Original Article

Comparison of the Proportion and Healthcare Utilisation of Adult Patients with Uncontrolled Severe Asthma versus Non-Severe Asthma Seen in a Southeast Asian Hospital-Based Respiratory Specialist Clinic

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Abstract

Introduction: Understanding the burden of uncontrolled severe asthma is essential for disease-targeted healthcare planning. There is a scarcity of data regarding the proportion, healthcare utilisation and costs of patients with uncontrolled severe asthma in Asia. This study aimed to plug the knowledge gap in this area. Materials and Methods: Consecutive patients with asthma managed in our respiratory specialist clinic were evaluated prospectively. Healthcare utilisation comprising unscheduled asthma-related primary care visits, emergency department (ED) visits and hospital admissions were obtained from the national health records system. We defined uncontrolled severe asthma as poor symptom control (Asthma Control Test score <20); 2 or more asthma exacerbations requiring ≥3 days of systemic corticosteroids in the previous year; 1 or more serious asthma exacerbation requiring hospitalisation in the previous year; or airflow limitation with pre-bronchodilator forced expiratory volume in 1 second (FEV_1) <80% predicted despite high dose inhaled corticosteroids and another controller medication. Results: Of the 423 study participants, 49 (11.6%) had uncontrolled severe asthma. Compared to non-severe asthma, patients with uncontrolled severe asthma were older and more likely to be female and obese. They had a median of 2 (interquartile range: 0 to 3) exacerbations a year, with 51% having ≥2 exacerbations in the past 12 months. They were responsible for 43.9% of the hospital admissions experienced by the whole study cohort. Mean annual direct asthma costs per patient was S$2952 ± S$4225 in uncontrolled severe asthma vs S$841 ± S$815 in non-severe asthma. Conclusion: Approximately 12% of patients with asthma managed in a hospital-based respiratory specialist clinic in Singapore have uncontrolled severe asthma. They account for a disproportionate amount of healthcare utilisation and costs. Healthcare strategies targeting these patients are urgently needed.

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Key words: Cost, Exacerbations, Singapore

Introduction

Patients with severe asthma have poorly controlled asthma despite high intensity asthma medication,[1] and historically have been thought to represent about 5% of the asthma population.[2] A more recent study conducted in the Netherlands estimated that 3.6% of the adult asthma population have uncontrolled severe asthma.[3] Although these patients constitute a minority of all patients with asthma, they have a high burden of disease and are responsible for a disproportionate amount of healthcare utilisation and costs.[4-7] It is therefore essential to understand the magnitude of the problem and appreciate the characteristics of this group of patients in order to optimise healthcare delivery.

Large cohort studies of patients with asthma and severe asthma have been carried out in Europe[8,9] and the United States,[10] providing invaluable insight into patient characteristics and asthma phenotypes. There is

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comparatively less data in non-Western populations. Apart from ethnic differences in asthma prevalence,[11] ethnic differences in asthma phenotypes,[12] asthma morbidity and healthcare utilisation[13] have also been observed in various populations. Therefore, findings in Western countries may not be globally representative, especially in Asia.

Four distinct asthma phenotypes have been described in 2 Korean adult asthma cohorts[14] but the proportion of patients with severe asthma was not reflected in this particular study. Asthma-related healthcare utilisation in Singapore has been reported previously[15,16] but the subgroup of uncontrolled severe asthma was not examined. To our knowledge, the prevalence and healthcare utilisation of uncontrolled severe asthma patients in Singapore (and Asia) have not been described before.

The recent 2014 European Respiratory Society/American Thoracic Society (ERS/ATS) guideline[1] defined patients with severe asthma as those with uncontrolled asthma despite being on high intensity asthma medication (Global Initiative for Asthma [GINA] treatment Step 4 or 5). Uncontrolled asthma is defined as 1 or more of the following: poor symptom control with Asthma Control Test (ACT) score <20; 2 or more asthma exacerbations requiring ≥3 days of systemic corticosteroids in the previous year; 1 or more serious asthma exacerbation requiring hospitalisation in the previous year; or airflow limitation with pre-bronchodilator forced expiratory volume in 1 second (FEV_1) <80% predicted.

This study aimed to determine the proportion of asthma patients who fulfilled the 2014 ERS/ATS criteria for uncontrolled severe asthma[1] in a respiratory specialist clinic in Singapore and describe their healthcare utilisation and direct asthma costs. We hope that this will better inform health practitioners about the burden of uncontrolled severe asthma in our local setting.

