Practical Considerations for the Diagnosis and Management of Asthma in Older Adults

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CME Activity

Target Audience: The target audience for *Mayo Clinic Proceedings* is primarily internal medicine physicians and other clinicians who wish to advance their current knowledge of clinical medicine and who wish to stay abreast of advances in medical research.

Statement of Need: General internists and primary care physicians must maintain an extensive knowledge base on a wide variety of topics covering all body systems as well as common and uncommon disorders. *Mayo Clinic Proceedings* aims to leverage the expertise of its authors to help physicians understand best practices in diagnosis and management of conditions encountered in the clinical setting.

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Learning Objectives: On completion of this article, you should be able to (1) describe the characteristics of asthma in older adults, (2) list the goals of asthma management in older adults, and (3) state treatment options for effective management of asthma in older adults, including inhalation device considerations.

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Abstract

Although often considered a disease of childhood, the prevalence of asthma in US adults aged 65 years or older is similar to that in children, with the number of older patients needing care for asthma likely to continue to increase. As with most chronic diseases, there are challenges associated with the diagnosis and management of asthma in an older population. This review discusses these challenges, suggesting practical management strategies for primary care physicians and their teams. Asthma comprises a spectrum of phenotypes, some associated with adult onset. The symptoms and characteristics of patients with late-onset asthma can differ from those of patients with early-onset disease. Furthermore, older patients may fail to recognize respiratory symptoms as abnormal and have other comorbidities, complicating the differential diagnosis of asthma. Once diagnosed, the long-term goals of asthma management are no different in older adults than in anyone with asthma, with inhaled corticosteroids being the cornerstone of therapy. Comorbid conditions become more common with age and have a direct impact on a patient's respiratory symptoms and potential adverse effects of therapy, thereby influencing the choice of therapies

and delivery systems and potentially increasing the likelihood of complex polypharmacy. In conclusion, asthma, although traditionally considered a disease of the young, should be considered as a potential diagnosis in older adults with respiratory symptoms, even without a history of asthma or allergies. As with all patients, the primary goals of asthma management in older adults are symptom control and exacerbation reduction.

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Although often considered a disease of children and adolescents, asthma prevalence in the US population aged 65 years or older is 6.9% and increasing[1] and is similar to that in children (8.6%).[2] With the older population estimated to double between 2012 and 2050,[3] the number of older patients needing care for asthma is likely to continue to increase.

Older adults with asthma are a heterogeneous population, including patients diagnosed in adulthood and those diagnosed earlier in life. As with most chronic diseases, there are challenges associated with the diagnosis and management of asthma in an older population. This review discusses these considerations and challenges and suggests practical management strategies that can be implemented by primary care physicians and their teams.

DIAGNOSIS

Asthma Phenotypes and Their Impact on Disease Characteristics

Recent work has characterized a spectrum of asthma phenotypes, some of which are associated with adult onset (Figure).[4] These types include obesity-associated asthma, asthma with fixed airflow limitation, smoking-associated asthma, and perhaps asthma–chronic obstructive pulmonary disease (COPD) overlap.

This difference in phenotypes means that the characteristics of patients with early-onset disease could differ from those with late-onset disease. For example, atopy and a family history of asthma are more common in patients with early-onset asthma, whereas current smoking is more common in those with late-onset disease.[5,6] Furthermore, patients with late-onset disease are less likely to report nighttime awakenings due to their asthma symptoms.[5] These differences may complicate the diagnosis of late-onset asthma because both atopy/allergy and nocturnal symptoms are often used to support an asthma diagnosis.

Impact of Age on Disease Expression

A further complication is that older patients may fail either to recognize respiratory symptoms as abnormal or to report them to their physician.[7] Breathlessness may be considered "normal" due to aging, and reduced activity levels may disguise the presence of dyspnea with exercise.[7] In addition, aging is associated with lung function decline (due to decreased muscle performance and/or decreased elastic recoil), reducing reversibility and potentially leading to fixed airflow obstruction,[4] with lung function decline being higher in inactive than active patients.[8] These aspects can delay diagnosis and increase diagnostic uncertainty. In addition, older adults are more likely to be diagnosed with COPD without consideration of asthma, especially if they have a history of smoking. Taken together, these factors often make the differential diagnosis of asthma in adults potentially more challenging than in children.

