

Detection of Treatment Adherence, Disease Control and Its Predictors in Asthma Patients by Rural Community Level Health Workers

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ABSTRACT

Background: Despite the availability of effective therapy, disease control in Asthma remains suboptimal with high morbidity. **Objectives:** To assess treatment adherence, asthma control and its influencing factors.

Methodology: A prospective, observational study was conducted among 152 adult asthma patients reporting consecutively to a BPHC for twelve months. Patients were followed up by trained healthcare workers to assess their treatment adherence and disease control using a predesigned, pretested and validated questionnaire.

Results: Mean age was 49.6 years (SD= \pm 14.0), males reported more cases (73.7%), addiction to tobacco was high (48.7%). 40.8% patients had high treatment adherence. Only 37.5% patients reported good asthma control of which 68.4% showed high adherence. The mean Asthma Control Test (ACT) score was 18.75 ± 4.8 SD. Increasing age (aOR=0.96, 95% CI= 0.93-0.99), tobacco smoking (aOR=2.90, 95% CI=1.20-6.99), dust allergy (aOR= 7.92, CI =3.15-19.91) and low treatment adherence (aOR=5.33, 95% CI=2.22-12.82) were found to be significant predictors of poor disease control.

Conclusions: Non adherence to treatment and poor disease control was high among rural asthma patients. Patient education for tobacco cessation and treatment compliance along with periodic monitoring undertaken by trained health workers can be an effective strategy to reduce disease burden in the community.

Key-words: Asthma control, Asthma Control Test, Bronchial Asthma, Medication adherence, Prevention and control, Risk factors

INTRODUCTION

Asthma is a disease characterized by chronic inflammation and hyper reactivity of the airways, leading to recurrent episodes of breathlessness, wheezing, coughing and chest tightness more frequent in the early morning or at night. Worldwide over 300 million people of all ages are affected with many cases remaining underdiagnosed and /or inadequately treated. ¹ The prevalence of asthma in India is esti-

mated at 2.38 % with more than 15 million people being affected reflecting a high burden of the disease.² Adherence to treatment is essential to optimize the benefits of therapy. In asthma, adherence to treatment tends to be poor, with rates of less than 50% in children and 30-70% in adults³. Among patients, disease control following treatment is observed between 30-50% with poorer rates reported from developing countries.⁴ Although asthma is a preventable cause of morbidity and disability, poorly

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controlled disease in asthma patients results in acute exacerbations, unnecessary hospitalization and even deaths leading to increased health care expenditure and an economic burden on the healthcare system. COPD and asthma were responsible for 75.6% and 20.0% of the chronic respiratory disease DALYs, respectively, in India in 2016.⁵ The Sustainable Development Goals aim to reduce premature mortality from non-communicable diseases by a third by 2030 through prevention and treatment. Under these circumstances screening for patients with asthma to assess disease control and understanding the factors influencing them assumes vital importance for early detection and prevent disease progression to severe stages and complications.

Although several standardized and validated instruments like Asthma control Test (ACT), Asthma control questionnaire (ACQ) and Control of Allergic Rhinitis and Asthma Test (CARAT) scales are available to assess the level of disease control in asthma patients but their use so far have been restricted in urban clinic settings and there is paucity of data in India especially in the rural context. Use of simple tools that require very little skill for interpretation can be utilized by trained primary level health care workers to identify asthma patients with inadequate compliance to therapy and suboptimal disease control. Further this can be an effective method to detect and refer uncontrolled patients for adequate management in order to achieve better health outcomes.⁶ With this background the current study was conducted with the objectives to assess medication adherence and disease control in adult patients with asthma and to determine the factors influencing their disease control.

METHODOLOGY

Study design and study participants: A prospective, observational type of study was conducted in the rural area of West Bengal. The study was conducted over a period of twelve months from January 2021 to December 2021. The study population included all adult (>18 years to 70 years) asthma patients, visiting the Block primary health centre (BPHC) during the study period.

Inclusion criteria: Patients diagnosed with Bronchial asthma by Medical Officer and under treatment with inhaled corticosteroids (ICS) with or without beta agonists or other medications for over one year, and residents in that area for at least 5 years.

Exclusion criteria: Those who refused to give their written informed consent, not completing two scheduled OPD visits, reporting later than eight weeks after initial visit, having acute exacerbations, other chronic lung diseases respiratory like COPD, cancers, pregnancy, severely ill or any cardiac, respiratory or other episode of illness requiring hospitalization in the previous one month.

