Physicians’ Knowledge and Practices Regarding Asthma: A Cross-Sectional Study in Saudi Arabia

Mohammad S Dairi

Department of Internal Medicine, College of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia

Correspondence: Mohammad S Dairi, Department of Internal Medicine, College of Medicine, Umm Al-Qura University, P.O. Box 13578, Mecca, Saudi Arabia, Tel +96655501560, Email msdairi@uqu.edu.sa

Objective: This study aimed to explore the characteristics of knowledge and practice of physicians towards asthma in Saudi Arabia.

Methods: An online cross-sectional study was conducted in Saudi Arabia between 28 August and 10 November 2021. Convenience sampling technique was applied in this study through social media websites. Previously developed 10-items questionnaire was used to assess the knowledge about asthma among the participating physicians. Descriptive statistics were used to describe the participants’ demographic characteristics. Binary logistic regression analysis was conducted to identify factors associated with being adherent to asthma practices guidelines.

Results: Overall, participants’ knowledge was moderate. The average percentage of physicians who reported practicing asthma management based on recommended guidelines 63.7%. Younger age (30–34 years) and having a work experience of (6–10 years) were significant predictors of being adherent to asthma practices guidelines (OR: 1.96 (95% CI: 1.21–3.17) (p=0.006) and OR: 1.67 (95% CI 1.05–2.67) (p=0.031), receptively).

Conclusion: This study showed that the percentage of physicians who reported practicing asthma management based on recommended guidelines in Saudi Arabia are moderate. Future studies to investigate factors associated with improvement in knowledge about asthma and adherence to guidelines are needed.

Keywords: practice, physicians, knowledge, Saudi Arabia, healthcare professionals, asthma

Introduction

Asthma is one of the most common causes for primary care visits in the world and in Saudi Arabia. According to the World Health Organization (WHO), asthma is a long-term condition affecting children and adults. The air passages in the lungs become narrow due to inflammation and tightening of the muscles around the small airways. The disease which is an obstructive inflammatory disease in its nature is characterised by hypersensitivity and hypersensitivity reactions of the immune system towards the small bronchi in the lungs. Asthma can vary from mild to more severe form and complicated attacks.

According to the WHO, there are more than 262 million of patients with asthma worldwide in 2019. In the United States, the CDC reported that the prevalence of asthma in the US is around 7.9% in 2019. In Saudi Arabia, according to a national household survey, the prevalence of asthma was around 4.0%. However, other studies reported that the prevalence of asthma is around 11%, including a systematic review and a meta-analysis that reported that the prevalence of asthma is around 14%.

Asthma can be associated with major complications and high rates of morbidity and mortality including ICU admission. The quality of life of patients with asthma can vary according to the frequency and severity of the symptoms. Therefore, accurate diagnosis and effective management of asthma plays an important role in the quality of life of patients with asthma.

The diagnosis and management of asthma is well established worldwide, and many countries have issued national guidelines for the management and diagnosis of asthma. These guidelines usually include recommendations and...
Evidence-based medicine information for the diagnosis and management of asthma. However, some studies worldwide have also shown that malpractice and non-adherence to guidelines also exist, leading to variation in the management, and in the long-term outcomes of patients with asthma. In addition, the cost of the management of patients with asthma is also affected by this variation in the practice.

Multiple studies worldwide have assessed the knowledge and practice of physicians towards asthma including the adherence of physicians to the guidelines. However, in Saudi Arabia little is known about the knowledge and practice of physicians towards asthma and the adherence of medical practitioners to the national and international asthma guidelines. Therefore, the aim of this study is to explore the characteristics of knowledge and practice of physicians towards asthma in Saudi Arabia.

Method

Study Design and Study Population
An online cross-sectional study was conducted in Saudi Arabia between 28 August and 10 November 2021 to explore the characteristics of asthma knowledge and practice of physicians concerned in Saudi Arabia.

