

Systematic Review of Randomized Controlled Trials Examining Written Action Plans in Children

What Is the Plan?

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Objectives: To evaluate the independent effect of a written action plan vs no plan and to compare different plans to identify characteristics of effective plans in children with asthma.

Data Sources: We searched the Cochrane Airways Group Clinical Trials Register until March 2006, including MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials, for randomized controlled trials that evaluated asthma action plans in the pediatric population.

Study Selection: Eligible studies were randomized or quasi-randomized controlled trials with participants aged 0 to 17 years diagnosed with asthma. Of 428 citations, 1 trial compared a peak flow-based plan with none and 4 parallel-group trials compared symptom-based plans with peak flow-based plans.

Intervention: Provision of a written action plan. Control groups received no action plan or another type of

plan. All cointerventions (both medical and educational) were similar in both groups.

Main Outcome Measure: The number of children with at least 1 acute care asthma visit.

Results: Written action plan use significantly reduced acute care visits per child as compared with control subjects. Children using plans also missed less school, had less nocturnal awakening, and had improved symptom scores. As compared with peak flow-based plans, symptom-based plans significantly reduced the risk of a patient requiring an acute care visit.

Conclusions: Although there are limited data to firmly conclude that provision of an action plan is superior to none, there is clear evidence suggesting that symptom-based plans are superior to peak flow-based plans in children and adolescents.

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NATIONAL AND INTERNATIONAL asthma guidelines universally recommend asthma education for all affected patients, including the provision of a set of written instructions, termed *written action plans*, to guide prevention and home management of symptoms and exacerbations.¹⁻⁵ However, there are no established practice guidelines regarding the ideal format and the critical instructions of an action plan for children. What are the optimal content and format of a pediatric written action plan? What is the best approach to recognize deteriorations—should monitoring be peak flow based as recommended by the Canadian,⁵ British,⁴ and American² guidelines or symptom based as recommended by the Australian³ guidelines?

Although asthma education undoubtedly improves outcomes in adults⁶ and chil-

dren,⁷ research has been unable to dissociate the independent effect of the provision of a written action plan from that of asthma education in children.⁸ A Cochrane review of written asthma action plan efficacy in children and adults by Toelle and Ram⁹ including 1 pediatric¹⁰ and 6 adult trials concluded that there was no consistent evidence that written action plans produced better patient outcomes than no action plan or that one type of action plan was consistently more effective than another. In a 2002 systematic review of 1410 adults and 91 children with asthma, Lefevre et al⁸ found no evidence to support the independent effectiveness of a written action plan as an essential component of a self-management plan; they concluded that until there is such confirmation, the provision of a written action plan may be an inadequate use of time and resources. Therefore, should we be advocating the use of self-management plans in children at all?

With the recent publication of several pediatric randomized controlled trials examining the efficacy of written asthma action plans, we believe that a systematic review may clarify 2 issues: (1) whether the provision of a written asthma action plan in children and adolescents improves health outcomes independently of other educational interventions, and (2) which characteristics of action plans are associated with the greatest effectiveness. This article is an update of a Cochrane review recently published on the topic.¹¹

METHODS

DESIGN

The design was a systematic review of randomized controlled trials comparing the provision of a written action plan vs no plan or another type of action plan. All cointerventions (both medical and educational) were similar.

TYPES OF OUTCOMES

The primary outcome was the number of children with at least 1 unscheduled acute care visit to the emergency department or general health care practitioner for management of an asthma exacerbation. Secondary outcome measures included the following: (1) measures reflecting the severity of exacerbations (need for systemic steroids and patients requiring hospital admission); (2) measures reflecting chronic asthma control (symptom scores, use of rescue β_2 agonists, pulmonary function tests, quality of life, number of symptomatic days per week, and school absenteeism); (3) parent and patient satisfaction; and (4) rates of adverse effects and withdrawal rates.

LITERATURE SEARCH

We searched the Cochrane Airways Group Clinical Trials Register until March 2006, which includes individual searches of MEDLINE, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials, for randomized controlled trials that evaluated asthma action plans in the pediatric population. We used the following Medical Subject Headings of the National Library of Medicine, full-text, and keyword term: (educat* OR self-manag* OR "self manag*" OR "action plan*" OR action-plan* OR self-care OR "self care" OR self-medicat* OR "self medicat*" OR "management-plan" OR "management plan" OR "management program") AND (child* OR paediat* OR pediat* OR infant* OR toddler* OR bab* OR young* OR school* OR newborn* OR new-born* OR neo-nat* OR neonat* OR parent*) AND asthma*. We checked the bibliographies of all of the included studies and review articles for additional trials.

