

Action plans in patients presenting to emergency departments with asthma exacerbations: Frequency of use and description of contents

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BACKGROUND: Although underused, written asthma action plans (AAPs) are associated with reduced numbers of emergency department (ED) visits and hospitalizations.

OBJECTIVE: To describe the frequency of use and contents of any AAPs reported by patients presenting with exacerbations to three urban Canadian EDs.

METHODS: Prospective data were collected through ED interview and chart review. Descriptive analyses used proportions and medians with interquartile range; multivariable logistic regression was used for the adjusted analyses.

RESULTS: Among 176 enrolled patients, the median age was 27 years (interquartile range 23 to 39 years) and 97 (55%) were female. Few (n=42 [24%]) reported having AAPs at ED presentation and only six were written. Most (n=35 [75%]) patients with any AAP took action before the ED visit; none used a valid anti-inflammatory strategy. The first step of 27 plans was to increase asthma medication; no patients appropriately increased inhaled corticosteroids (ICS). In multivariable analyses, only the use of either ICS or ICS/long-acting β -agonist combination agents (31% had AAPs versus 12% did not have AAPs (adjusted OR 3.0 [95% CI 1.14 to 8.07]) and asthma education (47% had AAPs versus 21% did not have AAPs, adjusted OR 3.2 [95% CI 1.13 to 9.19]) were independently associated with AAP possession.

CONCLUSION: Possession of AAPs among patients presenting to the ED with acute asthma was low, and only one in 10 AAPs were written. Patients who reported having any AAP used ineffective strategies to abort or mitigate the severity of an ED visit. Increasing frequency of written AAPs and improving their contents holds immediate promise in improving outcomes related to asthma.

Key Words: Acute asthma; Asthma education; Care gaps; Prevention

Approximately 10% of the population of North America has asthma, and the prevalence of this condition has been increasing in recent years (1,2). Patients with asthma frequently present to the emergency department (ED) with exacerbations that may result in potentially serious complications and relapses (3,4). Internationally, strategies for avoiding, mitigating and treating exacerbations have been developed and recommended (5-8).

Patients seen in the ED for asthma exacerbations should be encouraged to see their primary care provider (PCP) or specialist for follow-up, adjustment of asthma medications, reassessment and reinforcement of self-management strategies (5,9). Written asthma action plans (AAPs) are one of the key strategies for ambulatory asthma care, and involve self-monitoring and response to therapy based on symptoms or close monitoring of peak flow readings (10-12). Systematic reviews have shown that written AAPs, as part of self-management, are effective

Les plans d'action pour les patients qui se rendent à l'urgence à cause d'exacerbations de l'asthme : la fréquence d'utilisation et la description du contenu

HISTORIQUE : Même s'ils sont sous-utilisés, les plans d'action contre l'asthme (PAA) écrits s'associent à une diminution du nombre de consultations à l'urgence et d'hospitalisations.

OBJECTIF : Décrire la fréquence d'utilisation et le contenu des PAA déclarés par les patients qui ont consulté à cause d'une exacerbation dans trois urgences canadiennes en milieu urbain.

MÉTHODOLOGIE : Des chercheurs ont colligé des données prospectives par des entrevues à l'urgence et des examens de dossiers. Les analyses descriptives faisaient appel à des proportions et à des médianes accompagnées d'un intervalle interquartile. La régression logistique multivariable a été utilisée pour les analyses rajustées.

RÉSULTATS : Les 176 patients participants, dont 97 femmes (55 %), avaient un âge médian de 27 ans (intervalle interquartile de 23 à 39 ans). Quelques-uns (n=42 [24 %]) ont déclaré avoir un PAA lors de leur consultation à l'urgence, mais seulement six étaient écrits. La plupart des patients (n=35 [75 %]) qui avaient un PAA prenaient des mesures avant d'aller à l'urgence. Personne n'utilisait une stratégie anti-inflammatoire valide. La première étape des 27 plans consistait à accroître la médication contre l'asthme, mais aucun patient ne rajustait correctement ses corticostéroïdes inhalés (CSI). Dans les analyses multivariables, seules l'utilisation de CSI ou d'une polythérapie de CSI et de bêta-agonistes de longue durée (31 % avaient un PAA et 12 % n'en avaient pas; RC rajusté 3,0 [95 % IC 1,14 à 8,07]) et l'éducation sur l'asthme (47 % avaient un PAA et 21 % n'en avaient pas; RC rajusté 3,2 [95 % IC 1,13 à 9,19]) s'associaient de manière indépendante à la possession d'un PAA.