Sampling Strategy
Convenience sampling technique was applied to invite the physicians in this study. They were invited through social media websites (Twitter, Facebook, and WhatsApp). Practicing physicians who are currently practicing medicine in Saudi Arabia and managing asthmatic patients in their clinics were invited to participate in the study. The study's aim, objectives, and inclusion criteria were clearly mentioned in the cover letter of the survey. It was clearly mentioned that participation is voluntary, and by completing the questionnaire, this will be considered as written informed consent.

Study Assessment Tools
The Arabic version of a previously developed 10-items questionnaire by Adeniyi et al was used to assess the knowledge about asthma among the participating physicians. Knowledge questions were utilized using yes/no format (where yes indicates the right answer). Question numbers 1, 3, and 4 were negatively worded; therefore, when we calculate the percentage of participants who answered these items correctly, we subtract this percentage from 100%.

Physicians' asthma practices were assessed using Physicians' Practice Assessment Questionnaire (PPAQ) (14-items questionnaire). This questionnaire was developed to explore to which extent physicians implement asthma management guidelines. This questionnaire explores various characteristics of physicians practice including diagnosis, assessment, management, and follow-up. Participants response was recorded using continuous scale that range between 0% and 100% to indicate to which extent they apply each specific asthma management practice. Besides, participants were asked about their demographics (age, gender, work experience, and speciality) and practice characteristics (average number of patients seen at their clinic per day and the average number of asthmatic patients seen per day).

Statistical Analysis
Descriptive statistics were used to describe the participants’ demographic characteristics. Data were reported as mean ± standard deviation (SD). Categorical data were reported as percentages (frequencies). Binary logistic regression analysis was conducted to identify factors associated with being adherent to asthma practices guidelines. Adherent practice was defined as an average percentage of following asthma practices of 63.7% and above (which is the mean value), which was the cut-off for the logistic regression. A confidence interval of 95% (p < 0.05) was applied to represent the statistical significance of the results, and the level of significance was assigned as 5%. Data were analysed using SPSS software, version 27.
Ethical Statement
This study was approved by the faculty of Medicine at University of Umm Alqura, Mecca, Saudi Arabia.

Results

Characteristics of the Study Participants
Table 1 describes the characteristics of the participating physicians at this study. A total of 350 physicians were involved in the study of which around the half (53.2%) were aged below 34 years. More than half of them (56.0%) were males. A total of 43.4% of them had an experience of 5 years or less. Around one-third (36.0%) the participating physicians

| Variable                        | Frequency (%) |
|---------------------------------|---------------|
| Age (categories)                |               |
| 25–29 years                     | 85 (24.3)     |
| 30–34 years                     | 101 (28.9)    |
| 35–39 years                     | 60 (17.1)     |
| 40–44 years                     | 41 (11.7)     |
| 45–49 years                     | 28 (8.0)      |
| 50 years and above              | 35 (10.0)     |
| Gender                          |               |
| Male                            | 196 (56.0)    |
| Work experience (years)         |               |
| <5                              | 152 (43.4)    |
| 6–10                            | 107 (30.6)    |
| 11–15                           | 46 (13.1)     |
| 16–20                           | 28 (8.0)      |
| >20                             | 17 (4.9)      |
| Average number of patients seen per day |               |
| <10                             | 126 (36.0)    |
| 11–20                           | 140 (40.0)    |
| 21–30                           | 51 (14.6)     |
| >30                             | 33 (9.4)      |
| Average number of asthmatic patients seen per day |         |
| 1–5                             | 180 (51.4)    |
| 6–10                            | 131 (37.4)    |
| 11–20                           | 29 (8.3)      |
| >20                             | 10 (2.9)      |

(Continued)
reported that the average number of patients seen at their clinic is 1–10 patients per day. Around half (51.4%) the participating physicians reported that the average number of asthmatic patients seen at their clinic per day is one to five patients. Around one-third (30.3%) of the study participants were pulmonologists.