Materials and Methods

This was a cross-sectional observational study of consecutive patients with physician-diagnosed asthma seen at the respiratory specialist clinic of a restructured government hospital serving the eastern and north-eastern region of Singapore. About 35% of the country's population reside in the eastern and north-eastern region.[17] Our respiratory specialist clinic receives asthma referrals from primary care clinics, inpatient ward discharges, as well as interdepartmental referrals. Over a period of 1 year from 1 January 2015 to 31 December 2015, patients aged ≥18 years with asthma were invited to participate in the study. Patients were included only if alternative diagnoses were excluded and the managing respiratory specialists indicated that asthma was the most likely diagnosis. This study was approved by the SingHealth Centralised Institutional Review Board (Reference 2014/835/C). Verbal consent for questionnaire administration was obtained from all participants.

For patients with multiple visits to the respiratory clinic during the study period, inclusion into the study and data collection was performed only at the earliest clinic visit during the study period, irrespective of whether it was the subject's first consultation in the respiratory clinic. Demographic characteristics and asthma history were collected using a standardised questionnaire administered in clinic (Appendix 1). Comorbidities were based on patient report and supplemented by review of all available medical records. Medication adherence was assessed based on patient self-report. The most recent results, including but not limited to spirometric parameters and peripheral blood eosinophil counts, were used for analysis. All study participants were reviewed by asthma nurses to reinforce medication adherence and correct inhaler techniques.

Asthma-related symptoms were assessed using the ACT.[18] The ACT score is the sum of responses to the 5 items relating to asthma symptoms and asthma reliever use over the last 4 weeks. The ACT score ranges from 5 to 25, with a higher score reflecting better asthma control. A score less than 20 indicates poor control. Asthma exacerbation was defined by the requirement for 3 or more days of systemic corticosteroids. Healthcare utilisation comprising primary care visits, emergency department (ED) visits and hospital admissions for asthma exacerbations in the previous 12 months were based on a review of the National Electronic Health Records (NEHR) system. All visits to and medication prescriptions at government primary care clinics (polyclinics) and government hospitals in Singapore are reflected on the NEHR.

A conservative estimation of the direct costs of asthma was calculated based on the costs of maintenance of asthma drugs, unscheduled asthma-related primary care consultations, ED visits and asthma-related hospital admissions. Drug costs were based on unsubsidised retail pricing at our hospital's pharmacy, excluding the 7% Goods and Services Tax (GST). The unit cost per primary care consultation was the non-resident rate of S$44.60 at SingHealth polyclinics.[19] The unit cost per ED visit was our hospital's ED attendance fee of S$115. The cost of each hospitalised day was based on our hospital's unsubsidised private rate of S$430. Our cost calculation for primary care visits, ED visits and hospital stay did not include additional costs incurred for investigations and medications. Unsubsidised drug, medical consultation and hospitalisation costs were used to better reflect actual costs and provide uniformity of cost calculation across patient groups with varying subsidy levels. We did not have available data to

calculate the indirect asthma costs in our cohort.

Patients were considered to have uncontrolled severe asthma if they fulfilled the 2014 ERS/ATS criteria.[1] They had to have uncontrolled asthma defined as 1 or more of the following: poor symptom control with ACT <20; 2 or more asthma exacerbations requiring ≥3 days of systemic corticosteroids in the previous year; 1 or more serious asthma exacerbation requiring hospitalisation in the previous year; or airflow limitation with pre-bronchodilator FEV_1 <80% predicted, despite being on GINA treatment Step 4 or 5. In addition, these patients must have been managed in our clinic for at least 6 months to ensure asthma medication and comorbidities have been optimised.

Data were analysed using SPSS version 22. Estimates using categorical variables were expressed as number (proportions) and continuous variables were expressed as either median (interquartile range [IQR]) or mean (standard deviation [SD]). Comparisons between groups were performed using chi-square test, Mann-Whitney U test or Student's t-test as appropriate. A *P* value <0.05 was taken to be statistically significant.

Results

Demographics

During the study period, 528 patients with physician-diagnosed asthma were managed in our respiratory clinic, of which 423 (80.1%) agreed to participate in the study. The baseline characteristics of the 423 patients are shown in Table 1. Patients who declined to participate in the study (n = 105) were older (median age 59 [45 to 71] years vs 54 [34 to 65] years, *P* = 0.01) and were more likely to be female (61% vs 52.7%, *P* = 0.012).