Sample size and sampling technique: Sample size

was calculated considering a prevalence of 50% in achieving good asthma control by inhaled corticosteroids, as studies reported prevalence of well controlled asthma ranging from 30-50%.^{4,5} Assuming 95% confidence interval, 8% absolute margin of error, the minimum sample size required was 151. Adjusting for 10% drop out rate, initially 167 samples were included for the study. All eligible asthma patients consecutively attending the OPD of the BPHC were approached till the desired sample size was attained. However, despite best efforts 16 patients were lost to follow up, so the sample size considered for final analysis was 152 patients.

Patient recruitment and Data collection: At the first visit, asthma patients fulfilling the eligibility criteria were enrolled after getting their written informed consent on participation and data collection after full explanation of the study purpose, risks, benefits, confidentiality, right to withdraw at any time etc. in the local language. Disease detection and management of their disease was done by Medical Officer following existing protocol and patients were called for follow-up after four weeks. Enrolment continued till the required sample size was obtained. A one-day training of health care workers was provided. At the follow-up visit, patients reporting within eight weeks from the date of enrolment were assessed for their medication adherence and disease control by trained primary healthcare workers during the past one month. A four to eight weeks interval was allowed to reduce dropout while minimizing recall bias. Data collection was done using a pre-designed, pre-tested and validated questionnaire by trained healthcare workers who were supervised by the researchers. Two repeat home visits were made by ASHAs to include all defaulters as far as feasible.

Study tool: The questionnaire was divided into three parts as follows: Part I) comprising of socio-demographic variables which included age, gender, education, occupation, socioeconomic status etc. and other possible risk factors like smoking status, family history of asthma, allergy to smoke, dust or food, medical comorbidities, duration of illness, episodes of hospitalization; Part II) involved assessment of asthma control in last 4 weeks, using translated (Bengali) and validated versions of Asthma control test (ACT) scale and Part III) comprised of self-reported medication adherence to ICS, assessed by translated (Bengali) and validated versions of Medication Adherence Report Scale for Asthma (MARS - A). Asthma control was labelled as poor with a score of 19 or less in the ACT scale. Treatment adherence was labelled as high with a mean score equal and above 4.5 on the MARS-A scale. Medication adherence was also cross checked where available by the dose counters on Metered Dose Inhalers (MDI) or counting the DPI capsules at initial and follow up visit after 4 weeks.

Data analysis: All the data was analysed using the Statistical Package for the Social Sciences for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). The

descriptive analysis of the quantitative data was done through numbers and percentages for categorical data. For continuous data mean (\pm standard deviation) was obtained. Both univariate and multivariate logistic regression was done to identify the risk factors of disease control. Statistical significance level was set at p-value of < 0.05 and 95 % confidence intervals (CI).

Outcome measures: Asthma Treatment control as measured using the ACT scale was the primary outcome variable. Independent variables included sociodemographic characteristics like age, income, addiction history, history of allergy, comorbidities, treatment adherence etc.

Ethical considerations: Permission to conduct the study was obtained from the Institutional Ethical Committee of Bankura Sammilani Medical College, Bankura. Informed written consent was obtained from all the study participants. Patients with inadequate control of asthma were referred for further management to the tertiary Hospital.

RESULTS

Background information: The study was undertaken among 152 asthma patients. The mean age was 49.6 years with a SD = ± 14.0 , males reported more cases (73.7%) with a mean per capita income of Rupees 4064.8 ± 7768 . Majority (84.9%) of the patients reported using MDI with and without spacers. 17.8 % of patients reported using other medications for asthma with other comorbidities; Hypertension being the most common comorbidity (17.8%) [Table 1]

Treatment adherence: 62 (40.8%) patients reported high treatment adherence. 68.4% of patients with good asthma control showed high treatment adherence, while 24.2% of patients with poorly controlled asthma showed good adherence. Univariate analysis showed poor disease control to be significantly associated with history of smoke and dust allergy, addiction to tobacco smoking and low treatment adherence ($p < 0.05$). [Table 2]