**Knowledge About Asthma**

Table 2 describes characteristics of participants’ knowledge about asthma. Participants’ knowledge about asthma was assessed using 10 items. Overall, participants’ knowledge was moderate. The average percentage of correct answers for all subscales that explored asthma knowledge was 58.3%. The lowest percentage was for sign of asthma attack subscale with 50.9%. The highest percentage was for disease characteristics scale with 70.8%.

**Characteristics of Asthma Practices Among the Study Participants**

Figure 1 describes characteristics of asthma practices among the study participants. The average percentage of physicians who reported practicing asthma management based on recommended guidelines 63.7% (±5.7%). More than half of the study participants (54.9%) achieved a percentage of 63.7% or above. The most commonly reported practice was scheduling regular follow-up appointments for the patient, which was reported by 73.6%. The lowest percentage was for confirming diagnosis by pulmonary function tests (either spirometry and bronchodilator reversibility or broncho-provocation) which was reported by 52.6%.

**Adherence to Asthma Practices Guidelines**

In order to identify participants’ characteristics that are associated with being adherent to asthma practices guidelines, binary logistic regression was applied (Table 3). Younger age (30–34 years) and having a work experience of (6–10 years) were significant predictors of being adherent to asthma practices guidelines (OR: 1.96 (95% CI: 1.21–3.17) (p=0.006) and OR: 1.67 (95% CI 1.05–2.67) (p=0.031), receptively). On the other hand, older age (50 years and above) and longer work experience (16–20 years) were significant predictors of being non-adherent to asthma practices guidelines (OR: 0.29 (95% CI 0.14–0.63) (p=0.002) and OR: 0.36 (95% CI: 0.16–0.82) (p=0.015), respectively).

**Discussion**

This study aimed to explore the characteristics of knowledge and practice of physicians towards asthma in Saudi Arabia. Our findings showed that the overall level of asthma knowledge is moderate 58.3%. The lowest percentage was for sign of asthma attack with only 50.9%, while the highest percentage was for disease characteristics scale with 70.8%. Similar findings were reported by a study in West Nigeria, where only 61% of the study participants reported correct answers about the signs of asthma attack. Previous studies reported a good knowledge of physicians about the characteristics of
Table 2 Asthma Knowledge Characteristics for the Study Participants

| No. | Knowledge Scale                                                                 | Percentage of Participants Answered (Yes) |
|-----|----------------------------------------------------------------------------------|--------------------------------------------|
|     | Disease characteristics                                                          |                                            |
| 1   | Asthma is not a chronic inflammatory disorder of the airways                      | 26.6% (73.4%)§                             |
| 2   | Symptoms of asthma occur or worsen at night, awakening the patient                | 82.0%                                      |
| 3   | Symptoms of asthma does not have a seasonal pattern                               | 52.6% (47.4%)§                             |
| 4   | Family history is not relevant                                                    | 24.3% (75.7%)§                             |
| 5   | Asthmatic chronically inflamed airways are usually hyperresponsive                | 75.7%                                      |
|     | Average percentage                                                               | 70.8%                                      |
| 6   | Asthma symptoms: (more than one answer is possible)                               |                                            |
|     | Cough (worse particularly at night)                                               | 70.0%                                      |
|     | Recurrent wheeze                                                                 | 46.6%                                      |
|     | Recurrent difficulty with breathing                                               | 70.3%                                      |
|     | Recurrent chest tightness is possible                                             | 63.4%                                      |
|     | Average percentage                                                               | 62.6%                                      |
| 7   | Asthma trigger: (more than one answer is possible)                                |                                            |
|     | Animal fur                                                                       | 60.9%                                      |
|     | Aerosol                                                                          | 59.4%                                      |
|     | Changes in temperature                                                           | 63.7%                                      |
|     | Domestic dust                                                                    | 70.6%                                      |
|     | Drugs                                                                            | 36.6%                                      |
|     | Exercise chemicals                                                               | 66.3%                                      |
|     | Pollen                                                                           | 36.3%                                      |
|     | Respiratory (viral) infections                                                   | 68.6%                                      |
|     | Smoke                                                                            | 69.7%                                      |
|     | Strong emotional expression                                                       | 32.9%                                      |
|     | Average percentage                                                               | 56.5%                                      |
| 8   | Asthma diagnostic procedure: (more than one answer is possible)                   |                                            |
|     | Spirometer                                                                       | 70.3%                                      |
|     | Peak flow meter                                                                  | 49.7%                                      |
|     | Chest radiography                                                                | 35.4%                                      |
|     | Average percentage                                                               | 51.8%                                      |

