



Update on questionnaires for assessing adherence to inhaler devices in respiratory patients

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Purpose of review

It has been estimated that adherence to inhaled medications in patients with asthma and chronic obstructive pulmonary disease (COPD) is around 50%. This low adherence rate increases morbidity and mortality of these disorders. The objective of this review was to update information on main questionnaires used in daily for assessing adherence to inhalers of patients with chronic respiratory diseases.

Recent findings

The test of the adherence to inhalers (TAI) is a recently developed and validated 12-item questionnaire to assess adherence to inhalers of aerosolized drugs in patients with asthma or COPD. The instrument can easily identify nonadherence, classify the level of adherence into good, intermediate and poor, and establish three nonadherence behaviour patterns of erratic, deliberate, and unwitting, which are useful for tailoring corrective measures.

Summary

Adherence to inhaler devices may be underestimated with the use of validated self-report questionnaires as compared with other more sensitive methods. However, validated self-report questionnaires are more advantageous from a cost-effective perspective in clinical practice. The recently validated TAI is a reliable and homogeneous instrument to identify easily nonadherence and behavioural barriers to the use of inhalers in patients with asthma or COPD.

Keywords

asthma, chronic obstructive pulmonary disease, dry powder inhalers, medication adherence, metered dose inhalers

INTRODUCTION

Patient adherence is a crucial factor for the success of any medical treatment. Adherence is defined as 'the extent to which a person's behaviour-taking medication, following a diet, and/or executing lifestyle changes-corresponds with agreed recommendations from a healthcare provider' [1]. According to the WHO, adherence to long-term therapy for chronic illnesses in developed countries averages 50% [1]. Although there may be differences in adherence rates between different diseases and it is unquestionable that many patients experience difficulty in following treatment recommendations, poor adherence severely compromises the effectiveness of treatment and is a critical issue for the population's health. The recognition of adherence problems is an old claim but has emerged today as one of the most relevant issues in the management of patients, particularly those with chronic diseases [2]. Nonadherence behaviour has not changed substantially in the

past 25 years and affects indistinctly patients from different cultures, ages, and with a variety of pathological conditions [1].

ADHERENCE IN ASTHMA AND CHRONIC OBSTRUCTIVE PULMONARY DISEASE

In patients with the most common obstructive respiratory diseases, such as asthma and chronic obstructive pulmonary disease (COPD), the degree

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KEY POINTS

- Therapeutic adherence of patients with asthma or COPD does not surpass 50% and is associated with an increased morbidity and mortality of these diseases.
- As direct patient interview regarding compliance with prescribed medication overestimates adherence, more accurate methods are recommended.
- Self-report adherence using validated questionnaires is probably the most cost-efficient method.
- The TAI is a self-report questionnaire specifically designed for inhaled therapy, which allows to identify nonadherent patients with asthma or COPD and to establish the level of nonadherence and a suggestive pattern of nonadherent behaviour.
- It is likely that a combined use of information obtained with a validated self-report questionnaire (such as TAI) and electronic pharmacy dispensing records would be the most efficient and inexpensive approach to assess adherence to inhaled therapy in chronic respiratory patients.

of compliance with inhaled drug therapy does not surpass 50% [3,4]. Factors related to adherence with inhaled therapy include complexity of the inhalation regimen, peculiarities of inhaler devices, type of inhaled agent, and a variety of patient beliefs and sociocultural and psychological factors. A low adherence to inhaled medications increases

mortality, morbidity, and healthcare resource utilization [5,6]. Therefore, promoting optimal medication adherence is crucial to optimize the benefits of treatment and to achieve control of disease in these patients. This aspect has been consistently emphasized in the main clinical practice guidelines of COPD and asthma [7^a–9^a].

METHODS TO DETERMINE THE ADHERENCE

For an adequate clinical practice, it is essential to determine the degree of therapeutic adherence in the individual patient. The methods commonly used to assess adherence in patients with respiratory diseases are shown in Table 1.

Interviewing patients with a direct question about whether the previously prescribed medication has been taken properly, is probably the most easy-to-use and low-cost measure. When the patient admits having not being compliant, the positive predictive value of this method is very high. However, it is common for patients to overestimate their level of adherence and claim that they took their medication as prescribed, when in fact this has not been the case [10].