Although females were older than males in our cohort (median age 59 [44 to 67] years vs 48 [22 to 62] years, respectively, *P* <0.001), the median age of asthma onset in females was also older than males (37 [15 to 50] years vs 18 [7 to 48] years, respectively, *P* <0.001). Consequently, there was no difference in the duration of asthma between males and females.

Although there were disproportionately fewer Chinese and more Malay patients (Table 1) with asthma seen in our clinic cohort as compared to the national population census,[20] there was no difference in ethnic composition between patients who participated in the study and those who declined participation (*P* = 0.418).

Uncontrolled Severe Asthma

Forty-nine patients (11.6%) fulfilled the criteria for uncontrolled severe asthma. Compared to patients with non-severe asthma, patients with uncontrolled severe

Table 1. Baseline Characteristics of Patients

Baseline Characteristics	Values
Age, median (IQR)	54 (34 – 65)
Female, n (%)	200 (52.7)
Race, n (%)	
Chinese	217 (51.3)
Malay	149 (35.2)
Indian	39 (9.2)
Others	18 (4.3)
Smoking, n (%)	
Never smoker	294 (69.5)
Ex-smoker	58 (13.7)
Current smoker	64 (15.1)
Missing data	7 (1.7)
Smoking pack-years, median (IQR)	13 (2 – 23)
Age of onset, median (IQR)	29 (10 – 49)
Early onset <18 years, n (%)	175 (41.4)
Duration of asthma, median (IQR)	17 (7 – 33)
Family history of asthma (first degree relatives), n (%)	194 (45.9)
Presenting symptoms, n (%)	
Dyspnoea	256 (60.5)
Wheeze	286 (67.6)
Cough	293 (36.4)
Chest tightness	154 (36.4)
Self-reported asthma triggers, n (%)	
Dust mite	246 (58.2)
Animal dander	38 (9)
Pollen	3 (0.7)
Irritants	219 (51.8)
Viral infection	207 (48.9)
Exercise	66 (15.6)
Temperature change	160 (37.8)
NSAIDs	1 (0.2)
Work-related symptoms, n (%)	65 (15.4)
History of near-fatal asthma, n (%)	33 (7.8)
Asthma-related comorbidities, n (%)	
Sinonasal disease	134 (31.7)
Gastroesophageal reflux	65 (15.4)
Obesity (BMI >30 kg/m^2)	145 (34.3)
Non-asthma related comorbidities, n (%)	
Hypertension	132 (31.2)
Diabetes mellitus	63 (14.9)
Ischaemic heart disease	37 (8.7)
Self-reported medication adherence, n (%)	312 (73.8)

BMI: Body mass index; ED: Emergency department; FEV_1: Forced expiratory volume in 1 second; ICS: Inhaled corticosteroid; IQR: Interquartile range; LABA: Long-acting beta-agonist; NSAID: Non-steroidal anti-inflammatory drug

Table 1. Baseline Characteristics of Patients (Cont'd)

Baseline Characteristics	Values
Skin prick testing, n (%)	
Positive	57 (13.5)
Negative	6 (1.4)
Not performed	360 (85.1)
Sensitising allergens in patients with positive skin prick testing, n (%)	
Dermatophagoides pteronyssinus	44 (78.6)
Dermatophagoides farinae	42 (75)
Blomia tropicalis	43 (76.8)
Cockroach	12 (21.4)
Cat	19 (33.9)
Dog	13 (23.2)
Aspergillus	6 (10.9)
Asthma preventers, n (%)	
ICS only	79 (18.7)
ICS LABA combination	343 (81.1)
Oral corticosteroids	6 (1.4)
Leukotriene receptor antagonist	62 (14.7)
Theophylline	16 (3.8)
Tiotropium	6 (1.4)
ICS dose (beclomethasone dipropionate dose equivalent), n (%)	
Low dose 200 – 500 ug/d	146 (34.5)
Medium >500 – 1000 ug/d	187 (44.2)
High >1000 ug/d	87 (20.6)
Asthma Control Test score, median (IQR)	21 (18 – 23)
Number of exacerbations, median (IQR)	0 (0 – 1)
Patients with frequent exacerbations ≥2 per year, n (%)	101 (23.9)
Primary care visits, median (IQR)	1 (1 – 2)
ED visits, median (IQR)	1 (1 – 2)
Hospital admissions, median (IQR)	1 (1 – 2)
Pre-bronchodilator FEV_1, L/min, median (IQR)	1.9 (1.37 – 2.53)
Pre-bronchodilator FEV_1, percentage predicted, median (IQR)	76 (64 – 90)