(Continued)
asthma, this was also in line with the results reported in our study as it showed that around 70% of the study sample had a good knowledge about asthma characteristics.\textsuperscript{21,23}

Our study results also showed that around half of the study participants had a good knowledge about the triggers associated with asthma. These results are lower than those reported in previous studies in Jordan and southwest Nigeria.\textsuperscript{21,23} Investigating the risk factors of asthma can be challenging, and in many cases patients are likely to be referred to specialised doctors and this could be the reason for the low percentage about the knowledge of asthma triggers, especially knowing that only 30% of the study sample were pulmonologists, while the majority of the study participants were from different specialities.

The average score of the knowledge of physicians about drugs used in the management of asthma was around 57.2%. Similarly, the knowledge of physicians of asthma diagnostic procedure was around 51.8%. Given the nature of the disease and the high prevalence of asthma worldwide, this percentage of knowledge can be considered low. Previous studies in Jordan and Russia and Ukraine reported higher percentage of knowledge of physicians about the diagnostic tests and treatment of asthma.\textsuperscript{21,27}

Several initiatives have been conducted to improve the care of patients with asthma worldwide, this included the establishment of several guidelines internationally and nationally, the Global Initiative for Asthma (GINA) guidelines had been developed.\textsuperscript{27} In addition, Saudi Arabia issued national guidelines for the practice and management of asthma, these guidelines help physicians in the diagnosis and treatment of patients with asthma.\textsuperscript{28} Despite these

| No. | Knowledge Scale                                      | Percentage of Participants Answered (Yes) |
|-----|------------------------------------------------------|------------------------------------------|
| 9   | Sign of asthma attack: (more than one answer is possible) |                                          |
|     | Cyanosis                                             | 65.1%                                    |
|     | Fast pulse rate                                      | 65.7%                                    |
|     | Duration of attack                                   | 22.0%                                    |
|     | Average percentage                                   | 50.9%                                    |
| 10  | Drugs for the management of asthma: (more than one answer is possible) |                                          |
|     | Oral prednisolone                                    | 60.0%                                    |
|     | Salbutamol                                           | 68.0%                                    |
|     | Adrenaline                                           | 50.9%                                    |
|     | Cromolyn                                             | 47.7%                                    |
|     | Antibiotics                                          | 52.0%                                    |
|     | Intravenous hydrocortisone                          | 57.1%                                    |
|     | Intravenous aminophylline                           | 46.9%                                    |
|     | Ipratropium bromide                                  | 62.6%                                    |
|     | Intranasal oxygen                                    | 69.4%                                    |
|     | Average percentage                                   | 57.2%                                    |

Notes: \textsuperscript{1}Negatively worded items, the correct answer for them is no. Therefore, when we calculate the percentage of participants who answered these items correctly, we subtract this percentage from 100%.
recommendations. The results shown in our study are worrisome and must be investigated, as the lack of knowledge of specific guidelines-related therapy recommendations may be associated with poor clinical outcomes.

