

# A randomised controlled trial of clinics in secondary schools for adolescents with asthma

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## SUMMARY

**Aim:** To compare a nurse-led clinic in schools versus care in general practice for adolescents with asthma.

**Design of study:** Randomised controlled trial in four schools; parallel observational study in two schools.

**Setting:** Six comprehensive schools.

**Method:** In the randomised trial, pupils were invited to attend asthma review at a nurse-led clinic either in school, or in general practice. The parallel observational study compared pupils invited to practice care within and outside the randomised trial. Primary outcome measures were attendance for asthma review, symptom control, and quality of life. Secondary outcomes were knowledge, attitudes, inhaler technique, use of steroids, school absence, peak flow rate, preference for future care, health service utilisation, and costs.

**Results:** School clinic pupils were more likely to attend an asthma review than those randomised to practice care (90.8% versus 51.0% overall [ $P < 0.001$ , not consistent across schools]). No differences were observed in symptom control ( $P = 0.42$ ) or quality of life ( $P = 0.63$ ). Pupils attending school clinics had greater knowledge of asthma (difference = +0.38, 95% CI = 0.19 to 0.56), more positive attitudes (difference = +0.21, 95% CI = 0.05 to 0.36), and better inhaler technique ( $P < 0.001$ , not consistent across all schools). No differences were observed in school absence or peak flow rate. A majority (63%) of those who had received care at school preferred this model in future. Median costs of providing care at school and at the practice were £32.10 and £19.80, respectively. No differences were observed between the groups in the observational comparison on any outcome.

**Conclusions:** The schools asthma clinic increased uptake of asthma reviews. There were improvements in various process measures, but not in clinical outcomes.

**Keywords:** asthma; family practice; education; adolescence.

## Introduction

THERE is increasing recognition of the need to improve health care for adolescents.<sup>1,2</sup> The most common disease of adolescence is asthma,<sup>3,4</sup> which causes considerable morbidity and affects quality of life, particularly the ability to participate in physical activities.<sup>5-7</sup> Asthma leads to more days lost from school than any other condition.<sup>8,9</sup>

Although nurses in general practice now conduct most asthma care, adolescents attend relatively infrequently, leading to the need to consider other models of care. In recent years, there has been an increased awareness of the potential for schools as a setting for health promotion.<sup>10-13</sup> Schools provide a structured environment in which adolescents can easily seek advice tailored to their needs. Various initiatives to improve asthma care via schools have developed in a number of areas in England,<sup>14-16</sup> but evidence for the effectiveness of this approach has been lacking. This research is designed to test the hypothesis that delivery of a programme of asthma care via nurse-led clinics in schools will improve access to care and health outcomes for adolescents, compared with conventional care in general practice.

## Method

We conducted a randomised controlled trial of a nurse-run asthma clinic in four secondary schools. Pupils at these schools were individually randomised to receive an invitation for a review of their asthma, at school (school clinic group) or in general practice (practice care group). Because of the possible contaminating effect of the clinic on those pupils not invited to it, we also conducted a parallel observational comparison between pupils in the practice care group of the randomised trial and pupils in two control schools (control school group). Ethical committee approval was obtained from Southmead Medical Research Ethics Committee.

## Setting

Six comprehensive schools in Bristol, North Somerset and South Gloucestershire were recruited. The schools covered rural, urban, and suburban areas, and were representative of schools nationally in terms of indices of social deprivation and educational achievement. Schools were stratified by deprivation (the proportion of children entitled to free school meals), and two 'trial' schools plus one 'control' school were randomly selected from each of two strata.

## Patients

Adolescents with asthma were identified based on a brief

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Submitted: 28 September 2001; Editor's response: 3 December 2001; final acceptance: 11 March 2002.

©British Journal of General Practice, 2002, 52, 988-996.

**HOW THIS FITS IN***What do we know?*

Asthma is the most common disease of adolescence, causing considerable morbidity, but is undertreated. There is a need to improve the delivery of health care to adolescents and partnership between schools and general practice may be a way to do this.

*What does this paper add?*

By running a nurse-led asthma clinic in schools, a high proportion of adolescents with asthma received advice, leading to improvements in the process of care. This did not lead to any detectable improvements in symptoms or quality of life.

screening questionnaire (based on the International Study of Asthma and Allergies in Childhood questionnaire)<sup>5</sup> administered at school to all pupils in years seven to 11, cross-referenced with computerised prescribing records from local general practices. Those pupils who answered positively to at least one of the screening questions and had also been prescribed treatment for asthma in the previous two years were eligible for inclusion.

