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Reducing SABA overprescribing in asthma: lessons from a Quality Improvement prescribing project in East London

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What is known

Excess prescription and use of short-acting beta-agonist (SABA) inhalers is associated with poor asthma control and increasing risk of hospital admission. Excess SABA prescription remains a frequent finding in primary care even in those who have regular asthma checks.

What this study adds

Evidence from all 117 practices in one inner-city area of London demonstrates that overprescribing (≥6 SABA a year) affects 26% of the asthma population. Among the study practices there was a 12-fold variation in overprescribing rates. Assessment of inhaled steroid prescription uptake by patients suggests that underuse remains common. Analysis using logistic regression reveals that repeat

dispensing (whereby prescriptions are issued automatically) is strongly linked to overprescribing. Providing practices with tools to support the identification and management of high-risk patients based on prescribing records is warranted.

Abstract

Background

Excess prescription and use of short-acting beta-agonist (SABA) inhalers is associated with poor asthma control and increased risk of hospital admission.

Aim

To quantify the prevalence, and identify the predictors of SABA overprescribing.

Design and Setting

Cross-sectional study using anonymised clinical and prescribing data from the primary care records in three contiguous east London boroughs.

Methods

Primary care medical record data for patients aged 5 – 80 years, with 'active' asthma were extracted in February 2020. Explanatory variables included demography, asthma management, co-morbidities and prescriptions for asthma medications.

Results

In the study population of 30,694 people with asthma, 26% were prescribed ≥6 SABA inhalers in the previous year. A ten-fold variation between practices (<6% to 60%) was observed in the proportion of patients on ≥6 SABA inhalers/year.

By converting both SABA and ICS to standard units we improved the accuracy of comparisons across different preparations. 25% of those taking ≥6 SABA/year were underusing ICS, this rose to 80% for those prescribed <6 SABA/year. Prescription modality was a strong predictor of SABA overprescribing, with repeat dispensing strongly linked to SABA overprescribing (OR 6.52, (95% CI 4.64 to 9.41)). Increasing severity of asthma and multimorbidity were also independent predictors of SABA overprescribing.

Conclusion

In this multi-ethnic population a fifth of practices demonstrate an overprescribing rate of <20% a year. Based on previous data, supporting practices to enable the SABA≥12 group to reduce to 4-12 /year could potentially save up to 70% of asthma admissions a year within that group.

Background

Frequent use of short acting beta-agonists (SABAs) is a recognised marker of poor control[1] and a potentially modifiable warning sign of impending serious asthma attacks[2,3,4,5,6] and asthma death.[7,8,9,10,11] Asthma control is defined as the extent to which the manifestations of asthma, commonly wheeze, shortness of breath, chest tightness, cough and variable expiratory airflow limitation, can be observed in a patient on their current treatment.[12,13,14,18,19] Control can be assessed by current symptoms and is indicative of future adverse outcomes.[1,12] In East London, hospitalisation for acute asthma is 14% above the average for London, with hospital admissions rising from 1.3 to 7.5 per 100 asthma population as the number of SABA inhalers prescribed rises from 1–3 to more than 12 a year.[15] In addition to the individual patient harm associated with excess prescription of SABA, the pMDIs (pressurized Metered-Dose Inhalers) are a major contributor to healthcare associated carbon footprint, and thereby global warming.[16] Hence reducing SABA over-prescribing is important both for individuals and for global health.

The dangers of SABA over-prescribing have been highlighted in national (BTS[5], NRAD) and international[12] (GINA) guidance for many years. However, SABA overprescribing remains common across healthcare systems as highlighted in the recent SABINA studies.[6] Notably, SABA overprescribing is more common in the UK than other European countries. Recent data show that SABA overuse (defined as collection of more than two SABA canisters/year) is associated with a dose-dependent increased risk of all-cause mortality, increased use of antidepressants, hypnotics and sedatives, suggesting that those overprescribed SABA are a frailer patient group.[17] Another recent study found that SABA overuse (≥3 prescribed inhalers/year) was prevalent across all GINA steps, which may indicate suboptimal asthma control,[18] and concludes that further studies need to investigate the reasons behind SABA over-prescribing,[18] as well as effective interventions to reduce it.