Given that direct patient interview has a low negative predictive value, it is necessary to use other more sensitive methods for identifying low adherence. These methods are classified into direct and indirect, also labelled them as objective or subjective (Table 1).

Table 1. Methods to assess therapeutic adherence to inhaler devices chronic respiratory patients

Direct methods	Drug levels in biological fluids (blood and urine) Monitoring devices attached to the user's inhaler (e.g., Smart-inhalers)
Indirect methods	Clinical judgment. Direct patient interview Pill or dose count.; canister weight Clinical results after treatment: improvement of symptoms, pulmonary function (spirometry), or inflammation (FeNO in asthma) Databases. Electronic pharmacy dispensing records General self-reported adherence questionnaires Haynes–Sackett test Morisky–Green test Bogus pipeline method Batalla test (disease knowledge) Brief Medication Questionnaire Medication Adherence Questionnaire (MAQ) Other: Adherence Starts with Knowledge (ASK-12); Brief Adherence Rating Scale (BARS), Clinical Rating Scale (CRS) according to clinician, Personal Evaluation of Transitions in Treatment (PETiT questionnaire), Simplified MAQ (SMAQ) Specific self-report questionnaires for inhaler devices Test of the adherence to inhalers (TAI) Medication Adherence Rating Scale for Asthma (MARS-A) Pediatric Inhaler Adherence Questionnaire (PIAQ)

Direct methods

Direct measures are more sensitive and have a higher predictive value, but are more expensive. Direct measures include measurement of the drug or its metabolite concentration in body fluids, such as blood or urine [11] or adherence-monitoring electronic devices incorporated into the inhaler device [12] or the packing of a prescription medication, which record the time and date whenever the medication is removed assuming that the patient has taken that specific dose at that particular time. However, electronic methods are expensive, subject to malfunction, and cannot confirm ingestion.

Indirect methods

Less sensitive indirect methods and with a lower predictive value include pill count or canister weighing, therapeutic results (such as exhaled nitric oxide levels in patients with asthma) [13], electronic pharmacy dispensing records [14], or validated self-report adherence questionnaires or scales completed by patients themselves or their caregivers, which are the subjects of the present review.

SELF-REPORT ADHERENCE QUESTIONNAIRES

There are many validated self-report adherence questionnaires (Table 1) that in general are easy to administer and provide valid information on medication-taking behaviour, although they have potential limitations as in addition to the need to understand questions and statements, are dependent on the patient's veracity or memory [15]. The most commonly used self-report adherence instruments are described in the following sections.

Haynes–Sackett method

This self-report assessment of adherence is based on simply query the patient and has a high predictive value if the patient recognizes nonadherent behaviour. First, it is advisable to create a friendly environment during consultation and to comment on the difficulty that most patients usually have with taking the medication using the sentence *Most people often have difficulty taking all their pills*. Then, the patient is asked *Do you have difficulties in taking your pills?* An affirmative answer already qualifies the patient as noncompliant and appropriate action to solve the situation should be taken. A negative answer does not necessarily means good adherence, and the patient should keep questioning *How do you take them?* – every day, many days, some days, a few days, or rarely. Finally, if the patient continues to

considered him/herself good compliant, the following refection should be made: *Many people have difficulties following treatments, why do you not tell me how you are doing?* The Haynes–Sackett method is one of the simplest tests for use in the primary care setting. Its administration is rapid and cheap and can be used during a routine clinical visit. It does not require a high sociocultural level for its comprehension, and in case of recognition of nonadherence, the Haynes–Sackett method is reliable, with a high positive predictive value. However, its negative predictive value is low and has not been validated for measuring adherence to inhaler devices [16].

Morisky–Green scale or test

Morisky–Green scale or test was originally developed to assess medication adherence in patients with essential hypertension [17] and constitutes one of the instruments most widely used to measure adherence in chronic diseases, including COPD. The four questions of the instrument have been adapted for use with inhaled medication, with a specificity of 76% and a sensitivity of 67% [18]. It consists of four questions: first, *Do you ever forget to take your inhaled medication?* Second, *Are you careless at times about taking your inhaled medication?* Third, *When you feel better, do you sometimes stop taking your inhaled medication?* Fourth, *Sometimes, if you feel worse when you take the inhaled medication, do you stop taking it?*, with a simple dichotomous answer (yes/no). Good adherence is considered when all four questions are answered suitably (no/yes/no/no). The questions are intended to reflect the patient's attitude towards nonadherence, assuming that if the attitudes are incorrect, the patient is noncompliant. The questions are asked during the clinical interview, trying to create an atmosphere of cordiality. This questionnaire has the advantage of being easy to use and provides information on the type of nonadherence (erratic or deliberate). However, it does not provide information on unintended nonadherence. Among measures involving self-report questionnaires, the Morisky–Green test is probably the most widely used to assess therapeutic adherence in both clinical practice and research.