BMI: Body mass index; ED: Emergency department; FEV_1: Forced expiratory volume in 1 second; ICS: Inhaled corticosteroid; IQR: Interquartile range; LABA: Long-acting beta-agonist; NSAID: Non-steroidal anti-inflammatory drug

asthma were older, had a longer duration of asthma and were more likely to be female (Table 2). Other differences between patients with uncontrolled severe asthma and those with non-severe asthma are shown in Table 2. We did not observe any ethnic differences between the 2 groups.

As shown in Table 2, patients with uncontrolled severe asthma had poorer lung function and were more likely to be on high dose inhaled corticosteroids than those with non-severe asthma. In patients with uncontrolled severe asthma, 6.1%, 49% and 3.8% were on add-on tiotropium, leukotriene receptor antagonist and theophylline, respectively. Only 2 patients (4.1%) with uncontrolled severe asthma were on maintenance oral corticosteroids. None were on biologic agents for asthma.

Patients with uncontrolled severe asthma had a median of 2 (0 to 3) exacerbations a year; 51% were considered to be frequent exacerbators with ≥2 exacerbations the past 1 year. In patients with uncontrolled severe asthma, there was no significant difference between the frequent and non-frequent exacerbators in terms of peripheral blood eosinophils levels or comorbidities. A greater proportion of patients with uncontrolled severe asthma had at least 1 primary care visit, ED visit and hospital admission compared to patients with non-severe asthma (Table 2). There was no significant difference in the median hospital length of stay between the 2 groups.

Although patients with uncontrolled severe asthma made up 11.6% of the study cohort, they were responsible for 23.3% of the primary care visits, 23.4% of the ED visits and 43.9% of the hospital admissions. The annual total direct costs for asthma in the entire study cohort was S$459,023, with patients having uncontrolled severe asthma accounting for 31.5% of the total costs. The mean annual total direct asthma costs per person was S$2952 ± S$4225 for uncontrolled severe asthma and S$841 ± S$815 for non-severe asthma. Details of costs breakdown are described in Table 3.

Discussion

Our study is the first to examine the proportion of uncontrolled severe asthma in a restructured hospital in Singapore. We showed that 11.6% of asthma patients in our hospital's respiratory specialist clinic had uncontrolled severe asthma. This figure is comparable to results from a tertiary care hospital in Melbourne, Australia, where 13.3% of asthma patients seen in a respiratory specialist clinic were thought to be challenging to manage.[21]

Patients seen in the respiratory clinic are unlikely to reflect the general asthma population as most of the patients with milder asthma would have been managed at the primary care level. Only the difficult-to-manage cases would be referred on to specialist care.[22] Local data for the proportion of asthma patients managed by respiratory physicians in hospital-based clinics is not available, and we are therefore unable to extrapolate our data to determine the magnitude of uncontrolled severe asthma in Singapore. However, a population study conducted in Asian countries reported that 4.1% of asthmatics in the general population had severe asthma.[23]