STUDY SELECTION

Studies were eligible if they met the following criteria: (1) they were randomized or quasi-randomized (group allocation not entirely due to chance; eg, allocation by hospital record number) controlled trials; (2) participants were aged 0 to 17 years (mixed-age populations were included if pediatric subgroup analysis was available); (3) patients had asthma diagnosis based on signs of obstruction and reversibility¹² and, for children younger than 2 years, 3 or more wheezing episodes; (4) the intervention was provision of a written action plan; (5) control groups received no action plan or another type of plan; and (6) all cointerventions (both medical and educational) were simi-

lar in both groups. We defined a written action plan as a written set of instructions given to patients or parents that (1) was intended to stay in their hands until the next visit (thus excluding pharmacy prescriptions); (2) provided instructions for daily treatment and initiation or step-up treatment for acute deterioration; and (3) provided information regarding when to seek urgent medical consultation. This definition expands the description of a written action plan as proposed by the Global Initiative for Asthma by adding the instructions for daily management, a criterion we felt was important because daily anti-inflammatory medications are one of the few interventions clearly proven to be effective for reducing asthma exacerbations in children and adolescents.¹³

IDENTIFICATION OF TRIALS AND DATA EXTRACTION

Two of us (R.L.Z. and S.K.B.) independently screened each citation identified by the search strategy as definitely, possibly, or clearly not meeting inclusion criteria. Full-text articles of each definitely or possibly eligible citation were obtained irrespective of language of publication. The reviewers confirmed eligibility and, if eligible, independently extracted data and evaluated the methods of the article. Any discrepancies were resolved by consensus or involvement of a third reviewer (F.M.D.). Data were entered into the Cochrane Collaboration software program Review Manager version 4.2.3 (Update Software, Oxford, England). We contacted the authors of all of the analyzed studies via e-mail to verify methods and extracted data and to obtain additional data when necessary.

VALIDITY ASSESSMENT

The Physiotherapy Evidence Database scale,¹⁴ scored 1 (present) or 0 (absent) with a best score of 10, recognizes important methodological features (random allocation, concealed allocation, baseline patient similarity, subject blinding, therapist blinding, assessor blinding, outcome measurement, intention-to-treat analysis, between-group statistical comparisons, and variability measurements).¹⁵ The Physiotherapy Evidence Database scale was chosen because while blinding is important, the Physiotherapy Evidence Database scale does not overpenalize studies that are not double blinded owing to the nature of the intervention (ie, educational and physical therapy interventions). Blinding is heavily weighted in the Jadad scale and was deemed not to reflect the methodological rigor of the trials included in this review.

STATISTICAL ANALYSES

All of the trials were combined using RevMan Analysis software version 1.0.2 (Nordic Cochrane Center, Copenhagen, Denmark). Treatment effects for dichotomous outcomes were calculated as pooled relative risk (RR) using the fixed-effects model (or the random-effects model in the event of heterogeneity).¹⁶ The DerSimonian and Laird¹⁷ method was used to test homogeneity of effect sizes between studies. Heterogeneity was assumed at $P < .05$ and $I^2 \geq 25\%$.¹⁸ The weighted mean difference (WMD) was reported for continuous outcomes with the same unit of measure; the standardized mean difference, reported as standard deviation, was used when an outcome was reported in different units. When a study used the same group as comparator twice (eg, a study with 2 intervention arms but only 1 control arm), the number of participants in the group used twice was halved to avoid overrepresentation. For the event rate, the denominator was also halved in the control group. The fail-safe N test was applied to assess the robustness of the re-

sults.¹⁹ Lastly, the number needed to treat was calculated for the primary outcome from the pooled RR using Visual Rx, an online calculator (<http://www.nntonline.net>).²⁰

Several factors that might potentially influence the extent or directionality of the treatment effect were identified a priori: (1) presence or absence of daily anti-inflammatory therapy, (2) recommended severity-based step-up therapy, (3) recognition of deterioration based on symptoms or peak flow (percentage predicted or personal best), (4) plan target interlocutor (parent vs literate child), (5) reading level, (6) action plan format (number of steps and color or graphics), and (7) intensity of monitoring (daily vs only when symptomatic). The residual χ^2 test from the Peto odds ratio was used to examine differences in the magnitude of effect attributable to these subgroups.²¹ Sensitivity analyses were performed to investigate the potential effects of poor methodological quality, publication bias, and funding bias on results. Equivalence was assumed if the point estimates and the 95% confidence limits of the RRs were within 0.10 of the line of no effect.

