Written action plans for asthma: an evidence-based review of the key components

P G Gibson, H Powell

**Background:** Written action plans for asthma facilitate the early detection and treatment of an asthma exacerbation. Several versions of action plans have been published but the key components have not been determined. A study was undertaken to determine the impact of individual components of written action plans on asthma health outcomes.

**Methods:** Randomised controlled trials (n = 26) that evaluated asthma action plans as part of asthma self-management education were identified. Action plans were classified as being individualised and complete if they specified when and how to increase treatment (n = 17), and as incomplete (n = 4) or non-specific (n = 5) if they did not include these instructions.

**Results:** For individualised complete written action plans the use of 2–4 action points and the use of both inhaled (ICS) and oral (OCS) corticosteroid consistently improved asthma outcomes. Action plans based on personal best peak expiratory flow (PEF) consistently improved health outcomes while those based on percentage predicted PEF did not. The efficacy of incomplete action plans was inconclusive because of insufficient data. Non-specific action plans led to improvements in knowledge and symptoms.

**Conclusion:** Individualised written action plans based on personal best PEF, using 2–4 action points, and recommending both ICS and OCS for treatment of exacerbations consistently improve asthma health outcomes. Other variations appear less beneficial or require further study. These observations provide a guide to the types of variations possible with written action plans, and strongly support the use of individualised complete written action plans.

**Exacerbations of asthma usually occur gradually over several days to weeks or on a background of chronic poor asthma control.** This provides an opportunity for early intervention with corticosteroids and β agonists which act to reverse airflow obstruction and reduce the severity of the exacerbation. A written action plan facilitates the early detection and treatment of an exacerbation and is therefore an essential part of the self-management of exacerbations.

Asthma is characterised by episodes of expiratory airflow obstruction which occur in response to multiple stimuli. The frequency and severity of these episodes varies greatly, both between and within individuals. Since all individuals with asthma are susceptible to exacerbations of asthma, it follows that all those with diagnosed asthma need to know how to manage these episodes. This instruction in self-management can be formalised as a written action plan, and all asthmatics are candidates for such a plan. This contrasts with the need for inhaled anti-inflammatory therapy which only becomes necessary when the frequency and/or severity of exacerbations are sufficiently great. At present, however, there is a paradoxical situation where most patients are prescribed regular inhaled corticosteroids (ICS) yet only a few either have or use a written action plan.

A recent systematic review of asthma self-management education conducted in adults identified 17 randomised controlled trials (RCTs) which evaluated written action plans compared with usual care. When a patient was provided with a written action plan and instructed in its use in the context of self-monitoring and a review of asthma medications and severity, there were highly significant improvements in asthma health outcomes. The risk of being admitted to hospital for asthma fell by over 40% and presentations to the emergency department with asthma fell by over 20% (relative risk (RR) 0.78, 95% CI 0.67 to 0.91). Since action plans are highly effective when part of a planned self-management programme and many versions are available, it is reasonable to try to determine the key components of asthma action plans that make a difference to subjects with asthma. This study addresses this question.
Action point
Action plans prescribe a level of symptoms or lung function that determines when to activate the action plan. This is termed an action point. There are several variations in action points. Action points may be based on symptoms or peak expiratory flow (PEF). PEF based action points may be based on predicted or personal best PEF. The number of action points in any written action plan can also vary, generally between two and four different levels.

Literature search
To determine the impact of the individual components of written action plans on asthma health outcomes, RCTs that evaluated asthma action plans were identified. An initial broad search was conducted for RCTs on asthma education as part of a wider systematic review of asthma self-management education. Studies were identified from the Cochrane Airways Group Clinical Trials Register which is derived from Medline, Embase, Cinahl, hand searched respiratory journals, and meeting abstracts. Bibliographies of included studies were also searched. These articles were examined to identify those that included asthma action plans as part of the intervention. The asthma action plans were classified using the criteria described above.

Analysis of data
Data were extracted independently by two reviewers. The relative risk (RR) with 95% confidence intervals (CI) was calculated for dichotomous outcomes. The RR is the probability of experiencing an outcome when treated compared with the probability of experiencing that outcome if untreated, with values of <1 indicating a favourable treatment effect. For continuous outcomes using different units of measure, a standardised mean difference (SMD) and 95% CI was calculated using a fixed effects model. Significance was accepted at \( p < 0.05 \). The pooled results were tested for heterogeneity using a \( \chi^2 \) test with appropriate degrees of freedom. All outcomes were analysed according to the variations of the action plan and compared with a usual care control group. The variations analysed were: number of action points, personal best or percentage predicted PEF, “traffic light” action plan, or use of ICS or oral corticosteroids (OCS) alone.

RESULTS
Twenty six RCTs comparing action plans with usual care were identified (table 1), 17 of which used individualised complete written action plans. In 15 trials education, self-monitoring and regular medical review as well as provision of written action plans were incorporated into the self-management programmes. Four trials used incomplete individualised action plans and five used non-specific action plans.