**Intervention**

A nurse-run asthma clinic ran weekly in each of the four 'trial' schools during the academic year 1999–2000. The four nurses involved all had experience as school nurses and had undertaken specialist asthma training. Adolescents randomised to be invited for a review of their asthma at school (school clinic group) were sent an appointment and a reminder postcard. The care provided was similar to that offered at a nurse-led asthma clinic in general practice, but the discussion was specifically targeted at the needs and interests of adolescents. Details of each consultation were sent to the adolescent's general practitioner (GP).

Any modification to doses of existing treatment was made following national guidelines,<sup>17</sup> in line with a written clinic protocol. Normal follow-up at the school asthma clinic was at one month and six months after initial assessment. Pupils who needed a change of treatment or who had poor symptom control had a further follow-up at three months.

Pupils in the trial randomised to receive normal care in general practice (practice care group) and all pupils in the control schools (control group) were invited by their practice to attend for asthma review. This may have been provided by a practice nurse or a doctor, and in a designated asthma clinic or routine surgery, according to the practice's normal procedure.

**Assignment**

Block randomisation, stratified by school, was used to allocate pupils in the four trial schools to receive invitations to the school asthma clinic, or to continue normal care. Pupils at the two control schools all continued normal care. Randomisation was carried out independently of the clinical team involved in providing care, by statisticians at North Bristol NHS Trust using a computer random number generator.

**Outcomes**

Primary outcomes were the proportion of patients who had a review consultation for asthma in six months, health-related quality of life (assessed using the Paediatric Quality of Life questionnaire, standardised UK version, PAQLQ(S)),<sup>18</sup> and level of symptoms.<sup>19</sup> Secondary outcomes were patient knowledge and attitudes with regard to asthma (based on a quiz, which was tested for validity, reliability, and sensitivity to change), inhaler technique, the proportion of patients taking inhaled steroids every day, school absence owing to asthma, peak flow rate, and patient preference for the setting for care. Process measures included use of a peak flow meter or a written self-management plan and health service utilisation. Economic outcomes were the total cost of different models of asthma care, taking into account consultations in school, practice or hospital,<sup>20</sup> and the costs of drug treatment.<sup>21</sup>

At baseline, adolescents completed a questionnaire about symptoms,<sup>19</sup> current medication, and consultations about asthma in the previous six months. Outcomes were then assessed at six months by questionnaire, interview, and review of general practice records.

Outcomes were assessed blind to allocation group (except in the control schools, where all pupils had received practice care). The nurses were sent to different schools so that they conducted outcome assessments in schools where they had not provided asthma clinics.

Because of examinations, school holidays and non-attendance by pupils, outcome assessment could not always occur at six months. Reviews that took place less than four months or more than nine months after initial assessment were excluded from the analysis, as were pupils who failed to return a baseline questionnaire.

**Sample size**

Sample size calculations were based on an improvement in the proportion of adolescents receiving an asthma review from 40% (based on a pilot study in three general practices) to 60%, and an improvement of half a standard deviation in the quality-of-life measure.<sup>22</sup> We needed 97 and 63 adolescents, respectively, for these outcomes in each arm of the study, to have 80% power to detect these differences at a 5% significance level (two-sided test).

**Analysis**

Analysis was conducted on an 'intention-to-treat' basis. Comparisons between the two arms of the randomised trial were adjusted for school and baseline data (where recorded). School by treatment interactions (odds ratios that were calculated separately for each school) were examined and were retained, if statistically significant at the 5% level. Logistic regression, ordinal regression, and analysis of (co)variance were used, as appropriate. Where necessary, outcomes were transformed prior to analysis. All regression models were assessed for goodness of fit.

All observational comparisons (practice care versus control group) were stratified by school and adjusted for age, sex, and baseline data (where recorded). Resource use was measured and valued from the perspective of costs to the

NHS. Resource use data were collected from clinic records, general practice records, and follow-up questionnaires.