Differential Diagnosis of Late-Onset Asthma

No clear-cut, single diagnostic test exists for asthma. Asthma should be suspected in anyone with episodic wheezing, shortness of breath, cough, and chest tightness, especially if more than one of the symptoms is worse at night or is precipitated by an upper airway infection (Table).[4,7] However, these symptoms are relatively nonspecific in older individuals. Spirometry or peak expiratory flow testing may help confirm a respiratory etiology of symptoms, especially in patients who have a high response to short-acting bronchodilators or who have a positive response to a methacholine challenge test.[4] However, it should be noted that although nearly complete reversibility is common in asthma, it may not be present in older individuals, who may either have incomplete reversibility or fixed obstruction despite a confirmed asthma diagnosis.[7] In addition, a methacholine challenge test may not distinguish asthma from COPD in patients with airflow obstruction.[4]

Asthma-COPD Overlap

Another challenge in the differential diagnosis of asthma in older adults, especially those with a smoking history or fixed obstruction, is the coexistence of asthma and COPD, sometimes called *asthma-COPD overlap*. One of the reasons that this is challenging is that asthma-COPD overlap is not a single entity, with patients exhibiting a range of phenotypes.[4] Indeed, a joint Global Initiative for Asthma and Global Initiative for Chronic Obstructive Lung Disease working party defines asthma-COPD overlap purely on the basis of the coexistence of symptoms as "characterized by persistent airflow limitation with several features usually associated with asthma and several features usually associated with COPD."[4] If the differential diagnosis is equally balanced between asthma and COPD, initial therapy should be an inhaled corticosteroid (ICS), usually with the addition of a bronchodilator because it is important to treat both the asthma and the COPD.[4] However, this is a controversial area, and it is likely that the description, understanding, and diagnostic criteria of asthma-COPD overlap will evolve with further study and understanding of asthma and of COPD.

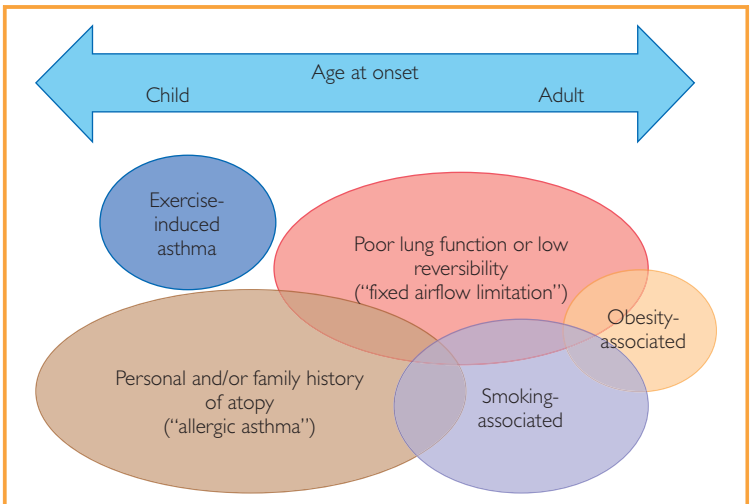

FIGURE. Schematic representation of proposed asthma phenotypes and association with age at diagnosis.

Practical Considerations

A quick review of systems can be included in most visits and should include a question about changes in activities due to shortness of breath. Asthma should be a consideration in patients with recurrent respiratory problems including frequent "bad colds" or "bronchitis." Age 50 years and older does not rule out new-onset asthma, although it is important to also consider other respiratory and cardiovascular causes of recurrent or prolonged shortness of breath, chest tightness, or wheezing. For current and former long-term smokers (in particular those with a smoking history of 20 pack-years and more), a diagnosis of both asthma and COPD may need to be considered, often accompanied by some type of heart disease.

OVERALL DISEASE MANAGEMENT

The goals of asthma management are no different in older adults than in anyone else with asthma—to achieve good symptom control and minimize the risks of exacerbations, fixed airflow limitation, and adverse effects of treatment.[4] Indeed, validated tools such as the Asthma Control Test or Asthma Control Questionnaire are just as useful in older adults and should be utilized at all clinic visits to monitor and record disease impact.[4] However, in older individuals, some factors that are of less concern in younger patients should be considered.