Individualised complete written action plans
Action points
Full details of the individual action points for the written action plans are shown in table 2. The number and level of action points for when to increase treatment varied, but each trial gave some instruction on increasing treatment. Fifteen trials set their first action points at 70–85% of the personal best or predicted PEF value. Action plans that used a personal best PEF were used in nine trials and six used percentage predicted PEF (table S1, figs 1–4 available online at www.thoraxjnl.com). When compared with usual care in a meta-analysis (five and four trials respectively), both types of action plan reduced hospital admissions (RR 0.78 for personal best and 0.46 for percentage predicted; fig 1), whereas only the action plan based on personal best PEF reduced emergency room visits (RR 0.78; fig S2). Similarly, only the personal best written action plan led to improvement in airway calibre (SMD: PEF 0.56; fig 2).

The number of action points provided in the individualised plans ranged from two to four. Eight studies used written action plans with four action points (six that could be used in a meta-analysis), whereas seven studies used written action plans with less than four action points (three that could be used in a meta-analysis). The use of two or three action points was consistently beneficial (figs 1 and 2; also table S2 and figs S5–S7 available online only at www.thoraxjnl.com). As was the use of four action points.

Action points were presented as a “traffic light” system in four trials, this was not consistently better than a conventional action plan presentation (fig 3; also table S3 and figs S8–S10 available online only at www.thoraxjnl.com). The action plans were based on PEF in 10 trials and on either PEF or symptoms in six trials. This was not consistently better than a conventional action plan presentation (fig 3; also table S3 and figs S8–S10 available online only at www.thoraxjnl.com). No comparison could be made with the use of OCS alone (four studies) because of insufficient data. No studies used action plans based on ICS alone.

Incomplete/non-specific plans
The efficacy of incomplete action plans was inconclusive as there were too few studies reporting data that could be used in a meta-analysis. Non-specific action plans led to an improvement in knowledge, symptoms, and reduced healthcare use in some but not other studies. Incomplete data reporting precluded meta-analysis.

DISCUSSION
This study has identified the key components of asthma action plans and examined the variations possible in preparing these plans. By using meta-analyses of data from RCTs, we have compared the different variations for their effect on key asthma outcomes such as hospital admissions, emergency room visits, and lung function. The results (table 3) give clear recommendations for preparing action plans and highlight areas needing further research.

Predicted or personal best PEF action plans
Individualised action plans can be based upon the predicted PEF or the personal best PEF for that individual. Action points based on personal best PEF consistently improved health outcomes, whereas those based on percentage predicted PEF did not. With personal best PEF as the basis of the action plan, there were reductions in hospital admissions, emergency room visits, and improvement in PEF. This suggests that action points based on personal best PEF may perform better than those based on percentage predicted PEF. The likely reasons for this difference relate to individual variability in PEF results. However, significant differences between percentage predicted and personal best PEF could not be determined because of an overlap of the confidence intervals.
Initial versions of written action plans recommended that the same level of PEF should be applied to all patients in order to indicate when to increase treatment. This was expressed as either percentage predicted or percentage personal best PEF. This commonly was set at 80% or 60% of the predicted peak flow value. Such a level would be

Table 1  Characteristics of written action plans

<table>
<thead>
<tr>
<th>Study</th>
<th>Individualised written action plans</th>
<th>When to increase treatment</th>
<th>How to increase treatment</th>
<th>How long to increase treatment</th>
<th>When to get help</th>
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<tr>
<td>Cote et al.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Cowie et al.</td>
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<td>Gallefoss et al.</td>
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<td>Yes</td>
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<td>Yes</td>
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<tr>
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<td>Heard et al.</td>
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<td>Jones et al.</td>
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Incomplete action plans

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Non-specific action plans

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<td>Abdulladul et al.</td>
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<td>Kotes et al.</td>
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<td>Mulley et al.</td>
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</table>

NS = not stated.
*Written action plan based on Beasley et al.*
†Written action plan based on Charlton.
‡Treatment based on British Thoracic Society guidelines.
§Based on Woolcock.
**Personal best PEF.
††Predicted PEF.

Table 2  Details of individual written action plans

<table>
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<tr>
<th>Study</th>
<th>When to increase treatment</th>
<th>How to increase treatment</th>
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<tbody>
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<td>85**</td>
<td>PEF/symptom</td>
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<td>70**</td>
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<td>80**</td>
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<td>Moudgil et al.</td>
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<td>Parner et al.</td>
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<td>Yoon et al.</td>
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<td>Zeiger et al.</td>
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<td>PEF/symptom</td>
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</table>

NS = not stated; PEF = peak expiratory flow; ICS = inhaled corticosteroids; OCS = oral corticosteroids.
*Based on Beasley et al.*
†Based on Charlton.
‡Based on Woolcock.
§Based on BTS.
**Personal best PEF.
††Predicted PEF.
Comparison of the effects of action plan components on hospital admissions for asthma. WAP = written action plan; PEF = peak expiratory flow; ICS = inhaled corticosteroids; OCS = oral corticosteroids.