## Results

### Response rates

Seven hundred and ninety pupils identified with asthma were approached to take part in the study. Figure 1 shows the numbers of participants recruited and followed up. Consent was obtained from 455 pupils (57.6%). Differences between those agreeing and refusing to take part were explored by comparing their scores on questions in the brief screening questionnaire. This showed that non-participants were significantly less likely to express symptoms of asthma, to agree they had asthma and to have or use an inhaler. Overall, 84% (382/455) of pupils were followed up, although not all pupils completed all measures. Follow-up rates varied

significantly between groups (76% school clinic; 89% practice care; 91% control group,  $P < 0.001$ ).

### Characteristics of responders

The characteristics of patients in each group were comparable at baseline (Table 1). Since the symptom questionnaire comprised ten questions, each scored from one (never experienced the symptom) to five (experiencing the symptom every day); a median symptom score of 19 indicates a low level of morbidity at baseline.

### Primary outcomes

**Attendance for asthma review.** Of the 156 pupils randomised to the school asthma clinic, 138 (88.5%) attended at least once. More pupils in the school clinic group attended a review, compared with those randomised to practice care

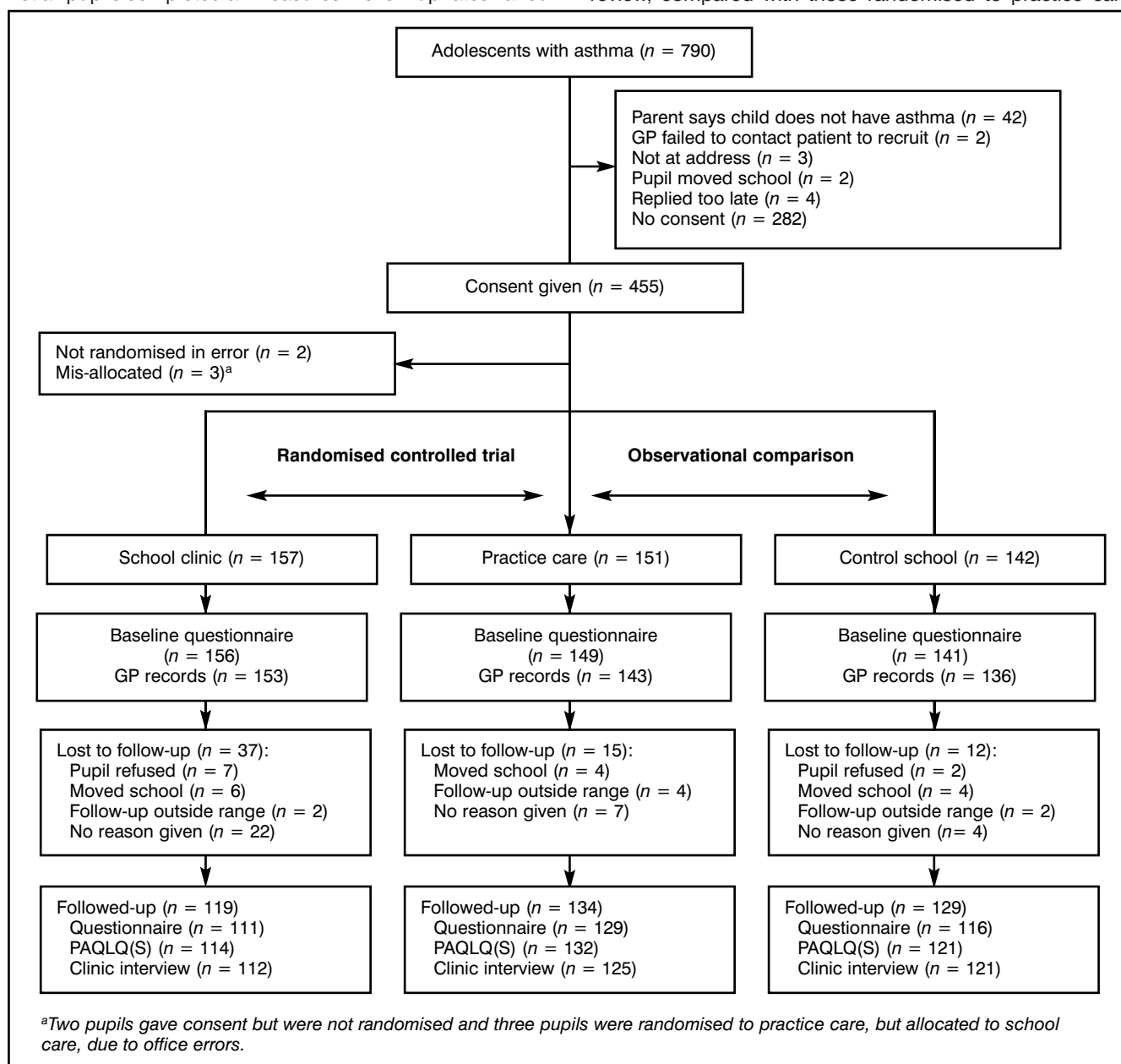


Figure 1. Flow of patients through trial.

( $P < 0.001$ ). Odds ratios (ORs) varied significantly ( $P = 0.006$ ) between schools (Table 2).

**Symptoms and quality of life.** There was no significant difference between the two arms of the randomised trial in symptoms ( $P = 0.42$ ) or quality of life ( $P = 0.63$ ).

**Observational comparison.** There were no significant differences between the practice care group and the control group in the proportion of pupils attending an asthma review ( $P = 0.17$ ), symptom score ( $P = 0.37$ ) or quality of life ( $P = 0.78$ ).

### Secondary outcomes

Secondary outcomes for the randomised trial are shown in Table 3. In the observational comparison, no significant differences between any of the secondary outcomes were found. Knowledge and attitude scores were significantly higher for pupils in the school clinic group, compared with the practice care group in the randomised trial ( $P = 0.001$  and  $P = 0.007$ , respectively).