Consider Comorbidities

Comorbidities (especially cardiovascular disease) become more common with increasing age[9] and are also more common in adults with asthma than in an age-matched cohort.[10] This factor is important, as the need to manage comorbidities increases the likelihood of complex polypharmacy. Comorbid conditions may also have an impact on a patient's asthma symptoms, severity, and the choice of therapies. For example, older nonselective β-blockers used for coronary heart disease can potentially provoke or worsen asthma, and their use should be reviewed (and ideally discontinued) before considering initiation or step-up of asthma therapy.[4] Asthma is not a contraindication for selective β-blockers. As always, the relative risks and benefits for all asthma treatments should be considered.[4]

TABLE. Differential Diagnosis of Adult-Onset Asthma[a,b]

Diagnosis	Trigger	Symptoms	History	Family history	Tests
Asthma	Inhaled allergens; irritants such as tobacco smoke or strong odors. May also be triggered by medications such as NSAIDs or ACE inhibitors	Worse at night; variable over time. Increase with triggers and exacerbations or "attacks"	Atopy/allergies; allergic rhinitis	Family history of asthma and atopy	Lung function highly reversible and variable over time Positive response to methacholine challenge test Hypoxemia and reduced DLCO rare IgE elevation common
Vocal cord dysfunction	Most common in adolescent girls and young women	Can sound like wheezing but rarely true dyspnea	Common onset in adolescence, rarely history of atopic or allergies in childhood	Variable	Inspiratory loop of spirometry demonstrates a typical drop in inspiratory flow with the closing of the vocal cord
Rhinosinusitis	Can begin at any age	Nasal stuffiness, rhinorrhea, facial pressure. May be episodic and associated with allergens or many other triggers including eating. Chronic rhinosinusitis may result in systemic symptoms Can aggravate asthma symptoms and be a barrier to asthma control	May be considered benign and not mentioned during health care visits. Often self-treated with over-the-counter products	Often positive with allergic rhinitis	Allergy evaluation, history, direct inspection of nasal mucosa, rarely imaging
Gastroesophageal reflux disease	Eating, lying flat, overeating, and often specific foods	Chest discomfort, may mimic shortness of breath	More common in older adults	Variable	GI imaging studies including functional imaging. May respond positively to oral antacid
Nonasthmatic eosinophilic bronchitis	Variable	Cough, may mimic asthma	More common in adults	Variable	Elevated sputum eosinophil levels in the absence of airway hyperresponsiveness. Bronchial mucosal biopsies are required to definitively diagnose eosinophilic bronchitis; a trial of inhaled corticosteroid therapy performed without biopsy because most patients respond well to treatment
Postinfectious tussive syndrome	Upper respiratory tract infection	Cough	Recent upper respiratory tract infection	NA	Clinical history

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TABLE. Continued

Diagnosis	Trigger	Symptoms	History	Family history	Tests
ACE inhibitor–induced cough	Begins after introduction of ACE inhibitor therapy	Chronic cough, usually not productive	Temporal relationship to beginning medication	Unknown	Stop medication and watch for improvement
Airway obstruction due to neoplasia	May occur at rest or be aggravated by activity. Sudden onset or increase over weeks or months, not years	Dyspnea, lung infections poorly responsive to therapy, localized abnormalities on lung imaging, weight loss	Smoking or long-term exposure to other noxious inhalants	Variable	Lung imaging
Primary tracheobronchomalacia	Rare to first appear in adults	Wheezing, may not be accompanied by dyspnea	Onset early in life	Variable	Functional imaging of bronchus or direct inspection
Secondary tracheobronchomalacia	Following trauma (such as an accident, surgery, or prolonged intubation) or chronic inflammation	Very nonspecific. Dyspnea, intractable cough, and possibly hemoptysis. Recurrent pulmonary infections. Occasionally pulmonary edema	Onset in adulthood	No	Functional imaging or direct inspection
COPD	Usually irritants or infections for exacerbations Dyspnea increases with exertion without exacerbations	Chronic and progressive over time. Aggravated with activity Often with cough especially in the morning and may note chronic sputum production in the morning	Exposure to tobacco smoke (including secondary exposure) or other noxious particles	Family history of COPD	Lung function: FEV_1 <50% predicted more likely to be COPD than asthma because COPD is seldom recognized at earlier stages and asthma, except with severe exacerbations, rarely has such low FEV_1 Hypoxemia increasingly common as disease progresses and likely to first appear with activity DLCO abnormalities are common IgE elevation is uncommon
Nonobstructive chronic bronchitis	Can begin at any age	Chronic, productive cough	More common in smokers	NA	Spirometry to confirm lack of airflow obstruction
Chronic heart failure	Cardiac disease, salt intake, cardiac events	Dyspnea at rest or on exertion, orthopnea, rales, S_3 gallop, neck vein distention, pedal edema, weight gain, may experience cough	Cardiac disease, often previous episodes of chronic heart failure	Variable	Echocardiographic abnormalities, BNP elevation, chest radiography often reveals diffuse bilateral infiltrates