Bogus pipeline method

Bogus pipeline method was designed to convince patients that a sophisticated Wew electronic device could accurately detect their 'true' attitudes and opinions; it was then presumed that patients would be motivated to respond truthfully to such questions, to avoid being revealed as a liar. In practice, patients are informed that their self-reports will be verified through drug urine analysis. If there is

resistance to urine sampling, it can be assumed that the patient is noncompliant. The bogus pipeline method is brief, easy to understand, and cheap, but it is not validated for assessing adherence to inhaled medications [19].

Batalla test (or patient's knowledge or awareness of disease)

Batalla test (or patient's knowledge or awareness of disease) is a questionnaire based on four simple questions that evaluate the patient's knowledge of his/her disease, assuming that correct responses require good knowledge of the disease and are associated with a higher degree of compliance. The questionnaire was originally validated for essential hypertension, although it has been subsequently used in other chronic diseases, such as diabetes. It has not been applied to patients with asthma or COPD [20].

Medication Adherence Rating Scale for Asthma

Medication Adherence Rating Scale for Asthma (MARS-A) [21] is a 10-item questionnaire initially designed for compliance with psychoactive medications [22] and then validated for its use in COPD [23] and asthma [21]. The questionnaire is self-administered, so that control of the patient's inhalation technique is lacking (unconscious noncompliance). Also, on many occasions patients find confusing the way in which questions are written, being necessary a certain cultural level for their understanding. However, the questionnaire has a good internal consistency (Cronbach's alpha of 0.86) and test-retest reliability (0.65).

Brief Medication Questionnaire

Brief Medication Questionnaire [24] is self-report tool for screening adherence and barriers to adherence. The questionnaire includes a five-item regimen screen that asks patients how they took each medication in the past week, a two-item belief screen that asks about drug effects and bothersome features, and a two-item recall screen about potential difficulties remembering. It has been validated using electronic adherence-monitoring devices in diabetes and hypertension, but has not been validated for adherence to inhaled therapy. The instrument is difficult to evaluate and a certain sociocultural level is required.

Test of adherence to inhalers

The above self-report questionnaires were developed to establish therapeutic adherence to pills or tablets.

Some of them were subsequently adapted to respiratory diseases (e.g., MARS-A) but none of them was designed for measuring adherence to inhaled therapy in adult patients with chronic obstructive respiratory diseases. Therefore, the test of the adherence to inhalers (TAI) was developed with the objective to provide a new questionnaire specifically designed to establish self-reported adherence to inhaler devices and to help clinicians to assess nonadherence barriers related to inhaled therapy in adult patients with asthma or COPD [25^{***}].

In comparison with its predecessors, this new questionnaire allows not only to identify the patient with low adherence, but also to determine the level of nonadherence classifying patients into the groups of adherent, intermediate adherent, and nonadherent, as well as to establish the behavioural pattern of nonadherence. The instrument is composed by two complementary questionnaires: 10-items TAI and 12-items TAI (Table 2). The 10-items TAI is self-completed by the patient and is designed to identify nonadherent patients and to establish the nonadherence level. Each item is scored from 1 to 5 (in which 1 is the worst possible score and 5 is the best possible score), with a range from 10 to 50. The mean time needed to fulfil the 10-items TAI is about 3 min. Adherence levels are scored 50 for adherent patients, between 46 and 49 for intermediate adherent patients, and 45 or less for nonadherent patients. The 12-items TAI has two domains: the patient (items 1–10) and the healthcare professional (items 11 and 12). For item 11, the healthcare professional should check the medical record to assess whether the patient knows the prescribed inhaled regimen (dose and frequency) and for item 12, the healthcare professional should check the inhalation technique to assess whether critical mistakes are present or absent (Table 2). These two items are scored as 1 (bad) or 2 (good). The patterns of nonadherence included erratic (items 1–5, score between 5 and 25), deliberate (items 6–10, score between 5 and 25), and unwitting (items 11 and 12, score between 2 and 4). The mean time to fulfil the 12-items TAI is about 5 min. An erratic and deliberate nonadherent behaviour was defined in the presence of scores at least 24 for items 1–5, and 6–10, respectively. The unwitting pattern was defined in the presence of a score of 3 or less for items 11 and 12. Of note, that the same patient may present more than one nonadherent behaviour pattern; also, a patient with a score of 50 in the 10-items TAI can be then an unconscious noncompliant in the 12-items TAI.