Pupils in the school clinic group had higher inhaler technique scores compared with those randomised to practice care ( $P < 0.001$ ), but differences in scores varied significantly between schools ( $P = 0.04$ ). There were no significant differences in the numbers of adolescents prescribed inhaled steroids ( $P = 0.89$ ) or taking inhaled steroids every day ( $P = 0.60$ ). Overall, 111 adolescents (31.2%) had at least one day away from school owing to asthma in the preceding six months. There was no significant difference between the two groups in the trial in the numbers of pupils who had at least one day absent from school ( $P = 0.78$ ). There were no differences between groups in pupils' peak flow readings ( $P = 0.36$ ). Overall, 174 adolescents (51.8%) indicated that they would prefer to attend their GP practice for future check ups. However, significantly more pupils who had experienced the school clinic (63% [65/104]) preferred future care in that set-

ting ( $P = 0.01$ ).

### Process measures

A significantly higher proportion of pupils randomised to the school clinic group had a peak flow meter ( $P < 0.001$ ; OR [school clinic/practice care] = 18.3, 95% CI = 5.4 to 61.6) and had a self-management plan ( $P < 0.001$ ; ORs varied between schools [ $P = 0.01$ ] and are not reported here) at the six-month assessment, compared with those pupils in the same schools randomised to practice care.

**Health service utilisation.** There were no significant differences in the use of hospital services between groups. Further details of use of health services with regard to asthma are available from the authors.

**Economic outcomes.** The total cost (including costs in practice, school asthma clinic, hospital, and medication) of six-month care in the school asthma clinic was higher (median = £32.10) than in the practice care group (£19.80) or the control group (£18.00) (Table 4).

### Discussion

The school asthma clinic was an attempt to improve asthma care for adolescents, a group that has been difficult to reach through existing models of care. This difficulty was confirmed in our results, as only 51% of adolescents in the practice care arm and 58% of those in the control schools had a review of asthma in their practice. However, this represents an improvement from 22% of pupils being reviewed during the six months before the research began, suggesting that an organised approach to inviting adolescents for review can lead to increased uptake of services in general practice.

In contrast, providing services at school meant that 91% of pupils received a review. Consequently, significantly more pupils received advice, had their peak flow measured, had a peak flow meter at home and had a written self-management

Table 1. Comparability of the groups at baseline (figures in brackets indicate percentages of pupils except where stated).