In the study, the average percentage of physicians who reported practicing asthma management based on recommended guidelines was 63.7% (±5.7%). A previous study in Spain that investigated the adherence of physicians to asthma guidelines reported a low percentage (26%) of adherence to the guidelines. However, another study that was conducted

**Table 3** Logistic Regression Analysis to Identify Factors Affecting Asthma Practices Guidelines

| Variable                        | Odds Ratio (95% CI) | p-value |
|---------------------------------|--------------------|---------|
| **Age (categories)**            |                    |         |
| 25–29 years (Reference group)   | 1.00               |         |
| 30–34 years                     | 1.96 (1.21–3.17)** | 0.006   |
| 35–39 years                     | 0.73 (0.42–1.27)   | 0.266   |
| 40–44 years                     | 0.95 (0.49–1.82)   | 0.870   |
| 45–49 years                     | 0.59 (0.27–1.29)   | 0.187   |
| 50 years and above              | 0.29 (0.14–0.63)** | 0.002   |
| **Gender**                      |                    |         |
| Male (Reference group)          | 1.00               |         |
| Female                          | 1.07 (0.70–1.64)   | 0.742   |
| **Work experience (years)**     |                    |         |
| <5 (Reference group)            | 1.00               |         |
| 6–10                            | 1.67 (1.05–2.67)*  | 0.031   |
| 11–15                           | 0.65 (0.35–1.22)   | 0.180   |
| 16–20                           | 0.36 (0.16–0.82)*  | 0.015   |
| >20                             | 0.72 (0.27–1.91)   | 0.509   |
| **Average number of patients seen per day** |       |         |
| <10 (Reference group)           | 1.00               |         |
| 11–20                           | 1.06 (0.67–1.63)   | 0.792   |
| 21–30                           | 0.63 (0.35–1.15)   | 0.132   |
| >30                             | 0.75 (0.37–1.55)   | 0.441   |
| **Average number of asthmatic patients seen per day** | | |
| 1–5 (Reference group)           | 1.00               |         |
| 6–10                            | 0.72 (0.47–1.10)   | 0.133   |
| 11–20                           | 1.50 (0.97–2.33)   | 0.072   |
| >20                             | 0.87 (0.41–1.87)   | 0.723   |

**Notes:** *p < 0.05, **p < 0.01.
in Jordan reported nearly similar results to our study. The variation in adherence of asthma guidelines across countries may arise from the fact that each country has its own strategies and protocols for the management of diseases. Some countries have organizational barriers, and in many cases, the reason could be attributed to factors such as in addition attitude and beliefs of the physician.\(^{30}\)

In the binary logistic regression, it was shown that younger age (30–34 years) and having a work experience of (6–10 years) were significant predictors of being adherent to asthma practices guidelines (OR: 1.96 (95% CI: 1.21–3.17) (p=0.006) and OR: 1.67 (95% CI 1.05–2.67) (p=0.031), receptively). Young clinicians tend to adhere much better to practice guidelines, this was also shown in a previous study that showed that early or mid-career clinicians reported higher agreement than late-career clinicians in adherence to the guidelines.\(^{31}\)

Saudi Arabia has several training programs for doctors and health care professionals, these programs are aimed to improve the training and the practice of health care provider; however, the results shown in our study reveal the need investigates the causes of this poor knowledge of a common health issue that is mainly seen on daily basis in the practice. Perhaps applying new approaches that involve tutorials, courses, and clinical audits may help improve the quality of care provided for patients with asthma.\(^{32}\)

To the best of our knowledge, this is the first study in Saudi Arabia that investigated physicians’ knowledge and practices regarding asthma management. This study used a validate web-based online survey; however, this study has some limitations. First, the study design being a cross-sectional survey design limited our ability to identify causality between the study variables and the outcome. Second, the study survey was distributed online, and therefore, we might have missed to include some of the targeted population; however, as this survey and the data collected were during the COVID-19 pandemic, an online survey was preferred to avoid the possibility of getting infected by COVID-19.
Conclusion
This study showed that the knowledge of physicians about asthma and the percentage of physicians who reported practicing asthma management based on recommended guidelines in Saudi Arabia are moderate. Future studies to investigate factors associated with improvement in knowledge about asthma and adherence to guidelines are needed.