CONCLUSION : Peu de patients possédaient un PAA lorsqu'ils consultaient à l'urgence à cause d'un asthme aigu, et seulement un sur dix était écrit. Les patients qui déclaraient avoir un PAA utilisaient des stratégies inefficaces pour éviter la consultation à l'urgence ou en atténuer la gravité. Si on rédige davantage de PAA et qu'on en bonifie le contenu, on peut espérer une amélioration immédiate de l'asthme.

in reducing the number of hospitalizations and ED visits due to acute asthma (13). Written AAPs have also been associated with improvement in medication adherence and health-related quality of life; furthermore, one study reported that patients with written AAPs were more satisfied with their asthma care (13,14). On the other hand, verbal AAPs are largely ineffective (12,13); in one study, the risk of death from asthma was four times lower with a written AAP than with a verbal AAP (15).

There are four main components to individualized written AAPs: triggers to increase therapy (based on symptoms or peak flow readings); strategies to increase therapy; the duration of increased therapy; and the 'tipping point' to seek additional medical help (12). Despite the aforementioned collective evidence of benefit, the use of written AAPs remains quite low, with 10% to 45% of patients reporting to have one (14,16,17). Canadian data from an unbiased sample found

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TABLE 1
Characteristics of patients presenting to an emergency department for asthma exacerbations

Characteristic	Asthma action plan	
	Yes (n=42)	No (n=134)
Age, years, median (IQR)	28 (24, 35)	27 (22, 40)
Female sex	25 (59.5)	72 (53.7)
Ancestry		
White	21 (50)	66 (49.2)
Nonwhite	21 (50)	68 (50.7)
Marital status		
Single	18 (42.9)	83 (61.9)
Other	24 (57.1)	51 (38.0)
Education		
Some high school	18 (42.9)	64 (47.8)
Other	24 (57.1)	70 (52.2)
Occupation during the past year		
Working for pay or profit	33 (78.6)	93 (69.4)
Other	9 (21.4)	41 (30.6)

Data presented as n (%) unless otherwise indicated. IQR Interquartile range (P_{75} , P_{25})

that 22% of physicians report providing AAPs to patients with asthma, and 11% of patients with asthma report receiving a written AAP (18). Barriers to the uptake of written AAPs include lack of adequate time for clinicians to produce and explain them to their patients, lack of experience and confidence in completing written AAPs, low awareness of their importance, and variations in both content and structure (eg, visual design, usability) (19,20). Previous research has mostly reported on stable patients, often in the primary care setting. There are limited data regarding care gaps related to asthma control and management, and written AAP uptake in patients presenting to EDs with asthma exacerbations (21).

The aim of the present study was to describe the frequency of use, content and potential correlates of the use of any AAPs by patients presenting to the ED and who are safely discharged after being treated for acute asthma.

METHODS

Study design and population

The present study was a secondary analysis of data obtained from two studies conducted in Edmonton, Alberta (one randomized controlled trial [NCT01107613] and one prospective, randomized, open-label study [NCT01079000]). Prospective data used for the present study were obtained from identical standardized baseline questionnaires and a medical chart review of patients 17 to 55 years of age who were treated for an asthma exacerbation and before being discharged back to the community. Screening and data collection were performed on a daily basis by trained research staff. Patients >55 years of age, individuals with chronic obstructive pulmonary disease or another end-stage lung disease, and those with an inability to consent were excluded.

Study variables

Sociodemographic data (eg, age, sex, race [visual assessment]), marital status, level of education and occupation) were considered for the present analysis. Chronic asthma factors, preventive factors and health care utilization were also explored. Finally, information regarding patient characteristics at ED presentation, concurrent medication, ED management and discharge plan were described.

AAP-related measurements

AAPs that exclusively involved home remedies, those not involving the use of medication, peak flow/symptom monitoring or seeking additional medical attention (n=5), were excluded from the present analysis. One of two clinician-investigators (CV-R, BHR) independently

reviewed the enrollment data and adjudicated patients' report and use of AAPs, and the presence of other gaps in asthma care (eg, availability of a PCP, use of spacer devices, influenza vaccination, cigarette smoking, asthma medication use and adherence, and asthma education). Agreement was assessed by comparing the first 50 cases and an ongoing random 10% sample of cases thereafter; differences were resolved through consensus. Finally, a third reviewer (EC) examined every record to document the content of each AAP and the actions taken before the ED presentations. Percentage of agreement between investigators regarding the care gaps adjudication was measured and inter-rater agreement was calculated based on the kappa statistic.