	School clinic (in RCT)	Practice care (in RCT)	Control school (observational comparison)
	<i>n</i> = 156	<i>n</i> = 149	<i>n</i> = 141
Median age (IQR)	13 (12–14)	13 (12–14)	13 <sup>a</sup> (12–14)
Number of male pupils	80 (51.3)	70 (47.0)	81 (57.5)
Median symptom score — Steen (IQR)	19 (16–24)	19 (15–24)	20 (16–25)
Number taking inhaled steroids every day	47 (30.1)	48 <sup>a</sup> (32.4)	58 <sup>a</sup> (41.4)
According to pupil, number of occasions in past six months they had:			
Seen GP about asthma	53 <sup>a</sup> (34.2)	47 (31.5)	53 <sup>a</sup> (37.9)
Seen nurse at practice about asthma	62 <sup>b</sup> (40.3)	59 (39.6)	31 (22.0)
Been to outpatient clinic about asthma	10 (6.4)	4 (2.7)	6 (4.3)
Been to A&E or out-of-hours primary care centre about asthma	8 (5.1)	1 (0.7)	2 (1.4)
Been admitted to hospital with asthma	4 (2.6)	1 (0.7)	1 (0.7)
	<i>n</i> = 153	<i>n</i> = 143	<i>n</i> = 136
According to GP records, number of pupils who had			
Been prescribed inhaled steroids in previous six months	45 (29.4)	54 (37.8)	47 (34.6)
Had an asthma review at general practice	39 (25.5)	25 (17.5)	29 (21.3)
Been admitted to hospital	1 (0.7)	0	0

<sup>a</sup>One case with missing data; <sup>b</sup>two cases with missing data. IQR = interquartile range; RCT = randomised controlled trial.

Table 2. Primary outcome measures (figures indicate the numbers [percentages] of pupils except where stated).

	School clinic (in RCT)	Practice care (in RCT)	Control school (observational comparison)
	<i>n</i> = 153	<i>n</i> = 143	<i>n</i> = 136
Record of asthma review consultation(s)			
By general practitioner	12 (7.8)	12 (8.3)	33 (24.3)
By practice nurse	26 (17.0)	64 (44.8)	49 (36.0)
By school asthma nurse	137 <sup>a</sup> (89.5)	–	–
By hospital (outpatients)	3 (2.0)	2 (1.4)	3 (2.2)
At any site	139 (90.8)	73 (51.0)	79 (58.1)
RCT: ORs (school clinic/practice care) varied between schools from 1.72 (95% CI = 0.51 to 5.72) to 59.6 (95% CI = 7.56 to 470). OC: OR (control school/practice care)	1.40	(95% CI = 0.85–2.29)	
	<i>n</i> = 114	<i>n</i> = 132	<i>n</i> = 121
Quality of life (PAQLQ[S]) <sup>b</sup>			
Median (IQR)	6.2 (5.5 to 6.7)	6.1 (5.5 to 6.7)	6.2 (5.2 to 6.5)
RCT: Difference in means <sup>c</sup> (95% CI)	–0.06	(–0.29 to 0.18)	–
OC: Difference in means <sup>d</sup> (95% CI)	0.10	(–0.12 to 0.33)	–
	<i>n</i> = 111	<i>n</i> = 129	<i>n</i> = 116
Symptom scores (Steen) <sup>e</sup>			
Median (IQR)	17 (14 to 22)	17 (14 to 21)	18 (14.5 to 22)
RCT: Ratio of means <sup>f</sup> (95% CI)	0.97	(0.91 to 1.04)	–
OC: Ratio of means <sup>g</sup> (95% CI)	0.99	(0.93 to 1.06)	–

<sup>a</sup>One additional pupil, for whom GP record data was unavailable, also saw the school asthma nurse; <sup>b</sup>higher scores represent better quality of life; <sup>c</sup>higher scores represent more symptoms; <sup>d</sup>school clinic/practice care; <sup>e</sup>control school/practice care; <sup>f</sup>school clinic/practice care (after rescaling [7.1-score], transforming to the log scale, and excluding one outlier); <sup>g</sup>control school/practice care (after rescaling [7.1-score], transforming to the log scale, and excluding one outlier). RCT = randomised controlled trial; IQR = interquartile range; OR = Odds ratio; PAQLQ[S] = Paediatric Quality of Life questionnaire [standardised UK version].

plan. Pupils in the school clinic arm had significantly better scores on a test of knowledge about asthma, more positive attitudes about asthma, better inhaler technique, and a majority would prefer to have their asthma care provided in that setting in future. Despite these improvements in the process of care (at an increased cost), there were no differences in the primary disease outcomes of quality of life or level of symptoms, nor in the secondary outcomes of use of inhaled steroids, peak flow readings, days off school, and hospital admissions.