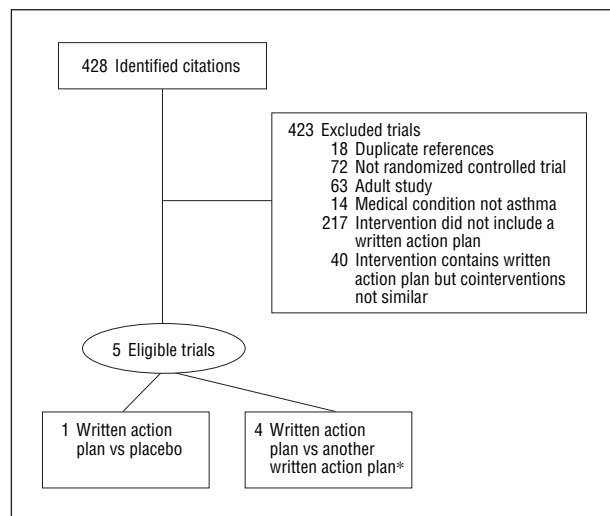


Figure 1. Trials selected for inclusion in review. *One of these trials²⁴ compared a symptom-based plan with 2 different peak flow-based plans. For the purposes of analysis, this yielded a total of 5 distinct comparator arms (or between-group comparisons) examining 2 types of action plan.

The literature search identified 428 citations, of which 423 were excluded, resulting in 5 eligible randomized controlled trials. Four studies aggregating 355 children compared symptom-based action plans with peak flow-based action plans, with all of the other educational cointerventions kept equal.^{10,22-24} One of these trials²⁴ compared a symptom-based plan with 2 different peak flow-based plans. For the purposes of analysis, this yielded a total of 5 distinct comparator arms (or between-group comparisons) examining 2 types of action plan. With regard to testing the efficacy of a written action plan over none, only 1 full-text publication trial involving 68 school-aged children was identified²⁵ (**Figure 1**). **Table 1** summarizes the methodological quality of the included studies, all of which were parallel-group designs.

Far more studies were excluded than were eligible, and the reasons for exclusion of the studies in which the intervention did not include a written action plan were variable (from asthma trigger exposure reduction to asthma knowledge translation interventions). No trials that were not randomized and controlled studied the sole effect of the written asthma action plan.

Trial characteristics are presented in **Table 2**. Patients were school aged with similar sex distribution and had mild to severe asthma. They were recruited from outpatient settings. With the exception of 1 study,²⁴ all of the children received daily preventive medication as part of management. With regard to the format of the action plan, all but 1 trial used 3-step, street sign-colored plans. Charlton et al¹⁰ did not use color and included 4 steps in the peak flow-based plan and 5 steps in the symptom-based plan (**Table 3**). All of the studies targeted both children and parents and only 1 study specified the reading level, which was at the 6th-grade level.²³ The symptom-based plans used similar descriptions to delineate zones (zone 1: being well; zone 2: persistent cough, dyspnea, wheeze, or common cold symptoms; and zone 3: uncontrolled coughing, shortness of breath with regular activity,

Table 1. Methodological Quality of the Included Studies Using the Physiotherapy Evidence Database Scale Score

Methodology	PEDro Scale Score				
	Trial Using Written Plan vs None	Trials Using Symptom-Based vs Peak Flow-Based Plan			
	Agrawal et al, ²⁵ 2005	Charlton et al, ¹⁰ 1990	Letz et al, ²³ 2004	Wensley and Silverman, ²² 2004	Yoos et al, ²⁴ 2002
Random allocation	1	1	0 ^a	1	1
Concealed allocation	1	0	0	0	1
Baseline comparability	1	0	1	1	1
Between-group comparison	1	1	1	1	1
Blinded subject	0	0	0	0	0
Blinded therapist	0	0	0	0	0
Blinded assessor	0	0	0	0	1
Adequacy of follow-up	1	1	0	1	1
Intention-to-treat analysis	0	0	0	0	0
Point estimate and measure of variability	1	1	1	1	1
Total PEDro scale score	6	4	3	5	7

Abbreviation: PEDro, Physiotherapy Evidence Database.