Table 2. Comparison of Uncontrolled Severe vs Non-Severe Asthma

	Uncontrolled Severe Asthma (n = 49)	Non-Severe Asthma (n = 374)	*P* Value
Age, median (IQR)	59 (47 – 70)	54 (32 – 65)	0.012
Female, n (%)	33 (67.3)	164 (44.7)	0.003
Race, n (%)			0.199
Chinese	19 (38.8)	198 (52.9)	
Malay	21 (42.9)	128 (34.2)	
Indian	5 (10.2)	34 (9.1)	
Others	4 (8.2)	14 (3.7)	
Smoking, n (%)			0.155
Never smoker	39 (79.6)	255 (68.2)	
Ex-smoker	7 (14.3)	51 (13.6)	
Current smoker	3 (6.1)	61 (16.3)	
Missing data	0	7 (1.9)	
Smoking pack-years, median (IQR)	5 (2 – 5)	13 (2 – 21)	0.788
Age of asthma onset, median (IQR)	35 (12 – 49)	28 (9 – 50)	0.347
Early onset <18 years, n (%)	17 (34.7)	158 (42.2)	0.313
Duration of asthma, median (IQR)	22 (12 – 37)	17 (6 – 32)	0.05
Work-related symptoms, n (%)	10 (20.4%)	55 (14.7%)	0.298
History of near-fatal asthma, n (%)	5 (10.2%)	28 (7.5%)	0.512
Asthma-related comorbidities, n (%)			
Sinonasal disease	16 (32.7)	118 (31.6)	0.886
Gastroesophageal reflux	9 918.4)	56 (15)	0.536
Obesity (BMI >30 kg/m^2)	23 (46.9)	122 (32.6)	0.047
Non-asthma-related comorbidities, n (%)			
Hypertension	20 (40.8)	112 (29.9)	0.123
Diabetes mellitus	13 (26.5)	50 (13.4)	0.015
Ischaemic heart disease	5 (10.2)	32 (8.6)	0.701
High dose ICS (beclomethasone dipropionate >1000 ug/d), n (%)	47 (95.9)	40 (10.7)	<0.001
Asthma Control Test score, median (IQR)	18 (12 – 21)	21 (19 – 24)	<0.001
Patients with frequent exacerbations ≥2 per year, n (%)	25 (51)	76 (20.3)	<0.001
At least 1 primary care visit, n (%)	21 (42.9)	63 (16.8)	<0.001
At least 1 ED visit, n (%)	19 (38.8)	83 (22.2)	0.033
At least 1 hospital admission, n (%)	17 (34.7)	45 (12)	<0.001
Number of primary care visits, median (IQR)	1 (1 – 2)	1 (1 – 2)	0.892
Number of ED visits, median (IQR)	2 (1 – 3)	1 (1 – 2)	0.453
Number of hospital admissions, median (IQR)	1 (1 – 3)	1 (1 – 1)	0.02
Duration of hospital stay, median (IQR)	4 (3 – 8)	3 (2 – 5)	0.213
Pre-bronchodilator FEV_1, L/min, median (IQR)	1.44 (1.01 – 2.19)	1.96 (1.47 – 2.64)	<0.001
Pre-bronchodilator FEV_1, percentage predicted, median (IQR)	68 (57 – 87)	77 (65 – 91)	0.018
Patients with peripheral blood eosinophil ≥0.3 x 10^9/L, n (%)	18 (39.1)	144 (50.3)	0.158

BMI: Body mass index; ED: Emergency department; FEV_1: Forced expiratory volume in 1 second; ICS: Inhaled corticosteroid; IQR: Interquartile range

Despite making up about 12% of the patients with asthma seen in our respiratory outpatient clinic, those with uncontrolled severe asthma accounted for nearly half of the total hospital admissions. Furthermore, half of the patients with severe asthma had frequent exacerbations and were more likely to have had at least 1 asthma-related healthcare visit in the past year. Our results are not surprising since increasing asthma severity has been associated with

Table 3. Annual Direct Costs* Per Patient of Asthma

	All Patients (n = 423)	Uncontrolled Severe Asthma (n = 49)	Non-Severe Asthma (n = 374)
Hospital admission costs, mean (SD)	346 ± 1460	1509 ± 3842	193 ± 573
ED visit costs, mean (SD)	57 ± 144	115 ± 228	49 ± 127
Primary care visit costs, mean (SD)	16 ± 49	32 ± 49	14 ± 45
Maintenance asthma drug costs, mean (SD)	667 ± 433	1296 ± 354	585 ± 370

ED: Emergency department; SD: Standard deviation
*In Singapore dollars.

greater healthcare use.[5,6] More than half of the asthmatics in a population study conducted in Asia[23] had at least 1 hospital emergency room or unscheduled emergency visit for asthma in a 12-month period. Pooled analysis of data from various severe asthma clinics in the United Kingdom found that more than 80% of patients had at least 1 ED or primary care visit, and almost half had at least 1 hospital admission for asthma in the past year.[24]

Yii et al recently described a cohort of patients with severe asthma in Singapore although the proportion of patients seen in their institution with severe asthma was not reported.[25] Similar to our findings, they reported high healthcare utilisation in their cohort. About 50% of their patients had an ED visit in the past 2 years, and 20% of the patients had a hospital admission for asthma in the past 2 years.