**Number of action points**

Action plans can use a variable number of action points. The studies in this review used two, three, or four action points. Action plans with four action points were not consistently better than action plans with two or three action points (table S2 available online at www.thoraxjnl.com/supplemental). Using a greater number of action points leads to a narrower range of peak flow in each of the zones which may not be feasible to use in practice. These results argue in favour of a simpler approach using two or three action points. It may be that the improved precision obtained by using four action points is offset by the greater complexity of these plans which limits patient understanding and acceptance.

**Symptoms versus peak flow based action plan**

Written self-management plans can use action points that are based on either symptoms, peak flow, or both. Several RCTs have compared these approaches and found them to be equivalent for both the number of people admitted to hospital for asthma (RR 1.17, 95% CI 0.44 to 3.12) and those attending the emergency department (RR 0.91, 95% CI 0.61 to 1.35).

**Presentation of written action plan**

A number of different ways of presenting action plans have been developed to facilitate their use. These include placing written self-management guidelines on a plastic card the size of a credit card, using electronic diaries or computerised “expert” systems, or the “traffic light” system where the colours green, yellow and red are used to signal continue usual treatment (green), increase treatment (yellow), or to seek help urgently (red). RCTs were identified that examined the “traffic light” approach. Individual written action plans without a “traffic light” action plan showed consistent benefits. There were fewer studies using a “traffic light” action plan configuration. Some outcomes were beneficial whereas others were not. This probably represents a lack of power rather than a lack of efficacy (table S3 available online at www.thoraxjnl.com/supplemental).

**Treatment instruction: how to increase treatment**

An exacerbation of asthma consists of a deterioration in both airflow obstruction and airway inflammation. It is therefore appropriate to recommend treatment with both bronchodilators and corticosteroids. A meta-analysis has confirmed the strong beneficial effect of OCS in severe exacerbations of asthma. The optimal treatment of mild exacerbations of asthma (forced expiratory volume in 1 second >60% predicted) is less clear. Current management practices include increased β2 agonists, ICS, and OCS. A recent randomised trial conducted in a primary care setting compared fluticasone 1 mg twice daily with prednisone (40 mg daily and reducing). Treatment of a mild exacerbation with ICS had a comparable success rate to the use of ingested prednisone (48% v 48%). There was a surprisingly high rate of treatment failure in both groups (27% and 23%, respectively). This failure rate may reflect inadequate doses, inadequate duration of treatment, or non-cosinophilic exacerbations. Doubling ICS was found to be less effective than OCS in another trial. The studies in this review support a combined approach where both ICS and OCS are used in the action plan.

**Limitations**

This review has used data derived from RCTs of asthma self-management programmes where written action plans were a key component. There are a number of limitations that need to be considered when reviewing these data. In some cases there were insufficient studies to allow a comparison and hence a type II error is possible. Where this is the case—for example, in the comparison of OCS with ICS and OCS—we
have been cautious in our interpretation of the data, reported the number of studies contributing to the meta-analysis, and only reported on outcomes where several studies contributed data. There are likely to be differences in the way the different self-management programmes were implemented. This does not seem to have a major impact on the results since there was no statistical heterogeneity identified in the key results.

Conclusion
The provision of individualised written action plans is of benefit to patients with asthma. Effective plans can be based on symptoms or PEF and use two, three or four action points. PEF-based plans should use personal best predicted PEF or use of ICS alone or OCS alone. For these variations were based on a traffic light system, the number of action points, or use of ICS only or OCS alone. With the data available, there is no statistical heterogeneity identified in the key results.

Acknowledgments
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References
LUNG ALERT

No clear benefit of parent initiated oral steroids in preschool children with viral wheeze

Asthma in children aged 1–5 years is characterised by recurrent transient episodes of wheeze triggered by viral infections. This is labelled “preschool viral wheeze” and is commonly treated with inhaled bronchodilators and oral corticosteroids. Persistent wheeze is associated with increased systemic eosinophil priming which is thought to be a risk factor for the development of atopic asthma.

In this randomised placebo controlled trial, children aged 1–5 years with known viral wheeze were stratified into either high or low eosinophil priming groups and parents administered 20 mg prednisolone or placebo for 5 days at the start of the next episode of viral wheeze. The primary outcomes were 7 day mean daytime and night time symptom scores.

217 children were randomised and outcome data were available for 51 and 69 children who received prednisolone or placebo, respectively. There was no improvement in daytime and night time symptom scores and no reduction in salbutamol use and hospital admissions in children treated with prednisolone compared with placebo. There were no differences between high or low eosinophil priming groups.

This study suggests no clear benefit of parent initiated oral prednisolone for preschool viral wheeze.

S S Birring
Specialist Registrar, Institute for Lung Health,
Department of Respiratory Medicine, Glenfield Hospital, Leicester, UK;
sb134@le.ac.uk

References