Electronic alerts can reduce excessive prescribing of SABAs, when delivered as part of a multicomponent intervention.[19] Asthma UK in conjunction with EMIS Web released a prescribing alert to highlight patients prescribed excessive SABA (add the date of this intervention). This activates if there are 3 prescriptions for SABA within a 3-month period. However, this assumes that only one device is issued per prescription and may underestimate SABA over-prescribing over the longer-term.

This report forms the initial phase of a quality improvement programme to reduce SABA over-prescribing in east London. In this first step we aim to:

1) Describe baseline data on SABA over-prescribing in East London
2) Standardise the calculation of prescription rates for SABA and ICS inhalers across formulations, taking into account the number of items on prescriptions
3) Examine prescription modality as a previously underappreciated factor in SABA over-prescribing.

Methods

Design and setting

A cross-sectional study using primary care electronic health data from 734,382 patients registered at all 117 practices in the east London boroughs of Newham, Tower Hamlets and Waltham Forest.

In the 2011 UK census, 55% of the population in these boroughs were recorded as being of non-white ethnic origin,[20] and the English indices of deprivation 2015 show that these localities fall into the top decile of the most socially deprived boroughs in England. [21]

The study population included patients aged 5-80 years registered at the practice for at least one year prior to data extraction in February 2020. All subjects had a coded diagnosis of asthma and at least one prescription for inhaled asthma medication in the previous year.

Data collection

Data were extracted on secure N3 terminals from EMIS Web. All data were anonymous and managed according to UK NHS information governance requirements.

Demographic variables included age, sex and self-reported ethnicity captured at registration with the practice or during routine consultations. Ethnic categories were based on the 18 categories of the UK 2011 census and were combined into four groups reflecting the study population.

Clinical measures included the latest value for smoking status, body mass index (BMI) and BTS asthma management step. To assess the burden of long-term conditions in the study population diagnostic data were extracted on 16 conditions that form part of the UK Quality and Outcomes Framework (QOF),[22] using the earliest recorded diagnostic code before the start of the study, based on version 44 of the QOF business rule set. To this we added SNOMED codes[23] for chronic rhinitis and generalised anxiety.

Prescribing data included all inhaled asthma medications and discrete courses of oral steroids in the previous year. All SABA inhalers were standardised to Salbutamol 100micrograms/dose (200 dose inhaler), and all inhaled steroid preparations were standardised using a method presented in the Supplementary materials (S1).

Prescribing modalities included acute (provided by clinicians in response to an acute episode of illness) and automatic (automatic prescriptions are used for patients who will require medication without fail each month, for example nursing home residents) repeat prescribing (regular long-term medications) and repeat dispensing (issued by a pharmacist from pre-authorised prescriptions for up to a year).

Statistical analysis

The primary outcome measure was the proportion of asthma patients prescribed ≥6 standard SABA 100micrograms/dose (200 dose Salbutamol inhaler) equivalent inhalers in the previous 12 months. All statistical analysis was undertaken in R (version 4.0.2). Both univariate and multivariate models were fitted. Sensitivity analyses were conducted to explore different groupings of co-morbidities.

Results

Among the GP registered population of 734,382, there were 30,694 people with asthma who fitted the study criteria. (see supplementary file S2). The characteristics of the study population are shown in Table 1, with the univariate odds for SABA overprescribing (≥ 6 SABA a year). Older adults had higher risks of SABA over-prescribing, as did those with increasing numbers of physical and mental co-morbidities. Prescription modality – in particular repeat dispensing - was also strongly associated with the risk of SABA over-prescribing.

In keeping with more severe disease, there was a significant association between higher asthma management step and increased SABA prescriptions. Furthermore, consistent with airways inflammation as a risk factor for uncontrolled asthma, there was a significant association between eosinophilia (eosinophil count ≥ 0.3) and SABA over-prescribing.

Children were found to have the lowest risk of SABA over-prescribing, hence subsequent analyses have been undertaken in the adult population only.

Table 1 here

Analysis by GP practice (see Figure 1) shows a ten-fold variation between practices in the percentage of asthma patients prescribed ≥6 SABA in the previous 12 months (range <6% to 60%). This variability was distributed uniformly across practices of all sizes. About one fifth of practices had an over-prescribing rate of less than 20%.