[a]ACE = angiotensin-converting enzyme; BNP = brain-type natriuretic peptide; COPD = chronic obstructive pulmonary disease; DLCO = diffusing capacity of the lung for carbon monoxide; FEV_1 = forced expiratory volume in 1 second; GI = gastrointestinal; NA = not applicable; NSAID = nonsteroidal anti-inflammatory drug.

[b]The contents of this table are based on the clinical judgment and experience of the authors.

Impact of Comorbidities on Asthma Control and Medication Adherence

The polypharmacy resulting from the management of multiple comorbidities can itself have a negative impact on asthma control.[11] Adherence to all medications decreases steadily with increasing numbers of drugs prescribed.[12] Some specific comorbidities such as depression and dementia significantly lower adherence rates.[12] Furthermore, the cost of medications, particularly when patients are faced with multiple copayments, likely affects the ability to obtain and use prescription therapies.[13]

Self-Management Plans

Self-management plans are a key component of the care of all patients with asthma[4] but are even more important in older patients, given their increased risk of mortality and generally poorer medication adherence. Family members and caregivers often need to be included in the development and discussion of an asthma self-management plan for older individuals, with a simple assessment of the patient's cognitive status, eg, impairment, being potentially useful when deciding who to include in an older patient's asthma management discussion.

Practical Considerations

Although the goals of asthma therapy are the same for patients of all ages, in the older adult with asthma the presence of comorbidities and the need to minimize the number of therapies required (polypharmacy) need to be considered. A clear and usable self-management plan should be tailored to any of the older patient's special needs.

TREATMENT OPTIONS FOR ASTHMA IN OLDER ADULTS

Few drugs have had their efficacy and safety profiles assessed specifically for older adults, with evidence often provided by subgroup analyses of clinical trials that recruited patients from broad age ranges. This lack of data is unfortunate because older adults are at increased risk of adverse drug effects due to age-related pharmacodynamic and pharmacokinetic changes.[14] In the absence of age-specific information, asthma in older adults should be managed with the same treatment classes as younger adults, using the same step-up and step-down approach to achieve asthma control.[4]

ICSs Are the Cornerstone of Asthma Management

Although ICSs are the cornerstone of management,[4] older patients may have a reduced response, potentially requiring higher doses to achieve control.[14] However, corticosteroid adverse effects are common in older patients (especially at higher doses)[15] and may be of greater concern than in younger populations. For example, skin thinning may increase the risk of bruising, and wearing of dental prosthetics may increase the risk of oral thrush. Data regarding increased risk of pneumonia with ICSs in asthma is mixed, although the totality of the data suggest a small increase in risk for pneumonia but not mortality.[16] Physicians often underestimate patients' experiences of adverse effects.[15] Furthermore, many patients are concerned or fearful about corticosteroid-related adverse effects,[15] potentially lowering the rates of adherence to ICS therapy. Adherence should therefore be explored with all patients, perhaps during drug reconciliation discussions.

Use of Inhaled Bronchodilators in Older Adults With Asthma

In all patients with asthma, not just older adults, long-acting β_2-agonists (LABAs) should be used only as an add-on to anti-inflammatory therapies because of the increased risk of respiratory-related death.[17] Therefore, LABAs are never appropriate first-line or monotherapy for asthma as highlighted by the inclusion of black box warnings on the US labels of all β_2-agonists. Theoretically, older patients may have a reduced response to bronchodilators as a result of age-related changes such as stiffening of the chest wall, reduced respiratory muscle function, and an increase in residual volume from loss of elastic recoil in the lung.[14] However, data have revealed that albuterol is effective in both younger and older patients,[18] and the addition of the LABA salmeterol to the ICS fluticasone has been reported to decrease the risk of asthma-related serious exacerbations compared with fluticasone alone.[19] Although

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LABAs have traditionally been the main add-on to ICSs in asthma, a long-acting muscarinic antagonist has also demonstrated efficacy as an ICS add-on, independent of patient age.[20] Taken together, these data suggest that inhaled long-acting bronchodilators are effective in older patients with asthma.