Statistical analysis

De-identified baseline data were appended and verified for consistency using the original data sources. Descriptive data include counts and proportions, or medians with interquartile range (P_{75} , P_{25}) as appropriate. Baseline comparisons based on having or not having any AAP at the ED presentation were performed using χ^2 tests for categorical variables and Mann-Whitney U tests for continuous variables. Multivariable logistic regression analyses were used to determine the independent association between having an AAP (either written or verbal) and variables identified at $P<0.05$ significance in the univariate comparisons and those deemed to be of clinical importance (eg, age, sex, Canadian Triage Acuity Scale [CTAS] score). Given that the reported use of AAPs was low, a parsimonious final modelling strategy was used with the aim of having no more than five or six variables (clinically significant: previous admissions to the intensive care unit [ICU], previous exposure to asthma education, and concurrent use of either inhaled corticosteroids [ICS] or ICS/long-acting beta-agonists [LABAs] combination agents; and forced due to clinical significance: age, sex, CTAS score) to prevent over-fitting. All analyses were performed using Stata version 11 (StataCorp, USA).

Ethical considerations

The Health Ethics Research Board at the University of Alberta (Edmonton, Alberta) granted ethics approval for the primary studies. All patients provided informed written consent; additional consent was not required for the present secondary analysis.

RESULTS

Sociodemographic and clinical characteristics

A total of 176 patients were included in the present analysis; all patients who were approached and provided informed consent completed the study questionnaires. The median age of the study population was 27 years (interquartile range 23, 39), 97 (55%) were female and one-half (49%) were white. Tables 1 to 3 summarize data regarding sociodemographics, chronic asthma factors and ED course.

AAPs

Forty-seven (27%) patients reported having an AAP that they used in case of worsening symptoms, 42 (24%) were potentially appropriate AAPs and six (14%) were written AAPs (Figure 1). There was no charted evidence of AAP delivery at discharge by treating ED physicians in this sample.

In general, univariate analyses revealed that patients with an AAP had received more asthma education (47% versus 21%; $P=0.004$), experienced more previous ED visits for acute asthma (29% versus 5%; $P=0.003$), more admissions to the ICU (43% versus 21%; $P=0.05$), and greater concurrent use of either ICS or ICS/LABA combination agents (31% versus 12%; $P=0.005$) than patients with no AAPs.

Description of AAP

The agreement between the independent adjudicators in the first 50 cases was 86%, followed by perfect agreement on the subsequent 10% random sample (simple agreement = 100%; kappa=1.0). Among the 42 patients with AAPs, the first step of 27 (64%) plans was to increase asthma medication; in eight (19%) plans, asthma medications were increased as a second-line treatment for worsening

TABLE 2
Comparison of chronic asthma factors and health system utilization of patients discharged from the emergency department (ED) for asthma exacerbations who reported having an asthma action plan (AAP) versus those who did not

	With AAP (n=42)	No AAP (n=134)
Chronic asthma factors		
Previous diagnosis of asthma	42 (100)	129 (96.3)
Time since asthma diagnosis, years, median (IQR)	21 (15, 26)	17 (11, 23)
Been intubated due to acute asthma	5 (11.9)	17 (12.7)
Intensive care unit admission for asthma*	9 (21.4)	12 (8.9)
Preventive factors		
Has a family physician	28 (66.7)	101 (75.4)
Saw family physician in past 2 years	5 (17.9)	8 (8.8)
Not documented	23 (82.1)	93 (92.1)
Seeing a respirologist frequently for asthma care	2 (4.8)	0 (0)
Has an inhaler	42 (100)	114 (85.1)
Has an aerochamber if patient has an inhaler	20 (47.6)	41 (35.9)
Received asthma education*	9 (21.4)	10 (7.5)
Ever had a flu vaccine	13 (30.9)	49 (36.6)
Smoking status		
Never	26 (61.9)	66 (49.2)
Current	10 (23.8)	38 (28.4)
Pack-years, median (IQR)	7 (3, 13)	3 (1, 8)
Previous	6 (14.3)	30 (22.4)
Pack-years, median (IQR)	6 (5, 18)	7 (2, 11)
Body mass index, kg/m ²		
≤19.9	2 (4.8)	11 (8.2)
20–24.9	20 (47.6)	41 (30.6)
≥25	20 (47.6)	75 (55.9)
Not documented	0 (0)	7 (5.2)
Health system utilization		
Provision of routine asthma care		
By family physician	19 (45.2)	48 (35.8)
In the ED	13 (30.9)	53 (39.5)
In walk-in clinics	10 (23.8)	23 (17.2)
Acute asthma care		
Has had previous ED visits for asthma*	40 (95.2)	99 (73.9)
Visited ED for asthma in past 2 years	19 (74.5)	51 (53.7)
Time since last ED visit for acute asthma, years, median (IQR)	1 (0.3, 4)	2 (0.3, 7)