Figure 1 here

To identify factors associated with SABA overprescribing among adults we used a multivariate model (Table 2). Severity of asthma, as measured by asthma step and by numbers of oral steroid prescriptions, were both major independent predictors of SABA over-prescribing.

The multivariate analysis confirmed that older adults (OR 1.34, (95% CI 1.24 to 1.45)), smoking and increasing numbers of both physical and mental co-morbidities were independent predictors of SABA over-prescribing.

We also confirmed that prescribing modality, and in particular repeat dispensing (where repeat medications are managed by community pharmacists) was strongly associated with excess SABA use. Repeat dispensing compared to repeat prescribing had an OR of 6.5 (95% CI 4.6 to 9.4). Although patients on repeat dispensing only represent about 1% of the population with asthma (*243/23893 in Table 2*), 84% of them (*204/243*) were prescribed ≥6 SABA/year.

Table 2 here

Previous studies have suggested that over-prescribing of SABA is associated with underuse of inhaled corticosteroid (ICS). Using the more precise measures of the Medication Prescription Refill (MPR) % for preventer ICS/ICS-LABA inhalers, which compares prescribed ICS against standard expected use, we were able to categorise ICS use for each patient for the previous twelve months as: MPR under-use

(<50%); MPR expected-use (≥ 50% to 120%) and MPR over-use (> 120%) (see Table 3 and supplementary file S1 for further details).

We examined MPR use across the range of SABA prescribing in the previous year. Figure 2 shows the fall in higher-than-expected ICS use (labelled 'MPR over prescribing') in parallel with the fall in number of SABA inhalers issued. It also shows that among patients prescribed between 6-12 SABA inhalers/year (likely a population with less controlled asthma) over a quarter of patients were issued ~~less~~ fewer ICS prescriptions than expected ('MPR under prescribing'). More than 80% were under prescribed ICS in the group of patients with SABA prescriptions below 6 a year (likely a population with milder, better controlled asthma). Patients prescribed between 6-12 SABA inhalers a year and under prescribed MPR are a target group to focus on to reduce SABA overprescribing, as they are likely to have significant asthma but inadequate preventive treatment that if improved will reduce their SABA overprescribing. Some may have significant asthma but inadequate preventive treatment that if improved will reduce their SABA prescriptions, others may need a review of their asthma diagnosis.

Figure 2 here
Table 3 here

To calculate how many hospital admissions could be avoided by improving asthma management and hence reducing SABA overprescribing, we used the results of a previous publication[15] based in the same population. In this publication, the hospital admission rate for SABA ≥12 was 7.5%/year. As an estimate, by enabling a reduction of SABA prescribing of this group to between 4-12 SABA (associated with a hospital admission rate of 2.3%/year), there is potential to avoid up to 70% of hospital admissions in this group.

Discussion

Summary

Rates of SABA over-prescribing remain high in this multiethnic, deprived urban population, with significant variation among practices. About one fifth of practices achieved a SABA over-prescribing rate of less than 20%.

By converting both SABA and ICS to standard units we were able to make more accurate comparisons across prescribed medications.

We found that among adults patients prescribed between 6 and 12 SABA inhalers/year (representing a population with less controlled asthma) over a quarter of patients were issued less ICS prescriptions than expected. Working with these patients to improve regular preventer use should be an early target to reduce SABA over-prescribing by improving their asthma control and reducing breakthrough asthma symptoms for which they may take reliever medication.[24]

Logistic regression analysis shows that alongside markers of asthma severity, multimorbidity and the type of prescription are important independent predictors of SABA overprescribing.

Strengths and limitations

The study results are based on asthma cases from a population of almost one million GP-registered patients in east London using prescribing data for a full year prior to data extraction. Results from this study will be generalisable to other multi-ethnic inner urban populations in the UK. With over 93% ethnicity recording, we were able to explore the contribution of ethnicity and deprivation alongside other established risk factors for SABA prescribing.

