

ORIGINAL ARTICLE

Improving the quality of care for children with wheeze: The use of electronic asthma action plans and electronic pre-school wheeze action plans

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Aim: To measure the long-term improvement in the documented provision of an asthma action plan (AAP) to children with asthma and wheeze discharged from the Emergency Department following the introduction of the electronic AAP (eAAP) and to determine the need for an electronic pre-school wheeze action plan in our population.

Methods: A retrospective case note review, from July 2014 to June 2015, of all patients over 12 months old discharged from the Emergency Department or Emergency Medical Unit, with a discharge diagnosis of either asthma or wheeze. The primary outcome was the documentation of an AAP, either recorded electronically as an eAAP or a report of an AAP as part of the patient medical record.

Results: Two thousand three hundred and forty-two patients were included in the study, 926 with asthma and 1416 with wheeze. The median age was 3.3 years (interquartile range (IQR) 3.5, range 1–15.9 years). The median age of the children with asthma was 5.3 years (IQR 4.6) and of the children with wheeze was 2.5 years (IQR 2.0). Overall, 1683 (71.9%) children had a documented AAP, with a significant difference between those with a discharge diagnosis of asthma (85.9%) compared with wheeze (62.9%), $P < 0.001$. These results justified the design of the electronic pre-school wheeze action plan.

Conclusions: The integration of an eAAP into the Emergency Department has resulted in a sustained improvement in the documented provision of an AAP to children with a discharge diagnosis of asthma. Children with a discharge diagnosis of wheeze are significantly less likely to receive an action plan.

Key words: asthma; child; education; pre-school; quality improvement.

What is already known on this topic

- 1 The provision of an AAP to children is a key quality indicator.
- 2 The provision of an AAP to children reduces the rates of hospital admissions, emergency presentations, school absences and use of reliever medications.
- 3 The documented provision of an AAP to children discharged after attending an Emergency Department may be suboptimal.

What this paper adds

- 1 The introduction of an electronic AAP into standard practice produces a sustained improvement in the documented provision of the AAP on discharge from the Emergency Department.
- 2 Children discharged with a diagnosis of wheeze are significantly less likely to be given an AAP.
- 3 The use of a pre-school wheeze action plan may be a useful resource for patients being discharged with a diagnosis of wheeze, rather than asthma.

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The provision of a personalised asthma action plan (AAP) to patients with asthma is a key quality indicator and can improve outcomes such as self-efficacy, knowledge and confidence for people with asthma.¹ In particular, patients with asthma who have had a recent acute exacerbation, resulting in admission to hospital, written personalised action plans may reduce readmission rates.¹ AAPs for children are recommended internationally by the Global Initiative for Asthma² and in Australia by the National Asthma Council (NAC)³ and have been shown to reduce rates of hospital admissions, emergency presentations, school absences and use of reliever medications.⁴

The diagnosis of asthma in pre-school children can often be controversial as the majority of patients who present with pre-school wheeze do not develop chronic asthma.^{3,5,6} However, the provision of an AAP to this group of patients is still widely recommended.^{2,3,7-9} This is in line with a key concept of the new Global Initiative for Asthma strategy: a road map to asthma control, of ensuring good communication and partnership with the patient, or carers in the case of pre-schoolers, considering health literacy, personal goals and fears, and cultural issues.⁹ In particular, the provision of an AAP to children with pre-school wheeze may reduce the prescription of oral steroids to this group, in line with the Thoracic Society of Australia and New Zealand position statement¹⁰ and the NAC guidelines which state 'Do not prescribe oral corticosteroids for children younger than 6 years unless acute wheezing is severe enough to require hospitalisation'.³ The side effects of oral steroids have been well described and risks are related to dosage and duration of usage. Twenty percent of children having four or more bursts per year demonstrate suboptimal adrenal response¹¹ and multiple oral corticosteroid bursts over a period of years can produce a dosage-dependent reduction in bone mineral accretion and increased risk for osteopenia in boys, but not in girls.¹²

In 2008, The Children's Hospital at Westmead demonstrated an improvement in the documented provision of an AAP to children discharged from the Emergency Department (ED) with a discharge diagnosis of asthma, from 17.9 to 78.8% ($P < 0.01$) by introducing an electronic AAP (eAAP) as standard of care.¹³ The eAAP is prescribed via Power Chart at the physicians' discretion and integrated into the patient's electronic medical record (eMR). A paper copy is provided to the family, for home use, and can be shown to the General Practitioner (GP) or school.

The aim of this study was to reaudit the documented provision of an AAP to measure sustainability of the intervention, to measure the documented provision of an AAP to children with a discharge diagnosis of wheeze. The second part of the paper was to design and implement an electronic action plan for children with pre-school wheeze (pre-school wheeze action plan (ePSWAP)).

Methods

Study design

A retrospective cross-sectional study of patients attending a large paediatric tertiary level teaching hospital over 1 year from 1st July 2014 to 30th June 2015. The Children's Hospital at Westmead Emergency Department sees a total of more than 50 000 patients each year. Ethical approval was granted by the Human Research Ethics Committee of the Sydney Children's Hospitals Network.