Data presented as n (%) unless otherwise indicated. * $P \leq 0.05$ in the univariate analyses. IQR Interquartile range (P_{75} , P_{25})

asthma. In addition, 12 of the 35 that recommended any increase at all increased their short-acting beta-agonist medication without increasing ICS. Only four patients reported doubling or tripling their controller medication dose, and no patients reported quadrupling or quintupling the ICS dose to prevent an asthma exacerbation. Interestingly, specific anti-inflammatory agents were never reported. Twelve AAPs consisted of home remedies as a first step for worsening asthma. Additional details regarding the AAP components are shown in Table 4. More than three-quarters (83%) of those with an AAP reported specific actions before presenting to the ED. The most common actions taken before presenting to the ED were an increase in medication (either only short-acting beta-agonist, ICS or combination [n=19]) or home remedies (alone or in addition to medication [n=9]).

In multivariable analyses, after adjusting for age (transformed variable due to non-normal distribution), sex, CTAS score and previous ICU admission, the use of either ICS or ICS/LABA combination

TABLE 3
Course and management of patients discharged from an emergency department (ED) following asthma exacerbations with and without an asthma action plan (AAP)

	With AAP (n=42)	No AAP (n=134)
ED presentation		
Canadian Triage and Acuity Scale score		
1 and 2	12 (28.6)	21 (15.7)
3	27 (64.3)	88 (65.7)
4 and 5	3 (7.1)	25 (18.7)
Most common symptoms		
Shortness of breath	42 (100)	129 (96.3)
Cough	37 (88.1)	116 (86.6)
Wheezing	38 (90.5)	111 (82.8)
EMS arrival	3 (7.1)	7 (5.2)
Used β -agonist puffs in past 24 h	37 (88.1)	90 (67.2)
Puffs, median (IQR)	15 (8, 20)	8 (4, 14)
Vital signs, median (IQR)		
Heart rate, beats/min	102 (90, 11)	95 (82, 106)
Respiratory rate, breaths/min	22 (20, 26)	20 (18, 24)
SaO ₂ (on room air)	97 (95, 98)	97 (96, 98)
Temperature, °C	36.6 (36.2, 36.8)	36.6 (36.3, 36.8)
Asthma medications at ED presentation		
Short-acting β -agonist	40 (95.2)	109 (81.3)
No ICS	8 (19)	46 (34.3)
On ICS alone	10 (23.8)	23 (17.2)
On combination agents alone (ICS/LABA)	19 (45.2)	47 (35.1)
On either ICS or ICS/LABA*	34 (81)	74 (55.2)
Anticholinergics	3 (7.1)	6 (4.8)
Prednisone	3 (7.1)	5 (3.7)
No asthma medication	0 (0)	21 (15.7)
ED management		
Received inhaled β -agonists	38 (90.5)	127 (94.8)
Received inhaled anticholinergic agents	31 (73.8)	111 (82.8)
Received systemic corticosteroids	32 (76.2)	106 (79.1)
Antibiotics	2 (4.8)	8 (5.9)
Lung function, median (IQR)		
Earliest PEF (n=152)	250 (214, 350)	280 (205, 350)
% predicted	60 (41, 71)	53 (44, 71)
Predischarge PEF (n=175)	327 (270, 377)	352 (297, 439)
% predicted	69 (61, 81)	71 (57, 88)
Change in % predicted PEFR	10 (0, 26)	14 (2, 27)
Asthma medications at ED discharge		
Short-acting β -agonist	40 (95.2)	122 (91)
Not on ICS	3 (7.1)	21 (15.7)
On ICS alone	14 (33.3)	54 (40.3)
On ICS/LABA agents	20 (47.6)	49 (36.6)
On ICS or ICS/LABA agents	39 (92.9)	113 (84.3)
Anticholinergic agents	4 (9.5)	17 (12.7)
Prednisone	40 (95.2)	118 (88.1)
Not discharged on any medication	0 (0)	1 (0.7)