The asthma population in this study is based on diagnostic codes and asthma medication prescribed in the previous year, however asthma over-diagnosis is known to occur in primary care[25] hence some cases may have alternative diagnoses. The study measures prescriptions issued rather than medication taken. Receiving a prescription does not necessarily mean that the prescription was filled and used, and it is possible that 'stock-piling' inhalers may inflate estimates of SABA over-prescribing. It will also contribute to medication waste. The MPR calculations, comparing prescribed medication against standard expected use, are based on typical regimes for specific inhalers, not the actual prescribed dosing frequency for individuals.

Comparison with existing literature

Our results showing rates of SABA overprescribing are consistent with those reported in a recent Swedish study[20] patients aged 12-45 years and a German study of >12years old[21], which found that about a third of patients with asthma are prescribed >3 SABA/year. In common with our study they developed a standard measure for ICS (low, medium and high dose), using budesonide equivalent doses.[17]

Consistent with our findings, the proportion of patients with SABA overprescribing was higher in patients at GINA steps 3–5 compared with those at GINA step 1 or 2, a sign of poor asthma control in patients with severe asthma.[20] This poor control was observed despite patients receiving ICS/LABA. Indeed, at GINA steps 3–5, the risk of SABA overprescribing was highest in patients using ICS/LABA. A recent multinational qualitative study[26] aimed at identifying drivers of patients' reliance on SABA in asthma revealed that patients can have a strong emotional attachment to SABA relievers, driven by their efficacy and success in quickly alleviating symptoms. Moreover, some patients typically do not understand that the frequent use of SABAs indicates poor asthma control, while others have a misperception of ICS, which could lead to a delay in escalation and poor adherence. Experiencing severe exacerbations can improve adherence to ICS, but only temporarily in many cases. Further, some adolescents and young adults who are high users of SABA adapt poorly to having asthma and have poor asthma control: overuse of SABA is a convenient way to enable them to live their lives[27].

Implications for research and/or practice

The wide variation in SABA overprescribing rates between practices in the same localities suggest there is potential to improve over-prescribing rates in higher-prescribing practices. Sharing data on comparative prescribing rates between practices encourages reflection and the development of shared strategies for the reduction of over-prescribing.[28]

Providing practices with software tools to identify asthma patients at high risk of hospital admission based on prescribing records is warranted. Such tools should be integrated with the software used by primary care teams, and enable the automatic flagging of patients over-prescribed SABA. Engaging practice teams to deliver systematic, structured asthma reviews is key to the optimisation of asthma management and prescribing.

Tackling SABA overreliance aligns with both the drive to improve asthma control and the drive to reduce the environmental impact of asthma care. This context offers an opportunity to significantly reduce the carbon footprint of the NHS.

Our results highlight the importance of general practice teams working effectively with pharmacists, to ensure a shared understanding on access to SABA medications. In some cases this may require removing SABA medications from repeat dispensing.

Improving asthma management, by adequate preventer treatment, education and regular support can translate into a reduction in acute hospital admissions. If all practices were enabled to support patients prescribed >12 SABA a year to reduce to 4-12 /year there is potential to reduce up to 70% of asthma admissions a year for this group.

Declarations

Funding

The project was funded by Barts Charity reference MGU0419. REAL- Health: REsearch Actionable Learning Health Systems Asthma programme.

Ethical approval

Ethical approval was not required for this study as patient-level data are anonymised, and only aggregated patient data are reported in this study. All GPs in the participating east London practices consented to the use of their anonymised patient data for research and development for patient benefit.

Data sharing

All data relevant to the study are included in the article.

Competing interests

The authors have declared no competing interests**.**

Author contribution

The study was designed by AS, SH, PP and CG. Data analysis was by HH. The report was written by AS and SH with contributions from all authors.

Acknowledgements

The authors are grateful to the participating GPs for their cooperation, without which, such studies would be impossible. The authors wish to thank staff at CEG for supporting practices with guidance and data entry tools which support this project.