Participants

All patients over 12 months old who were discharged from the ED or Emergency Medical Unit, a 24 h ward staffed by ED physicians, with a discharge diagnosis of either asthma (ICD-10-J45.9) or wheeze (ICD-10-R06.2).

Data sources and measurements

Case notes of patients attending the ED during the study dates were extracted from the eMR (Health E-Care, MCare Systems, Sydney, New South Wales, Australia).

The primary outcome was the documentation of an AAP, either recorded electronically as an eAAP or a report of an AAP as part of the patient notes.

Data for the primary outcome was combined from the eMR with the eAAP database (Cerner Powerchart, Kansas City, MO, USA). Where data matching was not possible electronically, patient records were searched manually by the study investigators.

Where data was unable to be matched electronically and an AAP was not identified by the first investigator, a second investigator reviewed the case notes to verify the absence of a recorded AAP.

Statistics

The data were analysed using SPSS version 22.0 (IBM, Armonk, NY, USA). Frequencies were summarised as percentages and 95% confidence intervals computed using a normal approximation. The significance of differences in frequencies between groups was estimated using Pearson chi-square tests. Age had a right skewed distribution and was therefore summarised using the median and interquartile range (IQR). The difference in ages between groups was examined using a Mann-Whitney U test for non-parametric data. P -values < 0.05 were considered statistically significant.

Results

A total of 2351 patients were extracted from the databases. Nine patients had incorrect discharge diagnoses, leaving 2342 patients for inclusion in the study.

The median age was 3.3 years (IQR 3.5, range 1–15.9 years). The median age of the children discharged with a diagnosis of asthma was 5.3 years (IQR 4.6) and of the children discharged with a diagnosis of wheeze was 2.5 years (IQR 2.0), with a difference of 2.8 years, $P < 0.001$.

A total of 1806 (77.1%) patients were admitted to the Emergency Medical Unit, with the remainder being discharged directly from ED.

Table 1 shows the frequencies of patients according to discharge diagnosis, triage status and documented AAP. The triage category reflects the severity of the presentation.

Design of pre-school wheeze action plan

Due to the significant difference in the documented provision of an AAP to those younger children discharged with a diagnosis of wheeze an ePSWAP was developed. The investigators identified several illustrative cases from the review where the use of a PSWAP may have benefited the patient (Table 2).

The ePSWAP was based on the four stages of the AAP currently advocated by the NAC: when well, when not well, if symptoms get worse and danger signs.³ Sections were modified to ensure the descriptives of each stage were applicable to the pre-school age group and the section on preventers was removed. It was decided that those patients with pre-school wheeze requiring preventers should be on a conventional AAP. The AAP was also modified to ensure the current best practice around only using oral steroids for those exacerbations needing hospital admissions was included.¹⁰ An example of an ePSWAP is illustrated in Appendix I.

Table 1 Data frequencies and comparisons between patients discharged with a diagnosis of asthma or wheeze

		Total sample <i>n</i> (%)	Asthma % (95% CI)	Wheeze % (95% CI)	<i>P</i> -value†
<i>n</i>		2342	926	1416	
Triage category	1	3 (0.1%)	—	0.2% (0, 0.4)	
Triage category	2	220 (9.4%)	7.6% (5.9, 9.3)	10.6% (9.0, 12.2)	
Triage category	3	1725 (73.7%)	70.3% (67.4, 73.2)	75.8% (73.6, 78.0)	
Triage category	4	394 (16.8%)	22.1% (19.4, 24.8)	13.3% (11.5, 15.1)	
Diagnosis	Asthma	926 (39.5%)			
	Wheeze	1416 (60.5%)			
Asthma action plan		1683 (71.9%)	85.9% (83.7, 88.1)	62.9% (60.4, 65.4)	<0.001

†For the difference between the wheeze and asthma groups. CI, confidence interval.

Table 2 Illustrative case descriptions of the need for a pre-school wheeze action plan

One day of increasing cough and wheezy the morning of presentation
Parents gave three Ventolin puffs via spacer, though unsure how to give it so came to ED
Previous episode of wheeze treated by GP with Ventolin, well in between
Family history of asthma
No documented previous AAP or AAP on discharge from ED

Three-year-old boy presented to ED at 17.00 with severe respiratory distress
Runny nose and fever for last 24 h
Hard, noisy and fast breathing overnight – Mum tried one puff Ventolin
Previous episode of wheeze treated by GP
No documented previous AAP or AAP on discharge from ED

Three-year-old boy presented to ED at 16.30 with moderate respiratory distress
Two-day history of cough and runny nose
Increased work of breathing since the morning
No reliever given at home. Went to GP who gave reliever and referred to ED
History of multiple episodes of acute wheeze responsive to Ventolin secondary to viral infections
Has eczema. Previous trial of 3-month course of Flixotide. Has eczema
No documented previous AAP or AAP on discharge from ED

Four-year-old presented to ED at 09.30 with severe respiratory distress
Runny nose for 2 days. Increasing cough, shortness of breath and wheezing overnight
Parents giving three puffs every 30 min overnight at home
Unable to speak in sentences on arrival, respiratory rate 62 per minute
Two previous admissions to hospital of viral induced wheeze
No documented previous AAP or AAP on discharge from ED

AAP, asthma action plans; ED, Emergency Department; GP, General Practitioner.

diagnosis of asthma and those with a discharge diagnosis of wheeze.