Increased healthcare utilisation has been shown to translate into direct asthma costs.[26,27] Patients with uncontrolled severe asthma had direct asthma costs that was more than 3 times higher than non-severe asthma in our cohort, largely attributable to the higher hospital admission costs. The Asthma Insights and Reality in Asia-Pacific (AIRIAP) study conducted in general asthma patients showed that urgent asthma care, as compared to maintenance care, accounted for a higher proportion of total care costs in many Asian countries, including China and Hong Kong.[28] The same study also showed that poor asthma control was responsible for significantly increasing urgent care costs.

Although not examined in our study, asthma morbidity resulting in loss of work productivity also contributes to asthma costs indirectly. A study conducted in the United Kingdom found that indirect asthma costs, estimated using the Disability Living Allowance, made up 13.2% of asthma costs.[26] Indirect asthma costs may even account for the majority of total asthma costs in certain populations.[29] A survey conducted in Singapore by Ng et al found a significant association between absence from work and acute healthcare resource use.[15] Therefore, apart from adversely impacting patient health outcomes, severe uncontrolled asthma has substantial economic and societal ramifications as well.

Our study and that of others[21] showed that a substantial proportion of patients with asthma who were managed by specialists would continue to have uncontrolled severe asthma. This was likely due to the complexity and heterogeneity of severe asthma. Some patients who may have truly treatment-resistant asthma would benefit from phenotype-targeted immunotherapy.[30-32] Others may have additional diagnoses or comorbidities contributing to poor asthma control.[33] There is increasing evidence to show that dedicated severe asthma clinics, through systematic evaluation, can improve asthma outcomes even in patients already managed by specialists.[24,34]

Limitations

We recognise certain limitations in our study. Firstly, a relatively large proportion of patients (19.9%) declined to participate in the study. We were unable to ascertain the study impact of differences between participants and non-participants. Secondly, we established healthcare utilisation based on visits recorded in the NEHR system. This would have missed healthcare visits to private clinics and hospitals which may result in an underestimation of asthma-related primary care visits as the majority of primary healthcare services are provided by private practitioners.[35] However, the reverse is true of hospital-related healthcare and we would have included most of the ED visits and hospital admissions. Thirdly, asthma was diagnosed based on clinician impression and not all patients had objective evidence of variable airflow obstruction. As this was an observational study, including only patients with objective evidence of variable airflow obstruction would lead to under-representation of a large proportion of our asthma cohort. Fourthly, medication adherence was based on patient report, which is notoriously inaccurate.[36] However, we did not have access to objective methods of adherence measurements, such as electronic dose monitors and pharmacy prescription refills. Lastly, we were unable to calculate the indirect asthma costs in our cohort due to

unavailability of relevant data. Tan et al recently described the direct and indirect asthma costs in a cohort of asthma patients seen at primary care clinics in Singapore.[37] In that study, indirect costs was about 12% of the direct costs. This figure is likely to be higher in uncontrolled severe asthma due to the higher frequency of exacerbations.

Conclusion

Patients with severe asthma make up about 12% of patients with asthma seen in the respiratory specialist clinic. Although representing a minority of the general asthma population, they account for a disproportionate amount of healthcare utilisation. Further understanding of the relevant mechanistic pathways driving poorer outcomes in severe asthma in our local context, as well as strategies to better manage this group of patients, are needed.

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Appendix 1

Patient initials:

Patient number:

Date:
Weight:_____
Height:_____
BMI:_____

(i) Demographics
Occupation: _____

Smoking
❒ Yes: Number of pack-years: ____
❒ No
❒ Ex-smoker (quit for ≥ 6 months)

(ii) Asthma history
Age of onset (symptoms): _____
If age of onset >12 yr old, any wheeze present in childhood (≤12years): ❒ Yes ❒ No

Symptoms at presentation (check all that apply)
❒ SOB ❒ Cough
❒ Wheeze ❒ Chest tightness

Triggers of symptoms (check all that apply)
❒ Environment:
- ❒ Dust mites
- ❒ Animal fur
- ❒ Pollen

❒ Irritants
- ❒ Smoke
- ❒ Chemicals
- ❒ Strong odors

❒ Temperature change

❒ Exercise

❒ Viral infection

❒ Medications
- ❒ NSAID
- ❒ B blockers

❒ Strong emotions

❒ Hormonal
- ❒ Menstrual cycle
- ❒ Pregnancy
- ❒ HRT/OCP

❒ Others: Specify _____

Continued exposed to any of the identified triggers (excluding temperature, exercise, emotions)?
❒ Yes ❒No