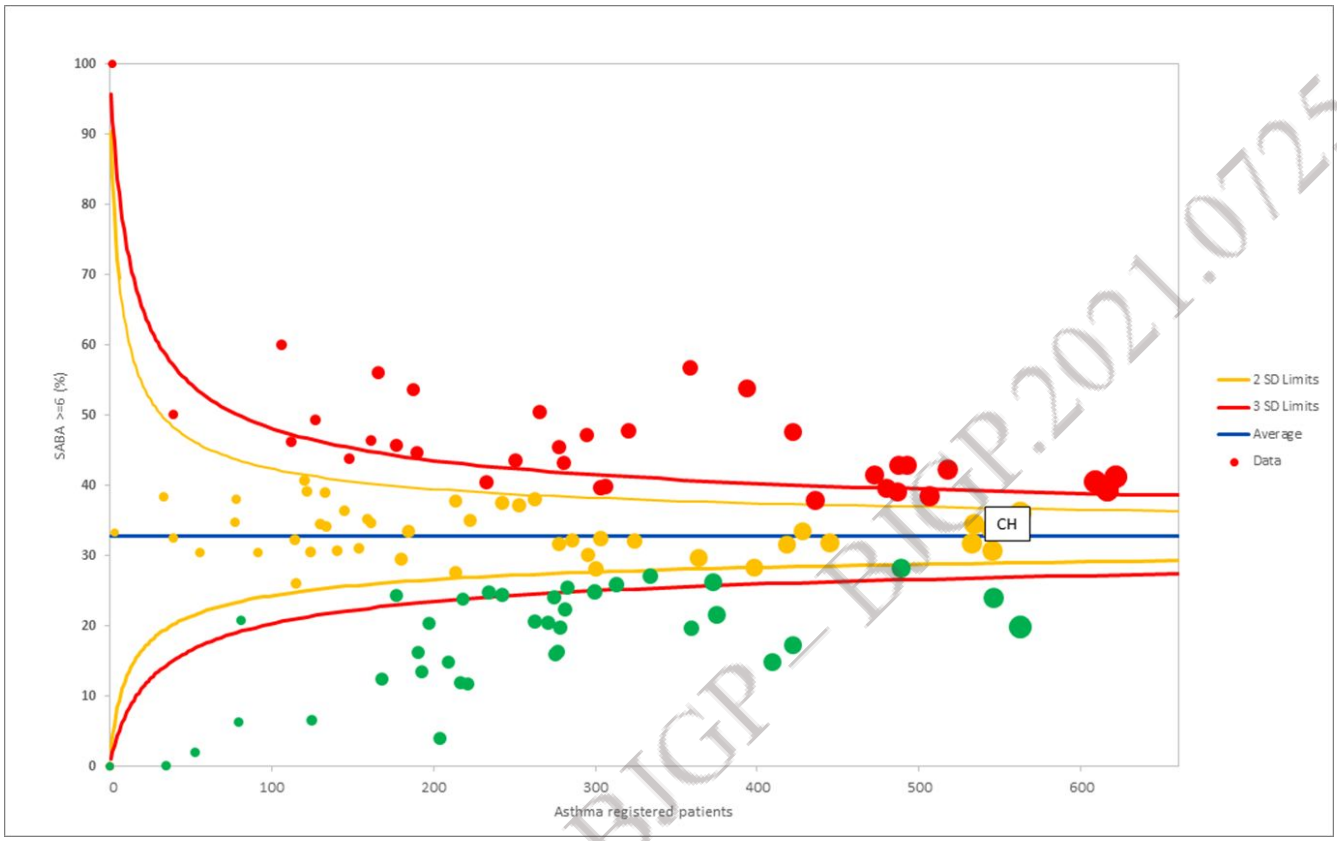
Table 1. Characteristics of the asthma study population.