There are no firm criteria for categorising the discharge diagnosis as asthma or wheeze. The difference demonstrated probably illustrates the problems in defining asthma in the pre-school age group described earlier. We are encouraged that 62.9% of patients with wheeze did have an AAP, which is better than we had predicted. The difference in the provision of an AAP may be reflected in the doctors perception that children with asthma should have an AAP, but those with wheeze do not need one. We have illustrated several cases from where a PSWAP may have helped parents care for their sick children more appropriately at home, or seek help earlier (Table 2). These cases have been taken from both the asthma and wheeze groups. The design and implementation of the PSWAP may lead to increased provision of a plan for this group of children. Further studies are required to determine if this is true and to determine if a PSWAP has the same demonstrable benefits seen in older children with AAPs.⁴ We would also like to encourage primary care physicians to consider the provision of a PSWAP to the patients they see with wheeze, who do not meet the criteria for an AAP.

We have demonstrated a sustained improvement in the provision of AAPs from 17.9% in 2007 to 71.9% overall, and 85.9% for those discharged with a diagnosis of asthma in 2014–2015. These results are consistent with the use of eAAPs that have been described in other studies and, as well as improved documented provision of an AAP, evaluations have shown an association between eAAP receipt and significant reductions in paediatric asthma exacerbations, including 33% lower odds of requiring oral steroids ($P < 0.001$), compared with controls.^{14–16} In addition, the electronic sharing of the AAP has the potential to increase efficiency and enhance effective communication among health-care providers, families and schools.¹⁷ This may be a possible enhancement for the eAAP and ePSWAP if they can be integrated with the Australian Patient Controlled eHealth Record.¹⁸

Additional benefits of the eAAP that have been anecdotally reported include the ability to view the eAAP during subsequent attendances and whilst providing telephone consultations to parents. The eAAP used in this study can easily be modified as the patient condition changes and provides a best practice, standardised framework for the prescriber to use which is legible to the consumer.

Discussion

We have demonstrated a sustained improvement in the documented provision of an AAP to children over a 6-year period by using an electronic AAP as standard of care. It has also shown a significant difference between those children discharged with a

One of the limitations of this study is the possibility that the patients may have had an AAP prescribed by their paediatrician or local GP and that this either was not asked or noted in the medical record. This may explain some of the 14% of those with a discharge diagnosis of asthma without an AAP. Other limitations are consistent with any single institution retrospective chart review. Our unique patient population, eMR and prescriber education programme may not make our findings applicable in other settings and our abstractors were not blinded to the study design opening up the possibility of bias.

This study aimed to investigate the documented provision of AAPs to children presenting to a tertiary ED. Further research is required to measure patient outcomes related to the provision of ePSWAPs such as frequency of GP visits, frequency of ED visits, need for oral steroids, time off school, etc. which were not part of this study design. Further research is also required to determine which factors, such as doctor seniority, age of patient, patient location and altering the design of the eMR to include auto triggering of the ePSWAP, may influence the provision of an action plan.

Conclusions

The integration of an eAAP into the ED has resulted in a sustained improvement in the documented provision of an AAP to children with a discharge diagnosis of asthma. Children with a discharge diagnosis of wheeze are significantly less likely to receive an Action Plan. The use of an ePSWAP may meet this need.

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Appendix I

AMO / GP:	MRN:
HOSPITAL/PRACTICE:	NAME:
DATE:	DOB:

PRE-SCHOOL WHEEZE ACTION PLAN

 **WHEN WELL** No symptoms

↓
No treatment required


 **WHEN NOT WELL** Increasing cough or wheeze
Breathing harder or faster

↓
Use a reliever to try and help them breathe
Consider a review by your General Practitioner
Use 2-4 puffs of with a spacer and face mask 3-4 times a day

Prednisolone (oral steroid) is not required for pre-school wheeze unless your child is admitted to hospital

 **IF SYMPTOMS GET WORSE** Increasing difficulty breathing
Playing less than usual

↓
Use 6 puffs of with a spacer and face mask every 3 hours
Take your child to your General Practitioner or local Emergency Department

 **DANGER SIGNS** Breathing Emergency
Breathing is so difficult that they are having trouble walking, talking, eating or playing
Child is drowsy or less alert than usual. Lips may be blue

↓
Call an Ambulance. Say your child is having a severe wheeze attack

DIAL 000 FOR AMBULANCE Use **4** separate puffs of with a spacer
(and face mask if you have one) every **4** minutes until the ambulance arrives

Name and signature of prescriber:.....

Adapted from the National Asthma Council Asthma Action Plan by The Children's Hospital at Westmead 2015