Asthma control: Only 37.5% patients reported good asthma control. The mean ACT score was 18.75 ± 4.8 SD. Multivariable logistic regression showed increasing age to be negatively associated with asthma control (aOR=0.96, 95% CI=0.93-0.99). Non-smokers achieved better asthma control than smokers (aOR=2.90, 95% CI=1.20-6.99). Patients with high treatment adherence attained better disease control (aOR=5.33, 95% CI=2.22-12.82). [Table 3]

DISCUSSION

Asthma control is a challenging issue globally with poor control and adherence reported across various countries. In our study, 37.5 % of the participants had good, controlled asthma symptoms while a study conducted by Ghanname I et al. showed that about

Table 1: Distribution of Study Participants According to background characteristics (n=152)

Characteristics	Frequency(%)
Age Category (In Completed Years)	
<25	12(7.9)
25-45	34(22.4)
45-65	76 (50.0)
≥ 65	30 (19.7)
Mean \pm SD (years)	49.6 \pm 14.0
Median (years)	50.5
Gender	
Male	112(73.7)
Female	40(26.3)
Education Level	
Illiterate	28(18.4)
Upto Primary School	64(42.1)
Upto Middle School	23(15.1)
Upto High School	23(15.1)
Intermediate and above	14(9.3)
Occupation	
Not Working/ Unemployed/Homemaker	71(46.7)
Unskilled Worker	25(16.4)
Semi-skilled Worker	6(3.9)
Skilled Worker	13(8.6)
Clerical/ Shop Owner/ Farmer	32(21.1)
Profession	5(3.3)
Socio-economic Status as per Modified B.G Prasad classification 2019 (In INR*)	
Upper (≥ 7008)	19(12.5)
Upper- Middle (3504-7007)	19(12.5)
Middle (2102-3503)	28(18.4)
Lower- Middle (1051-2101)	57(37.5)
Lower (≤ 1050)	29(19.1)
Mean \pm SD (\dagger PCI in INR)	4064.8 \pm 7768
Median (\dagger PCI in INR)	1800
Type of medication	
MDI	118 (77.7)
MDI and spacer	11(7.2)
DPI	23(15.1)
Others	27(17.7)
Comorbidities	
Hypertension	27(17.8)
Diabetes mellitus	11(7.2)
others	42 (27.6)
Hospitalization in last year	
	5 (3.2)

*INR = Indian National Rupees, \dagger PCI= Per Capita Income/ month of Family

53% of the participants suffered controlled, 18% had partly controlled and 29% had uncontrolled asthma symptoms and the one by Albatineh E et al. showed that asthma control was achieved in 45.2% of the sample.^{7,8} In India, there are relatively lower prevalence rates than its western counterparts, but still it accounts for a huge burden in terms of absolute numbers of patients. The reason may be attributed to the enormous population base in India and also the dismal availability and adherence to the standard asthma management guidelines.⁹

The index study found, increasing age was associated with poor asthma control [aOR (CI) =0.96(0.93-0.99)] whereas non-smoker [aOR (CI) =2.90(1.20-6.99)], no dust allergy [aOR (CI) = 7.92(3.15-19.99)] and treatment adherence [aOR (CI) =5.33(2.22-12.82)] was significantly associated with good asthma control.

Table 2: Distribution of Study Participants According to Asthma Control and Background Characteristics (n=152)

Characteristics	Asthma Control		Total (%)	Chi square	P value
	Good Control (%)	Poor Control (%)			
Family History of Asthma					
Yes	20(36.4)	35(63.6)	55(100)	0.04	0.82
No	37(38.1)	60(61.9)	97(100)		
Duration of Asthma					
<5 years	42(38.9)	66(61.1)	108(100)	0.31	0.85
5-10 years	10(34.5)	19(65.5)	29(100)		
>10 years	5(33.3)	10(66.7)	15(100)		
Smoke Allergy					
Yes	26(25.2)	77(74.8)	103(100)	20.48	0.00*
No	31(63.3)	18(36.7)	49(100)		
Dust Allergy					
Yes	22(21.2)	82(78.8)	104(100)	37.03	0.00*
No	35(72.9)	13(36.7)	48(100)		
Food Allergy					
Yes	20(29.4)	48(70.6)	68(100)	3.43	0.06
No	37(44.0)	47(56.0)	84(100)		
Treatment Adherence					
High	39(62.9)	23(37.1)	62(100)	28.83	0.00*
Low	18(20.0)	72(80.0)	90(100)		
Tobacco smoking					
Yes	15(20.3)	59(79.7)	74(100)	18.26	0.00*
No	42(53.8)	36(46.2)	78(100)		
Comorbidities					
Yes	30 (41.7)	42 (58.3)	72(100)	1.01	0.31
No	27 (33.7)	53 (66.3)	80(100)		
Total	57(37.5)	95(62.5)	152(100)		