Symptoms related to workplace (worse at work, better during weekends or holidays)
❒ Yes ❒ No ❒ NA

History of near fatal asthma (needing invasive or non-invasive mechanical ventilation)
❒Yes ❒ No

Family history of asthma: ❒ Yes ❒ No
If yes, specify:
❒ Parents
❒ Siblings

(iii) Comorbidities
❒ Rhinosinus disease
Treatment: ❒Yes ❒ No

❒ GERD
Treatment: ❒Yes ❒ No

❒ Eczema
Treatment: ❒Yes ❒ No

Skin prick test: ❒ Done ❒ Not done
Date: _____
❒ Positive:
❒D Pteronyssinus ❒D Farinae ❒Blomia ❒Cockroach
❒Cat ❒Dog ❒Peanut ❒Aspergillus
❒ Negative

(iv) Current medication
On controllers: ❒ Yes ❒ No
Compliance: ❒ Yes ❒ No
Type of controllers
❒ ICS
Specify: ❒ Beclomethasone ❒ Budesonide ❒ Others
❒ ICS + LABA
Specify: ❒ Seretide ❒ Symbicort ❒ Zenhale ❒ Others
❒ Leukotriene antagonist eg montelukast
❒ Theophylline
❒ Tiotropium
❒ Long term oral steroids (prednisolone)

Dose of ICS

	Low dose (ug/d)	Medium dose (ug/d)	High dose (ug/d)
Beclomethasone dipropionate	❒ 200-500	❒ >500-1000	❒ >1000
Budesonide	❒ 200-400	❒ >400-800	❒ >800
Fluticasone	❒ 100-250	❒ >250-500	❒ >500
Mometasone	❒200	❒≥400	❒≥800
Others	Specify:		

(v) Asthma control
ACT score: _____

Written asthma action plan:
❒ Yes ❒ No

SECTION D

Date of first respiratory clinic consult: _____

Age: _____
Gender: ❒ Male ❒ Female
Race: ❒Chinese ❒Malay ❒Indian ❒Others

(i) Health care use past 12 months (requiring ≥3days of steroid bursts)
Primary care visits
❒ Yes: Number of visits _____ ❒ No

A&E visits
❒ Yes: Number of visits _____ ❒ No

Hospital admissions
❒ Yes: Number of admissions _____ ❒ No
ICU admissions: ❒ Yes ❒ No

(ii) Other comorbidities
❒ Hypertension
❒ DM
❒ IHD
❒ OSA
❒ Psychiatric illness
❒ Anxiety ❒ Depression ❒ Others _____

(iii) Medications (past 6 months)
Antihistamines: ❒ Yes ❒ No
Nasal steroids: ❒ Yes ❒ No
GERD medication: ❒ Yes ❒ No
Aspirin: ❒ Yes ❒ No
NSAIDs: ❒ Yes ❒ No
ACE-I: ❒ Yes ❒ No
ARB: ❒ Yes ❒ No
B1 specific blockers: ❒ Yes ❒ No
Non selective B blockers: ❒ Yes ❒ No

(iv) Lung function:
❒ Done: Date _____ ❒ Not done

	Pre	% Predicted	Post	% predicted	%change
FEV1 (L)					
FVC (L)					
FEV1/FVC (%)					
FEF25-75 (L/sec)					

Methacholine challenge test
❒ Done: Date: _____ PC20 (mg/ml) _____
❒ Not done

CXR/CT
❒ Not done
❒ Normal
❒ Hyperinflated
❒ Other abnormalities: Specify _____

Investigations available
Blood eosinophil count: ❒ Done ❒ Not done
Date:_____
Absolute: _____
Percentage: _____

Blood neutrophil: ❒ Done ❒ Not done
Date: _____
Absolute: _____
Percentage

Serum IgE: ❒ Done ❒ Not done
Date: _____
Value: _____

FeNO: ❒ Done ❒ Not done
Date: _____
Value: _____

(v) Asthma diagnosis
❒ Objective asthma diagnosis ❒ Clinical diagnosis
❒ FEV1 or FVC BDR ≥20% + ≥200ml
❒ MCT positive (PC20 <16mg/ml)

(vi) Meets GINA criteria for severe asthma: ❒ Yes ❒ No
Step 4 or 5 of GINA treatment
GINA symptoms 'uncontrolled' or ACT score <20