Variables		Numbers		Univariate analysis*			
		SABA <6	SABA ≥6	OR	2.50 %	97.50 %	p-value
Age	Adult (18-60)	13098	5970	Ref			
	Child (5-17)	4828	1972	0.90	0.84	0.95	0.00
	Older adult (>60)	2686	2139	1.75	1.64	1.86	0.00
Gender	Male	9276	4651	Ref			
	Female	11336	5430	0.96	0.91	1.00	0.06
Ethnicity	White	7048	3664	Ref			
	Mixed	1052	474	0.87	0.77	0.97	0.02
	Asian or Asian British	8572	4388	0.98	0.93	1.04	0.58
	Black	2011	823	0.79	0.72	0.86	0.00
	Other	243	109	0.86	0.68	1.08	0.21
	Not Stated/unclassified	1686	624	0.71	0.64	0.79	0.00
IMD score	1 (least deprived)	2822	1306	Ref			
	2	3756	1751	1.01	0.92	1.10	0.87
	3	4526	2235	1.07	0.98	1.16	0.12
	4	5199	2506	1.04	0.96	1.13	0.33
	5 (most deprived)	4309	2283	1.14	1.05	1.24	0.00
Prescription Type	Repeat	11416	7895	Ref			
	Acute and Automatic***	9152	1955	0.31	0.29	0.33	0.00
	Repeat Dispensed	44	231	7.59	5.55	10.63	0.00
Smoking	Never	15345	6823	Ref			
	Current	2417	1538	1.43	1.33	1.53	0.00
	Ex	2850	1720	1.36	1.27	1.45	0.00
Asthma Step	step 1	3396	911	Ref			
	step 2	8415	4292	1.90	1.75	2.06	0.00
	step 3	2029	1998	3.67	3.34	4.04	0.00
	step 4+step5	155	352	8.47	6.93	10.39	0.00
	unknown	6617	2528	1.42	1.31	1.55	0.00
Oral Steroid Courses	zero	17622	7565	Ref			
	1	2159	1373	1.48	1.38	1.59	0.00
	2	463	480	2.41	2.12	2.75	0.00
	>=3	368	663	4.20	3.69	4.78	0.00
Physical co-morbidities	0	8263	3113	Ref			
	1	8102	3618	1.19	1.12	1.25	0.00
	2-3	3618	2677	1.96	1.84	2.10	0.00
	≥4	629	673	2.84	2.53	3.19	0.00
Mental co-morbidities	0	15314	6703	Ref			
	1	2926	1667	1.30	1.22	1.39	0.00
	2	2218	1528	1.57	1.47	1.69	0.00
	3	154	183	2.71	2.19	3.37	0.00
MPR category**	reasonable use	2826	5109	Ref			
	zero use	4360	657	0.083	0.07	0.09	0.083

	under use	13314	2109	0.082	0.08	0.09	0.082
	over use	112	2206	10.80	8.73	13.53	10.80
Eosinophil count	No count	683	227		-		
	<0.3	8707	4375		Ref		
	>=0.3	6394	3507	1.2	1.060	1.182	0.000

**univariate odds of using ≥6 SABA inhalers in the previous 12 months*
***MPR category: see details of MPR calculation in S1*
**** The number of patients on Automatic prescription was 285 for SABA <6 and 228 for SABA≥6, respectively.*

Figure 1. Funnel plot illustrating practice variation in the proportion of patients with asthma prescribed ≥6 SABA inhalers in the previous 12 months (Y axis). Data from 117 practices in east London, February 2020.



Each dot represents a practice.
The Y axis is the % of asthma patients prescribed ≥6 SABA
The X axis shows the size of the asthma population in the practice (larger dots represent practices with larger asthma population).

Table 2. Logistic regression model showing the predictors of SABA over prescribing (≥6 SABA in the previous 12 months) for adults with asthma.