There is no evidence that approved doses of long-acting bronchodilators pose additional safety concerns in older patients compared with younger patients.[21] However, in older patients with comorbid conditions, LABAs may need to be used with care. For example, β_2-mediated hypokalemia can be aggravated by LABA use in patients who are also using diuretics.[22] This risk must be balanced against the corticosteroid-sparing effect of LABAs, which may permit a lower dose of an ICS to be used and thereby lower the risk of common corticosteroid-related adverse effects. Monitoring of the serum potassium level continues to be valuable in patients taking diuretics and LABAs. Similarly, although the overall safety profile of the long-acting muscarinic antagonists is not different in older and younger adults, they should be used with patient and clinician awareness and vigilance in patients with some comorbidities, including narrow-angle glaucoma, prostatic hyperplasia, or bladder neck obstruction.

Other Therapy Options

Other controller options for the management of asthma are leukotriene receptor antagonists and theophylline.[4] Theophylline has a low therapeutic index and a high risk of adverse effects or toxicity, especially in older individuals, making close monitoring of blood theophylline levels essential when using therapeutic doses.[7] Leukotriene receptor antagonists such as montelukast, although in general less effective anti-inflammatories than ICSs, may be effective in some older patients, especially those with apparent corticosteroid resistance.[4,7] In addition, their oral route of administration could have advantages over inhaled administration for some patients.[23] A number of monoclonal antibodies are available for the management of more severe asthma, including omalizumab (for allergic asthma) and mepolizumab or reslizumab (for eosinophilic asthma).[4] Although none of these treatments have upper age limits for their use, little efficacy and safety data are available for older patients, and the high cost of such therapies may limit their acceptability for this as well as all other populations.

Practical Considerations

Age does not directly alter asthma therapy choices, with ICSs continuing as the preferred first-line therapy. Long-acting bronchodilators are used as add-on treatment when low to moderate doses of ICSs are inadequate to control symptoms. Always remember to assess adherence and inhaler device technique before simply stepping up therapy. The presence of comorbidities may affect therapy selection with the need to minimize the risk of potential adverse effects and drug interactions.

INHALER DEVICE CONSIDERATIONS

The ability to use an inhaler correctly is key to the management of asthma in any age group because poor technique is associated with poorer asthma control[24] and an increased hospitalization risk.[25] Use of different inhaler types can add to a patient's overall treatment burden, especially if the devices require very different techniques.

Does the Patient Know How to Use the Device Correctly?

Patient education on correct use of the inhaler device is essential when initially prescribed and at regular intervals because correct technique has been reported to decline over time.[14] This factor becomes even more important with older patients, as accuracy of inhalation technique has also been found to decline with increasing age.[26] Patients should be observed using their devices because not only does correct use decline with increasing age but also the gap in perception increases, with younger patients tending to rate their inhalation technique more poorly than their physicians whereas older patients tend to rate their technique more highly.[26] On a more positive note, older patients are more likely to accept instruction on inhalation therapy,[26] and education or training on device use has been reported to significantly increase overall treatment adherence in older patients.[25]

Is the Patient Able to Use the Device Correctly?

Some devices are capsule based and so require a degree of manual dexterity to fill. Other devices such as most pressurized metered-dose inhalers require sufficient hand strength or coordination to activate[14] or, as in the case of dry powder inhalers, may require patients to generate a minimum inspiratory flow, which can be compromised in the aging process.[27] As a consequence, even if patients are appropriately educated, they may be physically incapable of using a device correctly. The use of a spacer device with a pressurized metered-dose inhaler can be especially helpful in patients who are unable to coordinate device actuation and inhalation. The spacer also optimizes lung delivery through reduced oropharyngeal deposition and thus reduces systemic and local adverse effects, which is especially relevant for ICSs.[28,29] Nebulizers may be an appropriate alternative to inhalers for some patients,[14] but the need for medication preparation and daily cleaning, the size of the inhaler device and concerns about portability, and the limited number of drugs available in nebulized forms may limit their usefulness. Cognitive impairment may impact correct use and therapy adherence regardless of type of device used.[25]

Practical Considerations

As with any patient requiring inhaled medication, it is important to consider not only the drug molecule(s) when selecting a treatment but also how that molecule will be delivered. Physicians should not assume that because a patient has been using an inhaler device for years it is the most appropriate device for them or that they are using it correctly; education is as important a component of managing the disease in older as in younger patients. Only direct observation can confirm the accuracy and adequacy of the patient's inhaler technique. For physicians in the United States, consider including the instruction "assemble and prime" on prescriptions for devices that require assembly before first use—this notation is a request to the dispensing pharmacist to prepare the inhaler for use.