^aQuasi-random allocation of patients based on the last digit of the medical record number.

Table 2. Trial Characteristics

Plan Type and Source	Patient Characteristics						Study Characteristics			
	Patients, No.	Age, y	Male, %	Asthma Severity	Predicted FEV1 or PEF, %	OCS in Prior 12 mo, %	Run-in	Duration, mo	PE德罗 Scale Score	Funding by Peak Flow Producer
Written plan vs none Agrawal et al, ²⁵ 2005	68	5-12	NR	Moderate	76 ^a	NR	NR	3	6	No
Symptom-based vs peak flow-based plan Charlton et al, ¹⁰ 1990 ^b	46	< 16	44	Moderate to severe	NR	50	NR	12	4	No
Letz et al, ²³ 2004	51	Mean, 9.1	64	Mild to severe	78 ^c	74	NR	3	4	No
Wensley and Silverman, ²² 2004	90	7-14	53	Moderate to severe	95 ^c	NR	4 wk	3	5	No
Yoos et al, ²⁴ 2002 ^d	168	Mean, 10.8	59	Mild to severe	89 ^c	NR	3 mo	12	7	No

Abbreviations: FEV1, forced expiratory volume at 1 second; NR, not recorded; OCS, oral corticosteroid; PEDro, Physiotherapy Evidence Database; PEF, peak expiratory flow.

^aValue is expressed as the percentage of predicted PEF.

^bFor the trial by Charlton et al,¹⁰ data are combined among adult and children for sex and for severity.

^cValues are expressed as the predicted FEV1.

^dThe trial by Yoos et al²⁴ is treated as 2 studies in the meta-analysis.

Table 3. Action Plan Format

Plan Type, Source, and Written Action Plan	Total Steps, No.	Zone 1, Green ^a		Zone 1b ^b		Zone 2, Yellow ^a		Zone 2b ^b		Zone 3, Red ^a	
		Recognition, %	Step Instruction	Recognition	Step Instruction	Recognition, %	Step Instruction	Recognition, %	Step Instruction	Recognition, %	Step Instruction
Written Plan vs None											
Agrawal et al, ²⁵ 2005 Peak flow when symptomatic	3	> 80	β2 Agonist as needed and ICS twice daily			50-80	Double ICS			< 50	Call MD and start OCS
Symptom-Based vs Peak Flow-Based Plan											
Charlton et al, ¹⁰ 1990 Peak flow when symptomatic	4 ^b	> 70	β2 Agonist as needed and ICS twice daily			50-70	Double ICS and β2 agonist every 4 h	30-50	Start OCS	< 30	Urgent medical visit
Symptom-based	5 ^b	Feeling normal	β2 Agonist as needed and ICS twice daily	Getting a cold or starting to feel tight	β2 Agonist every 4 h	Night waking with wheezing or persistent cough		< 2 h relief with β2 agonist and SOB with activities		< 30 min relief with β2 agonist or difficulty talking	
Letz et al, ²³ 2004 Daily peak flow	3	80-100	β2 Agonist as needed and ICS twice daily			60-80	Double ICS and β2 agonist every 4 h			< 60	Call MD and/or start OCS
Symptom-based		No symptoms	β2 Agonist as needed and ICS twice daily			Persistent cough, URTI, and SOB				< 2 h relief with β2 agonist, SOB, continuous cough, or difficulty talking	
Wensley and Silverman, ²² 2004 Daily peak flow	3	> 70	β2 Agonist as needed and ICS twice daily			50-70	Double ICS and β2 agonist every 4 h			< 50	Call MD and/or start OCS
Symptom-based		Few symptoms	β2 Agonist as needed and ICS twice daily			NR				Severe symptoms	
Yoos et al, ²⁴ 2002 Daily peak flow	3	> 80	Preventive medications; avoid triggers			50-80	Double ICS and β2 agonist every 4 h			< 50	β2 Agonist now, call MD and/or 9-1-1
Peak flow when symptomatic						Some symptoms				Severe symptoms	
Symptom-based		No symptoms									

Abbreviations: ICS, inhaled corticosteroid; MD, medical doctor; NR, not recorded; OCS, oral corticosteroid; SOB, shortness of breath; URTI, upper respiratory tract infection.