Ethical Statement and Institutional Review of Board Statement
This study was approved by the faculty of Medicine at University of Umm Alqura, Mecca, Saudi Arabia. This study was performed in accordance with the principles stated in the Declaration of Helsinki.

Informed Consent Statement
Informed consent was obtained from all subjects involved in the study.

Disclosure
The author declares no competing interests in this work.

References
1. Akinbami LJ, Santo L, Williams S, Rechtsteiner EA, Strashny A. Characteristics of asthma visits to physician offices in the United States: 2012–2015 national ambulatory medical care survey. Natl Health Off Stat Rep. 2019;128:1–20.
2. World Health Organization. Asthma; 2022 [updated May 11, 2022]. Available from: https://www.who.int/news-room/fact-sheets/detail/asthma. Accessed July 12, 2022.
3. Mims JW. Asthma: definitions and pathophysiology. Int Forum Allergy Rhinol. 2015;5(S1):S2–S6. doi:10.1002/air.21609
4. World Health Organization. Asthma; 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/asthma. Accessed July 12, 2022.
5. Centers for Disease Control and Prevention. Most recent national asthma data; 2021. Available from: https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm. Accessed July 12, 2022.
6. Moradi-Lakeh M, El Beheraoui C, Daoud F, et al. Prevalence of asthma in Saudi adults: findings from a national household survey, 2013. BMC Pulm Med. 2015;15(1):77. doi:10.1186/s12890-015-0080-5
7. Al Ghoibai MO, Alagzlan SS, Oreibi TM. Asthma prevalence among adults in Saudi Arabia. Saudi Med J. 2018;39(2):179–184. doi:10.15537/ smj.2018.2.20974
8. Mohamed Hussain S, Ayesha Farhana S, Mohammed Alnasser S. Time trends and regional variation in prevalence of asthma and associated factors in Saudi Arabia: a systematic review and meta-analysis. Biomed Res Int. 2018;2018:810257. doi:10.1155/2018/8102572
9. Cazzola M, Calzetta L, Bettoncelli G, Novelli L, Ciricelli C, Rogliani P. Asthma and comorbid medical illness. Eur Respir J. 2011;38(1):42–49. doi:10.1183/09031936.00430110
10. Putcha N, Hansel NN. All-cause mortality in asthma. The importance of age, comorbidity, and socioeconomic status. Ann Am Thorac Soc. 2014;11(8):1252–1253. doi:10.1513/AnnalsATS.201408-392ED
11. Naser AY, Mansour MM, Alanazi AFR, et al. Hospital admission trends due to respiratory diseases in England and Wales between 1999 and 2019: an ecologic study. BMC Pulm Med. 2021;21(1):356. doi:10.1186/s12890-021-01736-8
12. Hossny E, Caraballo L, Casale T, El-Gamal Y, Rosenwasser L. Severe asthma and quality of life. World Allergy Organ J. 2017;10(1):28. doi:10.1186/s40413-017-0159-y
13. Edward KS. Asthma management guidelines: focused updates for 2020. Am Fam Physician. 2021;104(5):446–447.
14. Mauer Y, Taliercio RM. Managing adult asthma: the 2019 GINA guidelines. Cleve Clin J Med. 2020;87(9):569–575. doi:10.3949/ccjm.87a.19136
15. Holguin F, Cardet JC, Chung KF, et al. Management of severe asthma: a European Respiratory Society/American Thoracic Society guideline. Eur Respir J. 2020;55(1):1900588. doi:10.1183/13993003.00588-2019
16. Al-Moamary M, Alhaider S, Alangari A, et al. The Saudi initiative for asthma - 2021 update: guidelines for the diagnosis and management of asthma in adults and children. Ann Thorac Med. 2021;16(1):4–56. doi:10.4103/atm.ATM_697_20
17. Yawn BP, Rank MA, Cabana MD, Wollan PC, Juhn YJ. Adherence to asthma guidelines in children, teens, and adults in primary care settings: a practice-based network assessment. Mayo Clin Proc. 2016;91(4):411–421. doi:10.1016/j.mayocp.2016.01.010
18. Barr RG, Somers SC, Speizer FE, Camargo CA Jr. Patient factors and medication guideline adherence among older women with asthma. Arch Intern Med. 2002;162(15):1761–1768. doi:10.1001/archinte.162.15.1761
19. Rognmark MC, Sexton M. Adherence to asthma guidelines in general practices. J Asthma. 1999;36(4):381–387. doi:10.3109/02770909909068231
20. Chokhani R, Razak A, Waked M, et al. Knowledge, practice pattern and attitude toward asthma management amongst physicians from Nepal, Malaysia, Lebanon, Myanmar and Morocco. J Asthma. 2021;58(7):979–989. doi:10.1080/02770903.2020.1742351
21. Dahmaz E. Physicians’ knowledge and practices regarding asthma in Jordan: a cross-sectional study. Front Public Health. 2021;9:712255. doi:10.3389/fpubh.2021.712255
22. Assiri HA, Alkhaldi YM, Alsaleem SA, Alqarni HM. Knowledge, attitude and practices of PHC physicians in Aseer region regarding management of acute asthma. J Fam Med Prim Care. 2021;10(5):1882. doi:10.4103/jfmpc.jfmpc_1418_20
23. Adeniyi B, Ilesanmi O, Obsuku D, Desalu O, Betiku B, Erhabor G. Relationship between knowledge and quality of asthma care among physicians in South-West Nigeria. Niger J Clin Pract. 2017;20(5):566–572. doi:10.4103/1119-3077.206363
24. Dahmaz E. Physicians’ knowledge and practices regarding asthma in Jordan: a cross-sectional study. Front Public Health. 2021;9:1–7.
25. Boulet LP, Devlin H, O’Donnell DE. The physicians’ practice assessment questionnaire on asthma and COPD. Respir Med. 2011;105(1):8–14. doi:10.1016/j.rmed.2010.07.022