DISCUSSION

Overall, asthma diagnosis and management in older adults is no different than in younger patients. However, the "normal" aging process and the increased likelihood of comorbid diseases may make differential diagnosis of late-onset asthma more challenging, especially in certain groups such as smokers. In particular, different phenotypes may alter disease expression, and the "typical" symptoms of asthma may either be ignored by patients or ascribed to aging. Age alone does not rule out new-onset asthma, and even in a patient with no history of asthma or atopy, asthma should be a potential consideration in a patient with recurrent respiratory problems.

Once diagnosed, the aims of treatment are no different in older patients than in younger patients, with ICSs being the cornerstone of asthma management and long-acting bronchodilators added if necessary to achieve control. Whenever possible, consider using treatments that have evidence of safety and efficacy in older individuals; however, few drugs have had their profiles assessed specifically in this population. Age alone is not necessarily a determinant of choice of therapy, although the presence of comorbidities may impact selection of treatments and inhaler devices. Furthermore, as with all age groups, every effort should be made to minimize complex medication regimens—not only therapies to manage asthma but also, if applicable, to manage comorbidities.

CONCLUSION

Asthma, although traditionally considered a disease of the young, can be responsible for considerable morbidity and mortality in older adults. Asthma should be considered as a potential diagnosis in older adults, even if they have no history of the disease, and should be appropriately managed according to current asthma guidelines.

Abbreviations and Acronyms: **COPD** = chronic obstructive pulmonary disease; **ICS** = inhaled corticosteroid; **LABA** = long-acting β_2-agonist