The finding that improving the delivery of asthma care does not necessarily lead to improvements in patient outcomes is consistent with previous research into nurse-led asthma clinics in general practice.<sup>23–25</sup> One reason that improved management did not result in improved outcomes may be because the nurse was unable to make treatment changes herself, but had to advise pupils who needed a different drug or delivery device to contact their GP. Given that a main justification for the school clinic was that adolescents are sometimes reluctant to go to general practices, this may mean that pupils did not always receive the recommended treatment.

This research has a number of limitations. First, there may be potential for 'contamination' between those in the intervention and the practice care arms. The best approach to this problem would be to conduct a cluster randomised trial, with schools randomised to different models of care. At the outset an estimate of the intra-class correlation was unavailable and may have been large, given the different settings in which the schools worked, thereby requiring a large number

of schools to conduct a clustered randomised trial with similar power.<sup>26</sup> The relative importance of contamination and the limitations of cluster trials have been recently discussed by Torgeson.<sup>27</sup> The lack of significant differences between the practice care and control groups suggests that contamination was not a major problem in our study.

Secondly, only 58% of the eligible adolescents were recruited, which may not be surprising in this age group but may be problematic, as those not recruited may be least adherent to their asthma treatment. It is reassuring that pupils not recruited appeared to be less symptomatic than those recruited in terms of the symptoms recorded on the initial screening questionnaire. Thirdly, there was a differential loss to follow-up in the three groups, suggesting that the significant differences observed for some secondary outcomes should be treated with caution.

It is notable that the level of symptoms experienced was very low. Although the ISAAC study highlighted that asthma is common among adolescents (33% of 12 to 14-year-olds reported wheeze in the previous 12 months),<sup>5</sup> our results suggest that for most adolescents it is not troublesome in a four-week period. Given this low level of symptoms at baseline it is not surprising that we were unable to demonstrate improvements with better care. This may suggest that efforts to review and actively manage asthma would be more cost-effective if targeted at those with more severe symptoms.

In contrast to our inability to improve health outcomes, a recent study of a peer-led asthma education programme in schools demonstrated improvements in quality of life.<sup>28</sup> One way forward may be to link school-based asthma care with

Table 3. Secondary outcomes.

	School clinic (in RCT)	Practice care (in RCT)	Control school (observational comparison)
	<i>n</i> = 106	<i>n</i> = 124	<i>n</i> = 110
Knowledge of asthma			
Mean score (SD)	2.64 (0.66)	2.26 (0.76)	2.39 (0.69)
RCT: Difference in means <sup>a</sup> (95% CI)	0.38	(0.19 to 0.56)	–
OC: Difference in means <sup>a</sup> (95% CI)	0.16	(–0.02 to 0.34)	–
	<i>n</i> = 108	<i>n</i> = 126	<i>n</i> = 112
Attitudes to asthma			
Median score (IQR)	5.0 (4.6 to 5.2)	4.8 (4.4 to 5.2)	4.8 (4.4 to 5.2)
RCT: Difference in means <sup>b</sup> (95% CI)	0.21	(0.05 to 0.36)	–
OC: Difference in means <sup>a</sup> (95% CI)	–0.003	(–0.16 to 0.15)	–
	<i>n</i> = 111	<i>n</i> = 125	<i>n</i> = 121
Inhaler technique <sup>c</sup>			
Median score (IQR)	4 (3 to 5)	3 (2 to 4)	3 (2 to 4)
RCT: OR <sup>d</sup> (school clinic/practice care) varied between schools (not reported here) (95% CI)	1.17	(0.74 to 1.85)	–
OC: OR <sup>d</sup> (control school/practice care) (95% CI)			
	<i>n</i> = 110	<i>n</i> = 129	<i>n</i> = 114
Use of steroids (according to pupil)			
Number (%) taking inhaled steroids every day	35 (31.8)	38 (29.5)	40 (35.1)
RCT: OR (school clinic/practice care) (95% CI)	1.20	(0.60 to 2.35)	–
OC: OR (control school/practice care) (95% CI)	1.12	(0.55 to 2.26)	–
	<i>n</i> = 153	<i>n</i> = 143	<i>n</i> = 136
Use of steroids (according to GP records)			
Number (%) prescribed inhaled steroids in the previous six months	62 (40.5)	62 (43.3)	57 (41.9)
RCT: OR (school clinic/practice care) (95% CI)	1.03	(0.62 to 1.71)	–
OC: OR (control school/practice care) (95% CI)	1.01	(0.58 to 1.73)	–
	<i>n</i> = 111	<i>n</i> = 129	<i>n</i> = 116
Days off school with asthma			
Number (%) having at least one day off	34 (30.6)	42 (32.6)	35 (30.2)
RCT: OR (school clinic/practice care) (95% CI)	0.92	(0.53 to 1.61)	–
OC: OR (control school/practice care) (95% CI)	0.91	(0.52 to 1.59)	–
	<i>n</i> = 110	<i>n</i> = 125	<i>n</i> = 121
Peak flow measurements			
Mean score (SD)	434.8 (65.0)	427.0 (65.4)	441.2 (71.9)
RCT: Difference in means <sup>b</sup> (95% CI)	7.82	(–9.11 to 24.8)	–
OC: Difference in means <sup>b</sup> (95% CI)	8.02	(–5.83 to 21.9)	–
	<i>n</i> = 104	<i>n</i> = 119	<i>n</i> = 113
Preference for future care			
Number (%) preferring doctor's surgery to school	39 (37.5)	65 (54.6)	70 (62.0)
RCT: OR (school clinic/practice care) (95% CI)	0.49	(0.28 to 0.85)	–
OC: OR (control school/practice care) (95% CI)	1.25	(0.72 to 2.14)	–