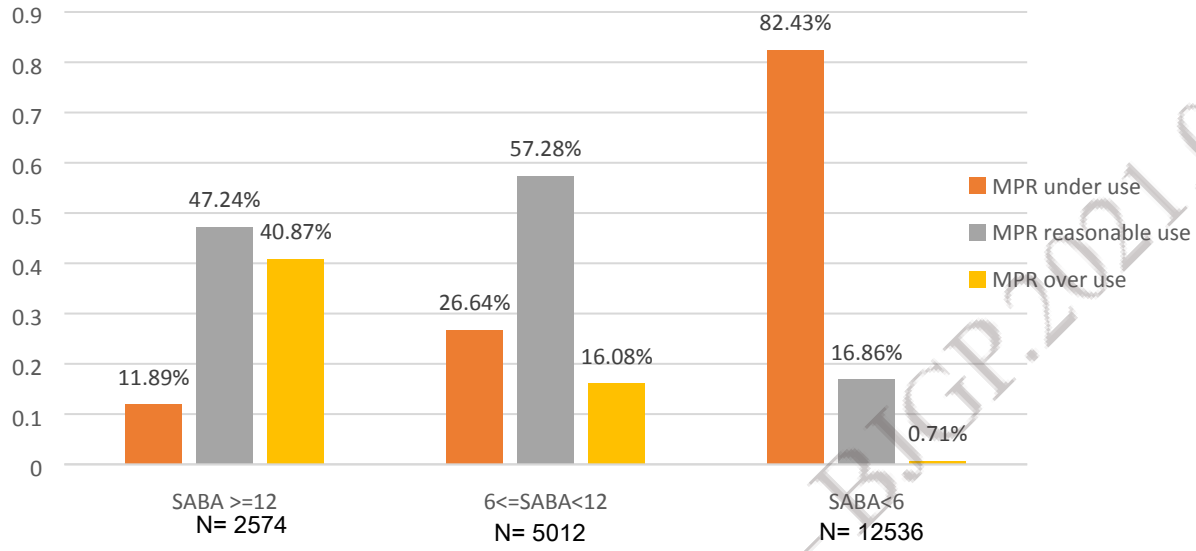
Variables		Numbers		Multivariate Logistic Model[a,b]			
		SABA <6	SABA ≥6	OR	2.50%	97.50%	P-value
Age	adult	13098	5970				
	older adult (>60)	2686	2139	1.34	1.24	1.45	0.00
Gender	Male	6392	3430				
	Female	9393	4679	0.85	0.90	0.80	0.00
Ethnicity	White	6066	3297				
	Mixed	6082	3297	0.87	0.75	1.00	0.39
	Asian or Asian British	1568	655	1.13	1.05	1.21	0.02
	Black	778	352	0.94	0.84	1.06	0.15
	Other	186	81	1.01	0.76	1.36	0.03
	Not Stated/unclassified	1104	427	0.84	0.74	0.96	0.03
Prescription Type	Repeat	8671	6392				
	Acute and automatic	7074	1513	0.29	0.27	0.31	0.00
	Repeat Dispensed	39	204	6.53	4.64	9.41	0.00
Smoking	Never	10512	4848				
	Current	2395	1524	1.51	1.38	1.63	0.00
	Ex	2840	1716	1.21	1.13	1.32	0.00
Asthma Step	step 1	2485	670				
	step 2	6218	3289	1.79	1.62	1.97	0.00
	step 3	1864	1826	2.87	2.56	3.21	0.00
	step 4+5	136	323	4.99	3.96	6.30	0.00
	unknown	5082	2001	1.19	1.05	1.35	0.00
Oral Steroid	zero	13188	5955				
	1	1851	1139	1.35	1.21	1.45	0.00
	2	392	412	2.67	1.82	2.48	0.00
	≥3	354	603	2.90	2.46	3.31	0.00
Physical co-morbidities	0	5401	2044				
	1	6307	2802	1.07	1.00	1.16	0.05
	2-3	3448	2591	1.58	1.47	1.73	0.00
	≥4	628	672	1.86	1.61	2.13	0.00
Mental co-morbidities	0	10630	4795				
	1	2796	1612	1.19	1.10	1.28	0.00
	2	2204	1519	1.32	1.22	1.44	0.00
	3	154	183	2.29	1.80	2.91	0.00

a. this model is adjusted by Index of Multiple Deprivation (IMD) score
b. this model is mixed effect multivariate logistic regression, which includes clustering based on the practice (Newham, Tower Hamlet and Waltham Forest). The adjusted interclass correlation coefficient (ICC) of this variable is 0.006, which is negligible.

Table 3. ICS categorization based on Medication Prescription Refill (MPR) percentage *(see S1 for methods)*

Description	MPR %
Over-prescribing	≥ 120
Expected-prescribing	≥ 50 to 120
Under-prescribing	<50

Figure 2. Medication Prescription Refill (MPR) Rate* for ICS for the different categories of SABA prescribing (SABA≥12, 6≤ SABA ≤ 12, and SABA ≤6) among adult patients prescribed ICS in the previous year.



See details of MPR calculation in S1

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