26. Bateman ED, Hurd SS, Barnes PJ, et al. Global strategy for asthma management and prevention: GINA executive summary. Eur Respir J. 2008;31 (1):143–178. doi:10.1183/09031936.00138707

27. Bontsevich RA, Mikhno AV, Dudchenko OV, et al. Assessment of physicians’ and medical majors’ knowledge of asthma basics: current results of the ASSA-II study. Res Results Pharmacol. 2019;5(2):79–88. doi:10.3897/rrpharmacology.5.36621

28. Al-Moamary MS, Alhaider SA, Alangari AA, et al. The Saudi initiative for asthma - 2021 update: guidelines for the diagnosis and management of asthma in adults and children. Ann Thorac Med. 2021;16(1):4–56.

29. Roman-Rodriguez M, Molina-Paris J, Fernandez Sanchez A, et al. Compliance with the clinical guidelines for managing asthma by primary care physicians: an ambispective observational study. Rev Clin Esp. 2021;221(4):207–216. doi:10.1016/j.reeng.2019.11.006

30. Wahabi HA, Alziedan RA. Reasons behind non-adherence of healthcare practitioners to pediatric asthma guidelines in an emergency department in Saudi Arabia. BMC Health Serv Res. 2012;12(1):226. doi:10.1186/1472-6963-12-226

31. Cook DA, Pencille LJ, Dupras DM, Linderbaum JA, Pankratz VS, Wilkinson JM. Practice variation and practice guidelines: attitudes of generalist and specialist physicians, nurse practitioners, and physician assistants. PLoS One. 2018;13(1):e0191943–e. doi:10.1371/journal.pone.0191943

32. Dogherty EJ, Harrison MB, Graham ID, Vandyk AD, Keeping-Burke L. Turning knowledge into action at the point-of-care: the collective experience of nurses facilitating the implementation of evidence-based practice. Worldviews Evid Based Nurs. 2013;10(3):129–139. doi:10.1111/wvn.12009