^aAll studies used a street light-colored format except that by Charlton et al.¹⁰

^bThe study by Charlton et al¹⁰ includes an extra zone between zones 1 and 2 for the symptom-based written action plan and a zone between zones 2 and 3 for both written action plans.

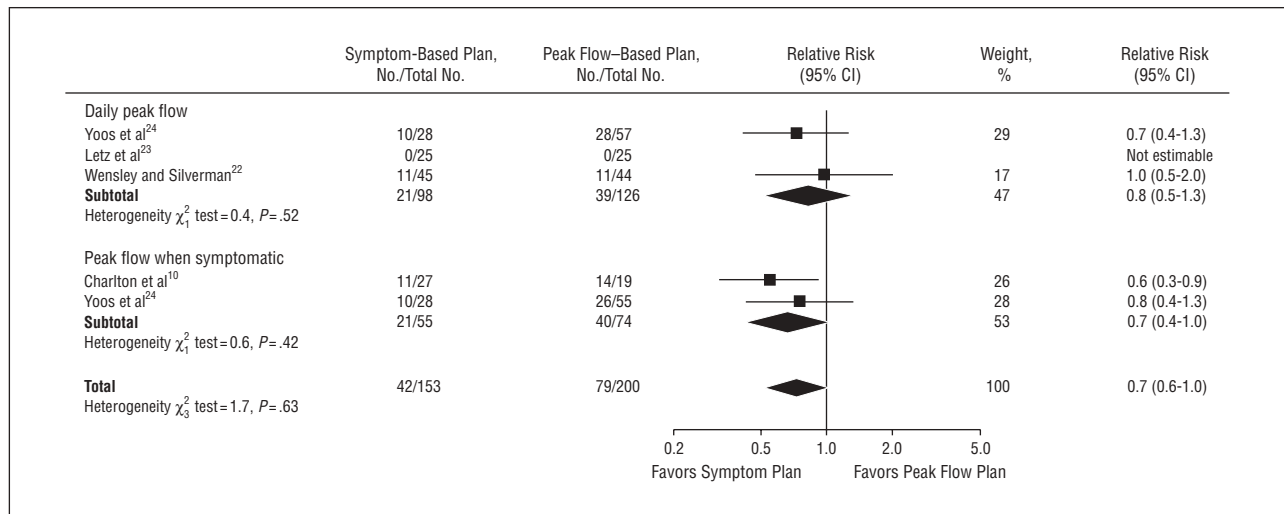


Figure 2. Number of patients with at least 1 acute care visit for asthma. CI indicates confidence interval.

less than 2-hour relief with a bronchodilator, and/or severe symptoms). All of the peak flow-based plans used similar peak flow levels based on personal best values to delineate zones (Table 3). Of interest, the recommended frequency of peak flow monitoring was twice or once daily or only when symptomatic, whereas daily monitoring was advised for symptom-based plans. Action plan instructions were also fairly uniform (step 1: use preventive medication; step 2: initiate β_2 agonist and double-inhaled steroid dose; and step 3: seek urgent medical attention with or without self-initiation of oral steroids).

PRIMARY OUTCOME

Symptom-based plans reduced by 27% the risk of a patient requiring acute care visits as compared with peak flow-based plans ($n=4$ trials; $RR=0.73$; 95% confidence interval [CI], 0.55 to 0.99) (**Figure 2**). The number needed to treat to prevent 1 patient from requiring 1 or more acute care visits was 8 (95% CI, 5 to 14). The fail-safe N test statistic was 1.93, indicating that 2 trials with no group difference would be needed to reverse these findings. Despite the apparent homogeneity of trials, subgroup analyses examined the impact of specific variables on the risk of a patient requiring acute care visits. Subgroup analyses failed to identify significant group differences in the use of daily anti-inflammatory medication ($\chi^2_3=1.73$; $P=.63$), written action plan format (number of steps or color) ($\chi^2_1=1.28$; $P=.26$), or intensity of peak flow monitoring ($\chi^2_1=0.23$; $P=.63$). Because all of the trials were quite homogeneous in recommended step-up therapy, use of personal best values for peak flow interpretation, and target interlocutors (parents and child) and because only 1 trial reported the reading level, subgroup analyses on these variables were not performed. Sensitivity analysis failed to alter the strength of the association when the analysis was restricted to the 2 trials with high methodological quality ($RR=0.74$; 95% CI, 0.50 to 1.11). With all of the studies published and none funded by producers of peak flows, sensitivity analyses examining publication bias and funding bias were irrelevant.