*Statistically significant

Table 3: Univariate and Multivariable Logistic Regression Showing Factors Associated with good Asthma Control (n=152)

Variables	Good Asthma control (%)	OR (95% CI)	AOR (95% CI)*
Age			
<65 years	41 (33.6)	1	1
≥65 years	16 (53.3)	0.44(0.19-0.97)	0.96(0.93-0.99)
Smoker			
Non-smoker	15(20.3)	1	1
Dust allergy	42(53.8)	4.58(2.23-9.43)	2.90(1.20-6.99)
Dust allergy			
Yes	22(21.2)	1	1
No	35(72.9)	10.03(4.54-22.14)	7.92(3.15-19.91)
Treatment adherence			
High	39 (62.9)	6.78(3.27-14.06)	5.33(2.22-12.82)
Low	18 (20.0)	1	1

OR= Odds ratio, CI =Confidence interval, AOR= Adjusted OR

*P <0.05 was considered to be statistically significant.

Hosmer-Lemeshow Goodness of fit=0.67; Nagelkerke R²=0.51, Cox and Snell R²=0.37

In a hospital based prospective study conducted by Ghannam I et al. having respiratory infections (aOR = 5.71), suffering from concomitant diseases (aOR = 3.36) and being allergic to animals (aOR = 2.76) were positively associated with poor control of asthma. However, adherence to treatment (aOR = 0.07), possession of health insurance (aOR = 0.41) and having more than 2 children (aOR = 0.47) were associated with good asthma control whereas in a study by Albataneh E et al. showed that on multivariate analyses, only atopy to two or more allergens and having severe asthmatic attacks were statistically significantly associated with poorly controlled asthma.^{7,8} Another study revealed that in-

adequate prescription, non-adherence to treatment and inhaler misuse were responsible factors for bad asthma control.¹⁰

House-dust was proven to be associated with asthma in our study as also various guidelines on immunotherapy in Asthma.¹¹ As per the study on children done by Okasha et al.,¹² sensitisation to house dust mite increased asthma severity and decreased the ability to control symptoms. Thereby it is imperative that, physicians may adopt a pragmatic approach house-dust and mite contact avoidance and to advise sensitized patients to implement feasible set of

measures for reduction in exposure to them as much as possible.

Various cohort studies undertaken across the globe agrees to the findings as our study that non-smokers are having better asthma control.^{13,14} The reason for the same may be, smoking affects the bronchial asthma symptoms and declines the pulmonary function tests. Thereby, smoking cessation programs must be co-ordinated with assessment of asthma symptoms and pulmonary function tests, especially in community settings with emphasis on behaviour change communication activities.

In the current study high treatment adherence was reported to be among 40.8% patients. Similarly, Patel et al¹⁵ revealed that 35 % of the patients missed less than one dose during last 3 months. Aggarwal et al.¹⁶ found in their study that self-reported medication adherence was seen in 75.7% of the total patients. This difference could be attributed to the difference in methods of reporting adherence. In the latter study a single question was used to assess it subjectively. Rafi et al.¹⁷ reported high non adherence prevalence of 86% in their study population attributing to factors like presence of comorbidities, prolonged duration of disease, consulting non-qualified practitioners etc. Treatment adherence has a direct relation to asthma control, which was found consistently in our study as also other studies across the globe.¹⁸⁻²⁰ As due to the fact that asthma is a chronic disorder, it may be necessary to assess routinely the concerns and necessity of asthma medication in patients through our existing healthcare infrastructure, so as to improve treatment adherence and thereby to improve treatment outcomes.

Compared to other NCDs like cardiovascular diseases and Diabetes, the burden of respiratory diseases has been overlooked and limited resources are devoted in primary care settings. In most Low middle income (LMIC) countries diagnosis of Asthma in primary care settings is mostly clinical without spirometry. Further Asthma control Guideline recommend structured assessment of asthma control at each follow-up visit.²¹ However Medical Officers in PHCs and BPHCs are usually overburdened with huge case load and regular review for disease control within limited time periods is a challenge. The findings of this study show the feasibility of utilizing trained primary health care workers in aiding clinicians by effectively addressing this gap in early detection of factors responsible for poor Asthma control which can contribute to better outcomes. Limitations of this study may include some diagnostic overlap of cases with other similar respiratory conditions and recall bias of patients.