Data presented as n (%) unless otherwise indicated. * $P \leq 0.05$ in the univariate analyses. EMS Emergency medical services; ICS Inhaled corticosteroids; IQR Interquartile range (P_{75} , P_{25}); LABA Long-acting β -agonist; PEF Peak expiratory flow; PEFR PEF rate; SaO₂ Oxygen saturation

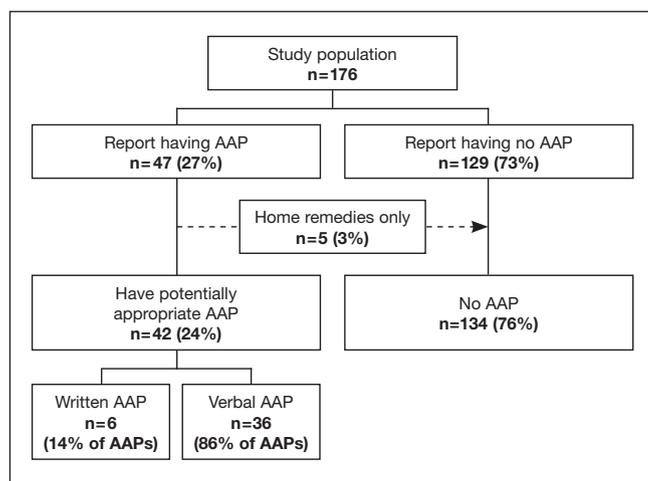


Figure 1) Flow of 176 patients enrolled in two prospective studies in the emergency department and their reported asthma action plans (AAP)

agents (31% versus 12%, adjusted OR [aOR] 3.0 [95% CI 1.14 to 8.07] and asthma education (47% versus 21%, aOR 3.2 [95% CI 1.13 to 9.19]) were independently associated with self-report of an AAP. The *c*-statistic for the final multivariable model was 0.72.

DISCUSSION

Despite good evidence for the effectiveness of AAPs (particularly written versus verbal) to abort or mitigate relapses, only one-quarter of patients who were treated and discharged from the ED for asthma exacerbations reported having one in the present study. Moreover, most of these were verbal AAPs; only 3% of patients had a written AAP. While research confirms that written AAPs are effective, verbal AAPs are not definitively associated with improved asthma outcomes (15).

Despite reporting an AAP, many patients used ineffective interventions as their first- and second-line treatments for loss of asthma control. This represents an important care gap and that could be related to a potential knowledge gap from the health provider and/or patient perspectives (eg, misperception of appropriateness) or a failure to follow instructions. Variations in both the content and structure of available AAPs could also be barriers to their delivery, uptake and make the comparison of their effectiveness difficult (20). Finally, because the most effective therapy in any AAP involving early increased use of anti-inflammatory agents were never reportedly used, the effectiveness of these AAPs would be lower than found in the published literature (16,17).

Patients with an AAP appeared to have more chronic and severe asthma. For example, they had more formal asthma education, more previous ED visits for acute asthma, more previous admissions to the ICU and greater use of ICS or ICS/LABA agents. In adjusted analyses, however, only the use of either ICS or ICS/LABA combination agents and asthma education were significantly associated with self-report of an AAP. As such, it is likely that they may have had more health care encounters, been more often exposed to education and have been instructed in escalating controller therapy more often than those with milder disease.

Nonetheless, few of the patients with AAPs used effective strategies such as Symbicort Maintenance and Reliever Therapy (SMART [AstraZeneca Canada Inc]), quadrupling or quintupling preventer (ICS) therapy, starting systemic corticosteroids or using formal monitoring strategies (5). Consequently, no patients in the present study used what would be considered to be current best-evidence as part of a written AAP. To be fair, many physicians may still be promoting old, ineffective strategies such as 'double for trouble'; however, we were unable to verify this hypothesis in the present study.