With only 1 study²⁵ comparing the effect of a written asthma action plan against none, we could not perform a meta-analysis. This study of 68 children with moderate persistent asthma concluded that the use of a peak flow-based written action plan significantly reduced the mean number of acute care events per child as compared with control subjects (WMD, -0.50 ; 95% CI, -0.83 to -0.17).

SECONDARY OUTCOMES

There was no group difference in the number of patients requiring rescue oral steroids (RR, 0.40; 95% CI, 0.05 to 3.40) or number of patients requiring hospital admission (RR, 1.51; 95% CI, 0.35 to 6.65). More children intended to continue to use symptom-based strategies over peak flow-based self-management plans (RR, 1.21; 95% CI, 1.00 to 1.46); however, there was no apparent parental preference for intended continued use (RR, 0.96; 95% CI, 0.87 to 1.07). Although children assigned to peak flow plans had an additional half-day reduction in the number of symptomatic days per week (WMD, 0.45; 95% CI, 0.04 to 0.25), there was no group difference in other secondary outcomes, namely school absenteeism, lung function, symptom scores, quality of life, and withdrawals.

The 1 study comparing a peak flow-based plan with none reported significant reductions in the mean difference of school days missed (WMD, -1.03 ; 95% CI, -1.85 to -0.21 ; $P=.02$), nocturnal awakenings (WMD, -1.50 ; 95% CI, -2.13 to -0.87 ; $P=.001$), and symptom score (WMD, -11.80 ; 95% CI, -18.22 to -5.38 ; $P<.001$).

COMMENT

This systematic review identified 1 pediatric trial comparing the provision of 1 peak flow-based plan with a control group and 4 trials comparing the provision of symptom-based written asthma action plans with peak flow-based action plans in children, with all other cointerventions being similar. The provision of a written ac-

tion plan reduced the mean number of acute care visits, school absenteeism, nocturnal awakenings, and symptoms in the only published trial on the topic. Symptom-based action plans significantly reduced the risk of patients requiring 1 or more acute care visits as compared with peak flow–based plans, with only 8 as the number needed to treat to prevent 1 acute care visit. Furthermore, children preferred using symptom-based plans over peak flow–based action plans as supported by their intention to continue such monitoring. However, children assigned to peak flow plans experienced an additional half-day reduction in the number of symptomatic days per week. Owing to the small number of published trials, we were unable to identify characteristics of action plans associated with greater protection. The evidence supports the provision of written action plans, preferably based on symptoms rather than peak flows for recognizing deterioration, for managing asthma in school-aged children.

To our knowledge, this is the first review to examine the effectiveness of written action plans with all cointerventions similar in the pediatric population. Gibson et al²⁶ had concluded that written action plans associated with asthma education and regular medical review clearly reduced asthma morbidity in adults. In a reanalysis of these data, it appeared that successful plans could be either symptom or peak-expiratory flow based and were generally associated with instructions to increase the dose of inhaled steroids and/or add oral steroids.⁶ However, it was unclear whether the benefit was truly attributable to the written action plan per se or to cointerventions. A subsequent review by Toelle and Ram⁹ that aimed to isolate the benefit of written action plans concluded that the data were too small and inconsistent to determine the benefit of a written action plan within an educational program; their data included 6 adult trials and 1 trial with mixed adult and pediatric populations.¹⁰ Our study, focused on children, suggests that written action plans confer inherent benefit to the patient above and beyond asthma education and regular medical review. It also confirms that in contrast to plans for adults⁶ in which equivalence of symptom- and peak-based plans has been found, plans for children based on symptoms are more effective than those based on peak flow. The latter does not seem attributable to the instructions for maintenance or step-up therapy, which were quite uniform across trials.