<sup>a</sup>school clinic — practice care; <sup>b</sup>school clinic — practice care, omitting one outlier; <sup>c</sup>if more than one inhaler was used a mean score was calculated. If below 0.5, fractional values were rounded down, otherwise they were rounded up; <sup>d</sup>estimated from ordinal regression model, OR for a unit increase in score. OR = odds ratio; RCT = randomised controlled trial; IQR = interquartile range.

a peer-led programme for asthma education.

This project demonstrates that involving school nurses makes it possible to provide care for asthma (and potentially other chronic diseases, such as diabetes, epilepsy, and eczema) that reaches a high proportion of adolescents, who

may not attend in general practice or elsewhere.<sup>29</sup> However our results suggest that this would not be cost effective for asthma, and would also raise doubts about the cost effectiveness of six-monthly review of all asthmatic adolescents in general practice, as currently recommended.<sup>30</sup>

Table 4. Costs of components of care.

	School clinic (in RCT)		Practice care (in RCT)		Control school (observational comparison)	
	Mean	Total	Mean	Total	Mean	Total
<b>Practice costs</b>						
Doctor consultations	4.35	666	3.40	486	7.30	990
Practice nurse consultations	2.00	306	5.54	792	3.90	531
Drug costs	23.24	3555.04	26.44	3755.19	22.38	3043.04
<b>School asthma clinic</b>						
Nurse salaries	18.20	2790	—	—	—	—
Administration salaries	2.94	449.50	—	—	—	—
Postage and consumables	0.51	77.50	—	—	—	—
<b>Hospital costs (based on GP records)</b>						
Admissions	3.46	529	—	—	—	—
Outpatient consultations	1.90	291	2.70	388	2.14	291
A&E attendance	0	—	0	—	0	—
<b>Total costs</b>						
Mean	56.63	8664.04	38.11	5412.19	35.70	4855.04
Median	32.10	—	19.80	—	18.00	—
IQR	21.40–63.52	—	3.92–42.12	—	9.00–49.60	—

RCT = randomised controlled trial; IQR = interquartile range.

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## Acknowledgements

We would like to thank the pupils, teachers and school nurses in each school; Charlotte Carmichael, assistant statistician at North Bristol RDSU, who carried out many of the preliminary analyses and descriptive statistics; Kate Baxter for health economics advice; Selma Eaton, senior nursing officer, for valuable support and for seconding the school nurses; Dr Sylvia Clements, community paediatrician, for her advice; and doctors, nurses and administrative staff at the general practices for their cooperation.

This research was funded by the NHS Research and Development Programme on Asthma Management. The Research and Development Unit at North Bristol NHS Trust is supported by a grant from the South West NHS Research and Development Directorate.