TABLE 4
Asthma action plans (AAPs) of patients presenting to and discharged from the emergency department (ED) for asthma exacerbations (n=42)

Action	All, n (%)	AAP, n	
		Written (n=6)	Verbal (n=36)
Increase medication as first step	27 (64.3)	4	23
Increase medication as second step	8 (19.1)	1	7
Increase SABA alone	12 (28.5)	1	11
Increase ICS alone	3 (7.1)	0	3
Increase both ICS and SABA	20 (47.6)	4	16
Medication increase not specified	8 (19.0)	1	7
Double/triple ICS dose	4 (9.5)	1	3
Quadruple/quintuple ICS dose	0 (0)	–	–
Seek medical attention as first step	8 (19.0)	2	6
Seek medical attention as second step	8 (19.0)	1	7
Only seek medical attention	7 (16.7)	1	6
Home remedies as first step	12 (28.6)	0	12
Home remedies as second step	4 (9.5)	1	3
Home remedies alone	5 (11.5)	0	5
Increase medication then seek medical help	8 (19.0)	1	7
Patients with AAP based on peak flow	1 (2.4)	0	1
Patients report using AAP before ED visit	35 (83.3)	6	29
Action reported did not match AAP described	32/35 (91.4)	5	27

ICS Inhaled corticosteroids; SABA Short-acting β -agonist

Of note – and particular concern – was the uptake of written AAPs in our study, which was lower than proportions reported by studies involving patients not presenting to the ED with an acute episode of asthma (14,16,17,22,23). A possible reason for this finding is that patients presenting to ED represent a poorly controlled subset of the general asthma population. This subset may be less likely to use effective self-management techniques for their chronic disease. Alternatively, while similar to the provincial averages, their access to primary or specialist care may have been restricted due to cultural or socioeconomic issues (24). Finally, we were unable to find evidence that the treating ED physicians discussed or provided an AAP to any patients. Despite the fact that the ED encounter represents a 'teachable moment', it appears that AAPs are not part of current recommendations of emergency physicians.

Our results point to a significant care gap in asthma knowledge and management in patients presenting to the ED with asthma exacerbations, and supports the urgent need for ED-directed evidence-based and cost-effective interventions to restore asthma control and improve AAP uptake in the ambulatory care setting (21). Strategies, such as early referral to a nurse educator, respiratory therapist or PCP, for the establishment of a personalized AAP could be the focus of future research.

Limitations

There are several limitations to the present study that warrant discussion. First, our analyses were focused on the comparison between having any AAPs (either written or verbal) and having no AAP. While the comparison between written AAPs and nonwritten AAPs may have been informative, our quantitative and qualitative analytic choices were driven by our interest in exploring AAP possession and usage despite their appropriateness; the low event rate (3% having written AAPs) precluded us from comparing subjects who reported

having written versus not having written AAPs. Second, given that the present study was a secondary analysis, AAP details were not the main focus of the primary studies. To ensure comprehensive data and accuracy, every baseline questionnaire used in compiling the information for the present study was double-checked. In addition, when needed, we used access to electronic health records and hospital charts to complete information required for our analysis. Third, the sample size was relatively small; however, given the compelling results, additional patients in the sample would be unlikely to materially change the results. Fourth, the present study was conducted in one Canadian centre; therefore, the generalizability of the results to other centres and jurisdictions may be a concern. Compared with previous studies, however, our patient population had similar sociodemographic characteristics, asthma severity and eligibility criteria for enrollment; therefore, we do not believe this is a substantive issue (25-27). Fifth, we excluded admitted patients and those cared for by specialists (eg, respirologists, general internists) because we anticipated their access to education and AAPs would be guaranteed. Finally, we did not examine admitted patients, patients with mixed asthma-chronic obstructive pulmonary disease and those with complicated presentations, perhaps also limiting the external validity of our findings.

CONCLUSION

Despite high-quality evidence supporting their use, uptake of written AAPs remains very low in asthma patients presenting to EDs with acute exacerbations. Even when patients have an AAP, their strategies to prevent an ED visit are either not used or clinically ineffective. Strategies to improve the understanding, uptake and early self-activation of valid AAPs during a loss of asthma control are urgently needed to avoid or mitigate ED visits and reduce the burden of disease in this at-risk population.

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