This review is the first to include a study²⁵ comparing a written asthma action plan against a control group in a pediatric population with all cointerventions being similar. This peak flow monitoring–based study concluded that written action plans improve overall asthma control by reducing acute asthma events, school days missed, nocturnal awakenings, and symptom score. Clearly, more evidence is desperately needed to support the use of a written action plan as an essential intervention, alone or in combination with education, to improve compliance and reduce asthma morbidity.

Why would symptom-based action plans appear to be superior to peak flow–based action plans? Greater compliance with the monitoring strategy is certainly 1 possible explanation; this is supported by a greater proportion of children in the symptom-based group than in the

peak flow group intending to continue using their plan after the end of the trial. Indeed, participation of both the parent and child are required for optimal application; a simpler plan without needing cooperation with peak flow monitoring might lead to better compliance with daily preventive medication and step-up treatment. The apparent superiority of symptom-based plans may also be due to some incongruity between zone definitions. Deteriorations may be identified earlier with symptoms than with peak flow values, allowing for earlier intervention. Conversely, we cannot rule out that peak flow values may identify severe deterioration earlier than symptoms, thus leading to earlier emergency visits in peak flow groups. This hypothesis might explain why more patients using peak flow–based plans required acute care visits despite apparently better symptom control (greater reduction of daily symptoms per week). It is important, however, to consider the outcome of daily symptom reduction in the context that this finding is based on only a single trial's results. The arbitrariness of peak flow cut-offs is compounded by inaccuracies of peak flow values in younger children²⁷ and in children with moderate to severe airflow obstruction.²⁸ In fact, several consensus groups have expressed concerns regarding overmedicating or undermedicating children based on inaccurate peak flow readings.³

It is unclear why the group with peak flow–based plans would experience better symptom control by half of a day per week and yet visit acute care settings more often. One may wonder whether this is an artifact caused by twice-daily peak flow monitoring as compared with the once-daily monitoring of symptoms. There were no significant differences between the 2 action plans for any other outcomes, namely systemic steroid use, hospital admissions, school absenteeism, lung function, symptom scores, quality of life, and withdrawals, probably due in part to insufficient power. The small number of trials prevents any firm conclusion regarding equivalence of the 2 plans with regard to these outcomes. With no adverse effects and a low dropout range of 0% to 8%, both types of action plan appear to be acceptable to both children and parents.

This review is strengthened by the fact that all of the included studies are randomized or quasi-randomized controlled trials with fair to good methodological scores, thus minimizing bias. Acknowledging a lack of statistical power, we found no evidence of publication bias. Furthermore, we confirmed data and obtained additional unpublished data by contacting the primary authors of all of the analyzed studies.

These findings should be interpreted in the context of the following limitations. First, with only 1 published randomized controlled trial, no firm conclusion can be made regarding the independent effect of an action plan compared with none; this trial supports but does not firmly confirm the provision of a written action plan in children with asthma as an effective part of asthma education and regular medical review. Second, the small number of trials limited detection of possible differences in secondary outcomes and restricted the conduct of subgroup analyses to identify characteristics associated with greater effectiveness. Third, these results cannot be gen-

eralized to preschool-aged children because this population was not examined in the included studies and peak flow monitoring is difficult in this age group. Fourth, the absence of blinding, inherent to this type of intervention, remains an important issue, leading to fair to good method scores of included studies. Fifth, compliance with monitoring, action plan activation, and medication use was not measured. We would strongly recommend that future studies monitor these aspects to identify usefulness and to attribute efficacy. Lastly, only 2 new trials showing no group difference would change the conclusion; clearly, given the paucity of pediatric trials, we need additional studies to confirm these findings.

CONCLUSIONS

There are limited data to firmly conclude that provision of a written action plan as compared with none reduces acute care visits and symptoms. However, there is clear evidence that symptom-based action plans are superior to peak flow-based action plans in children and adolescents in the context of asthma education and regular medical review.

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Author Contributions: Dr Zemek and Bhogal had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Zemek, Bhogal, and Ducharme. *Acquisition of data:* Zemek, Bhogal, and Ducharme. *Analysis and interpretation of data:* Zemek, Bhogal, and Ducharme. *Drafting of the manuscript:* Zemek and Ducharme. *Critical revision of the manuscript for important intellectual content:* Zemek, Bhogal, and Ducharme. *Statistical analysis:* Bhogal and Ducharme. *Administrative, technical, and material support:* Ducharme. *Study supervision:* Ducharme.

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