CONCLUSION

The results of this community-based study, conducted in rural areas provide insight into the important causes of poor asthma control and help in under-

standing the role of different risk factors that may culminate to poor asthma outcomes. The burden of Asthma in India is significant hence in order to improve disease control, substantial attention might be paid to recognizing modifiable risk factors for poor asthma outcomes.

Recommendation: Early detection of poor disease control together with patient education for tobacco cessation, avoidance of dust and other allergens and treatment compliance along with periodic assessment of issues pertaining to poor medical adherence undertaken by trained healthcare workers at the grassroot levels can be a low cost and effective strategy to reduce disease burden in the community.

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REFERENCES

1. Bousquet J, Kaltaev N. Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach / edited by Jean Bousquet and Nikolai Kaltaev [Internet]. Switzerland: World Health Organization; 2007 [cited 2022 May 20]. Available from: <https://apps.who.int/iris/handle/10665/43776>.
2. Aggarwal AN, Chaudhry K, Chhabra SK, et al. Prevalence and risk factors for bronchial asthma in Indian adults: a multicentre study. *Indian J Chest Dis Allied Sci* [Internet]. 2006 Jan-Mar [cited 2022 Jul 15];48(1):13-22. Available from: <https://pubmed.ncbi.nlm.nih.gov/16482947/>
3. Engelkes M, Janssens HM, de Jongste JC, et al. Medication adherence and the risk of severe asthma exacerbations: a systematic review. *Eur Respir J* [Internet]. 2015 Feb [cited 2022 Jul 15];45(2):396-407. Available from: <https://doi.org/10.1183/09031936.00075614>
4. Mohd Isa NA, Cheng CL, Nasir NH, et al. Asthma control and asthma treatment adherence in primary care: results from the prospective, multicentre, non-interventional, observational cohort ASCOPE study in Malaysia. *Med J Malaysia* [Internet]. 2020 Jul [cited 2022 Jul 15];75(4):331-7. Available from: <https://pubmed.ncbi.nlm.nih.gov/32723990/>
5. India State-Level Disease Burden Initiative CRD Collaborators. The burden of chronic respiratory diseases and their heterogeneity across the states of India: the Global Burden of Disease Study 1990-2016. *Lancet Glob Health* [Internet]. 2018 Dec [cited 2022 Jul 15];6(12):e1363-74. Available from: [https://doi.org/10.1016/S2214-109X\(18\)30409-1](https://doi.org/10.1016/S2214-109X(18)30409-1)
6. Lourenço O, Calado S, Sá-Sousa A, et al. Evaluation of allergic rhinitis and asthma control in a Portuguese community pharmacy setting. *J Manag Care Spec Pharm* [Internet]. 2014 May [cited 2022 Jul 15];20(5):513-22. Available from: <https://doi.org/10.18553/jmcp.2014.20.5.513>
7. Ghanname I, Chaker A, Cherkani Hassani A, et al. Factors associated with asthma control: MOSAR study (Multicenter Observational Study of Asthma in Rabat-Morocco). *BMC Pulm Med* [Internet]. 2018 Apr 24 [cited 2022 Jul 15];18(1):61. Available from: <https://doi.org/10.1186/s12890-018-0624-6>
8. Albatineh E, Al-Zayadneh E, Al-Shagahin H, et al. Asthma Control and Its Predictive Factors in Adult Asthma Patients. *J Clin*