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REFERENCES

1. Centers for Disease Control and Prevention. Table 4-1. Current asthma prevalence percents by age, United States: National Health Interview Survey, 2001. https://www.cdc.gov/asthma/nhis/01/table4-1.htm. Published 2001. Updated April 27, 2009. Accessed November 10, 2016.
2. Centers for Disease Control and Prevention. Most recent asthma data. http://www.cdc.gov/asthma/most_recent_data.htm. Published 2016. Updated June 7, 2017. Accessed November 10, 2016.
3. Ortman JM, Velkoff VA, Hogan H. An aging nation: the older population in the United States; population estimates and projections: current population reports. US Census Bureau website, https://www.census.gov/prod/2014pubs/p25-1140.pdf. Published May 2014. Accessed November 10, 2016.
4. Global Initiative for Asthma. *Global Strategy for Asthma Management and Prevention*. http://ginasthma.org/2017-gina-report-global-strategy-for-asthma-management-and-prevention/. Published 2017. Accessed February 20, 2017.
5. Tan DJ, Walters EH, Perret JL, et al. Clinical and functional differences between early-onset and late-onset adult asthma: a population-based Tasmanian Longitudinal Health Study. *Thorax*. 2016;71(11):981-987.
6. Herscher ML, Wisnivesky JP, Busse PJ, et al. Characteristics and outcomes of older adults with long-standing versus late-onset asthma. *J Asthma*. 2017;54(3):223-229.
7. Hanania NA, King MJ, Braman SS, et al; Asthma in Elderly Workshop Participants. Asthma in the elderly: current understanding and future research needs—a report of a National Institute on Aging (NIA) workshop. *J Allergy Clin Immunol*. 2011;128(3, suppl):S4-S24.
8. Brumpton BM, Langhammer A, Henriksen AH, et al. Physical activity and lung function decline in adults with asthma: the HUNT Study. *Respirology*. 2017;22(2):278-283.
9. Wardzyńska A, Kubsik B, Kowalski ML. Comorbidities in elderly patients with asthma: association with control of the disease and concomitant treatment. *Geriatr Gerontol Int*. 2015;15(7):902-909.
10. Bozek A, Rogala B, Bednarski P. Asthma, COPD and comorbidities in elderly people. *J Asthma*. 2016;53(9):943-947.
11. Ban G-Y, Ye Y-M, Lee Y, et al; Premier Researchers Aiming New Era in Asthma and Allergic Diseases (PRANA) Study Group. Predictors of asthma control by stepwise treatment in elderly asthmatic patients. *J Korean Med Sci*. 2015;30(8):1042-1047.
12. Rolnick SJ, Pawloski PA, Hedblom BD, Asche SE, Bruzek RJ. Patient characteristics associated with medication adherence. *Clin Med Res*. 2013;11(2):54-65.
13. Campbell JD, Allen-Ramey F, Sajjan SG, Maiese EM, Sullivan SD. Increasing pharmaceutical copayments: impact on asthma medication utilization and outcomes. *Am J Manag Care*. 2011;17(10):703-710.
14. Reed CE. Asthma in the elderly: diagnosis and management. *J Allergy Clin Immunol*. 2010;126(4):681-687.
15. Cooper V, Metcalf L, Versnel J, Upton J, Walker S, Horne R. Patient-reported side effects, concerns and adherence to corticosteroid treatment for asthma, and comparison with physician estimates of side-effect prevalence: a UK-wide, cross-sectional study. *NPJ Prim Care Respir Med*. 2015;25:15026.
16. McKeever T, Harrison TW, Hubbard R, Shaw D. Inhaled corticosteroids and the risk of pneumonia in people with asthma: a case-control study. *Chest*. 2013;144(6):1788-1794.
17. Nelson HS, Weiss ST, Bleecker ER, Yancey SW, Dorinsky PM; SMART Study Group. The Salmeterol Multicenter Asthma Research Trial: a comparison of usual pharmacotherapy for asthma or usual pharmacotherapy plus salmeterol [published correction appears in *Chest*. 2006;129(5):1393]. *Chest*. 2006;129(1):15-26.
18. Kradjan WA, Driesner NK, Abuan TH, Emmick G, Schoene RB. Effect of age on bronchodilator response. *Chest*. 1992;101(6):1545-1551.
19. Stanford RH, Blanchette CM, Roberts MH, Petersen H, Fuhlbrigge AL. Effect of combination fluticasone propionate and salmeterol or inhaled corticosteroids on asthma-related outcomes in a Medicare-eligible population. *Am J Geriatr Pharmacother*. 2012;10(6):343-351.
20. Kerstjens HAM, Moroni-Zentgraf P, Tashkin DP, et al. Tiotropium improves lung function, exacerbation rate, and asthma control, independent of baseline characteristics including age, degree of airway obstruction, and allergic status. *Respir Med*. 2016;117:198-206.
21. Kagohashi K, Satoh H, Ohara G, et al. Long-term safety of budesonide/formoterol for the treatment of elderly patients with bronchial asthma. *Exp Ther Med*. 2014;7(4):1005-1009.
22. Bellia V, Battaglia S, Matera MG, Cazzola M. The use of bronchodilators in the treatment of airway obstruction in elderly patients. *Pulm Pharmacol Ther*. 2006;19(5):311-319.
23. Scichilone N, Battaglia S, Benfante A, Bellia V. Safety and efficacy of montelukast as adjunctive therapy for treatment of asthma in elderly patients. *Clin Interv Aging*. 2013;8:1329-1337.
24. Baddar S, Jayakrishnan B, Al-Rawas OA. Asthma control: importance of compliance and inhaler technique assessments. *J Asthma*. 2014;51(4):429-434.
25. Turan O, Turan PA, Mirici A. Parameters affecting inhalation therapy adherence in elderly patients with chronic obstructive lung disease and asthma. *Geriatr Gerontol Int*. 2017;17(6):999-1005.
26. Hira D, Komase Y, Koshiyama S, et al. Problems of elderly patients on inhalation therapy: difference in problem recognition between patients and medical professionals. *Allergol Int*. 2016;65(4):444-449.
27. Janssens W, VandenBrande P, Hardeman E, et al. Inspiratory flow rates at different levels of resistance in elderly COPD patients. *Eur Respir J*. 2008;31(1):78-83.
28. Rubin BK, Fink JB. Optimizing aerosol delivery by pressurized metered-dose inhalers. *Respir Care*. 2005;50(9):1191-1200.
29. Lavorini F, Fontana GA. Targeting drugs to the airways: the role of spacer devices. *Expert Opin Drug Deliv*. 2009;6(1):91-102.