatric patients with asthma. *Manag Care Interface* 1998; 11(12):82-92.
19. Young NL, Foster AM, Parkin PC, Reisman J, MacLusky I, Gold M, et al. Assessing the efficacy of a school-based asthma education program for children: a pilot study. *Can J Public Health* 2001;92(1):30-4.
20. Bartholomew LK, Gold RS, Parcel GS, Czyzewski DI, Sockrider MM, Fernandez M, et al. Watch, discover, think, and act: evaluation of computer-assisted instruction to improve asthma self-management in inner-city children. *Patient Educ Couns* 2000;39(2-3):269-80.
21. Guendelman S, Meade K, Benson M, Chen YQ, Samuels S. Improving asthma outcomes and self-management behaviors of inner-city children: a randomized trial of the Health Buddy interactive device and an asthma diary. *Arch Pediatr Adolesc Med* 2002;156(2):114-20.
22. Ronchetti R, Indinnimeo L, Bonci E, Corrias A, Evans D, Hindi-Alexander M, et al. Asthma self-management programmes in a population of Italian children: a multicentric study. Italian Study Group on Asthma Self-Management Programmes. *Eur Respir J* 1997;10(6):1248-53.
23. Kelly CS, Morrow AL, Shults J, Nakas N, Strobe GL, Adelman RD. Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in medicaid. *Pediatrics* 2000;105(5):1029-35.
24. Wesseldine LJ, McCarthy P, Silverman M. Structured discharge procedure for children admitted to hospital with acute asthma: a randomised controlled trial of nursing practice. *Arch Dis Child* 1999;80(2):110-4.
25. Homer C, Susskind O, Alpert HR, Owusu C, Schneider L, Rappaport LA, et al. An evaluation of an innovative multimedia educational software program for asthma management: report of a randomized controlled trial. *Pediatrics* 2000;106(1 pt 2):210-5.
26. Shegog R, Bartholomew LK, Parcel GS, Sockrider MM, Mâsse L, Abramson SL. Impact of a computer-assisted education program on factors related to asthma self-management behavior. *J Am Med Inform Assoc* 2001;8(1):49-61.
27. Matthews B, Dickinson A, Cram F. Establishment and evaluation of a preschool asthma programme: a pilot study. *Nurs Pract NZ* 1998;13(3):25-34.
28. Liu C, Feekery C. Can asthma education improve clinical outcomes? An evaluation of a pediatric asthma education program. *J Asthma* 2001;38(3):269-78.
29. Liljas B, Lahdensuo A. Is asthma self-management cost-effective? *Patient Educ Couns* 1997;32(1 suppl):S97-104.

Copyright of *CMAJ: Canadian Medical Association Journal* is the property of *CMA Media Inc.* and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.