- Med Res [Internet]. 2019 Dec [cited 2022 Jul 15];11(12):807-17. Available from: <https://doi.org/10.14740/jocmr4021>. Erratum in: J Clin Med Res [Internet]. 2020 Feb [cited 2022 Jul 15];12(2):127. Available from: <https://doi.org/10.14740/jocmr4021c1>
9. Kotwani A, Chhabra SK, Tayal V, et al. Quality of asthma management in an urban community in Delhi, India. *Indian J Med Res*[Internet]. 2012 [cited 2022 Jul 15];135(2):184-92. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3336849/?report=classic>
 10. Ribó, P, Molina J, Calle, M, Maiz L, Campo C, Ryttilä P et al. Prevalence of modifiable factors limiting treatment efficacy of poorly controlled asthma patients: EFIMERA observational study. *npj Prim. Care Respir. Med* [Internet]. 2020 [cited 2022 Jul 16];30:1-8. Available from: <https://doi.org/10.1038/s41533-020-00189-6>
 11. Zuiani C, Custovic A. Update on House Dust Mite Allergen Avoidance Measures for Asthma. *Curr Allergy Asthma Rep* [Internet]. 2020 Jun 19 [cited 2022 Jul 15];20(9):50. Available from: <https://doi.org/10.1007/s11882-020-00948-y>
 12. Okasha, N.M., Sarhan, A.A. & Ahmed, E.O. Association between house dust mites sensitization and level of asthma control and severity in children attending Mansoura University Children's Hospital. *Egypt J Bronchol* [Internet]. 2021 [cited 2022 Jul 16];15:1-7. Available from: <https://doi.org/10.1186/s43168-021-00082-x>
 13. Accordini S, Calciano L, Johannessen A et al. Ageing Lungs in European Cohorts (ALEC) Study. A three-generation study on the association of tobacco smoking with asthma. *Int J Epidemiol* [Internet]. 2018 Aug 1 [cited 2022 Jul 15];47(4):1106-17. Available from: <https://doi.org/10.1093/ije/dyy031>
 14. Spears M, Cameron E, Chaudhuri R, et al. Challenges of treating asthma in people who smoke. *Expert Rev Clin Immunol* [Internet]. 2010 [cited 2022 Jul 15];6(2):257-68. Available from: <https://doi.org/10.1586/eci.09.85>
 15. Patel NS, Christian DS, Kamdar DJ, Patel KR. Treatment adherence related to asthma patients of a tertiary care institute. *Indian J Comm Health* [Internet]. 2018 [cited 2022 Jul 16];30(2):127-32. Available from: <https://www.iapsmupuk.org/journal/index.php/IJCH/article/view/854>
 16. Aggarwal D, Bhardwaj M, Singh B, Janmeja AK. Factors Determining Adherence to Inhaled Corticosteroids in Bronchial Asthma Patients at a Tertiary Care Hospital in India. *J Clin Diagn Res* [Internet]. 2017 Dec [cited 2022 Jul 16];11(12):OC14-18. Available from: <https://doi.org/10.7860/JCDR/2017/32568.10988>
 17. Rafi, MA, Tahmin, CI, Tashrik, S, Bonna AS, Jannat F, Mily SJ et al. Adherence to inhalers and associated factors among adult asthma patients: an outpatient-based study in a tertiary hospital of Rajshahi, Bangladesh. *Asthma Res and Pract* [Internet]. 2022 Feb 9 [cited 2022 Jul 16];8(1):1-8. Available from: <https://doi.org/10.1186/s40733-022-00083-7>
 18. Smits D, Brigis G, Pavare J, et al. Factors related to good asthma control using different medical adherence scales in Latvian asthma patients: an observational study. *NPJ Prim Care Respir Med* [Internet]. 2017 Jun 20 [cited 2022 Jul 15];27(1):39. Available from: <https://doi.org/10.1038/s41533-017-0042-x>
 19. Neffen H, Chahuàn M, Hernández DD, et al. Key factors associated with uncontrolled asthma - the Asthma Control in Latin America Study. *J Asthma* [Internet]. 2020 Feb [cited 2022 Jul 15];57(2):113-22. Available from: <https://doi.org/10.1080/02770903.2018.1553050>
 20. Tiotiu A, Ioan I, Wirth N, Romero-Fernandez R, González-Barcala FJ. The Impact of Tobacco Smoking on Adult Asthma Outcomes. *Int J Environ Res Public Health* [Internet]. 2021 Jan 23 [cited 2022 Jul 16];18(3):992. Available from: <https://doi.org/10.3390/ijerph18030992>
 21. Price C, Agarwal G, Chan D, et al. Large care gaps in primary care management of asthma: a longitudinal practice audit. *BMJ Open* [Internet]. 2019 Jan 29 [cited 2022 Jul 15];9(1):e022506. Available from: <https://doi.org/10.1136/bmjopen-2018-022506>