In the validation study, the TAI questionnaire demonstrated good psychometric characteristics (reliable, homogeneous, and unidimensional), with

Table 2. Description of the test of the adherence to inhalers [25**]

Patient domain					Score
1. How often did you forget to take your regular inhalers in the last 7 days?					
All (1)	More than half (2)	About a half (3)	Less than half (4)	None (5)	1–5
2. You forget to take your inhalers					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
3. When you are feeling well, you stop taking your inhalers					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
4. At the weekend or when you go on holiday, you stop taking your inhalers					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
5. When you are anxious or sad, you stop taking your inhalers					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
6. You stop taking your inhalers out of fear or potential side effects					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
7. You stop taking your inhalers because you believe that they are of little help in treating your condition					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
8. You take fewer inhalations than those prescribed by your doctor					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
9. You stop taking yours inhalers because you believe that they interfere with your day-to-day or work life					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
10. You stop taking your inhalers because you have trouble paying for them					
Always (1)	Almost always (2)	Sometimes (3)	Almost never (4)	Never (5)	1–5
Healthcare professional domain.					
A healthcare professional responsible for the patient must answer the following two questions according to the data that appear in the patient's medical record (question no. 11) and after confirming the inhalation technique (question no. 12)					
11. Does the patient know or remember the regimen (dose and frequency) that they were prescribed?					
No (1)		Yes (2)			1 or 2
12. The patient's inhalation technique for the device ^a					
Has critical errors (1)		Has no critical errors or is correct (2)			1 or 2

Pressure metered dose inhalers (pMDIs): do not remove the cover, do not hold the inhaler in a vertical position, firing the device before beginning inspiration, inhalation stopped, inhalation too fast, incorrect insertion of MDI into the inhaler camera, several device firing in the same inhalation, no breath hold after inhalation, cough during inhalation. Dry power inhalers (DPIs): do not open the inhaler, do not prime properly, place the device down after preparation of the dose (before inhalation), blow into the device before inhalation, inhalation not deeply and forcefully, no breath hold after inhalation.

^aCritical mistakes.

an excellent internal consistency (Cronbach's alpha coefficient of 0.873) and test–retest reliability (intra-class correlation coefficient of 0.883). As compared with the Morisky–Green test, TAI showed a slightly better, but statistically significant, correlation with adherence evaluated using electronic inhaler devices (Smart-inhalers; Melbourne, Vic 3000 Australia) ($p = 0.286$ vs. 0.247) [25**]. In addition, other interesting findings were a higher percentage of adherence to inhalers among patients with COPD (49%) as compared with patients with asthma (28%) [26]. On the other hand, the pattern of nonadherence was more frequently erratic and deliberate in asthma patients, whereas unwitting nonadherence was more frequently observed in COPD [26].

The TAI questionnaire has been already translated and validated into 14 languages: English,

French, Italian, German, Spanish, Dutch, Russian, Greek, Polish, Portuguese/Brazilian, Turkish, Arabic (Saudi Arabia), Arabic (Egyptian), and Arabic (United Arab Emirates) (available from www.taitest.com).

In the real-world clinical practice, the combination of two simple and immediate methods, such as a self-report questionnaire and information obtained from electronic pharmacy dispensing records is probably the most effective and inexpensive approach to assess adherence in asthma treatment. The efficiency of both methods for identifying nonadherent patients is similar, ranging between 52 and 84% for self-report questionnaires, and between 40 and 86% for electronic pharmacy drug dispensing records [27,28], although inconsistent results were found in some studies [14]. In a

recent study, the combination of TAI and pharmacy dispensing records increased the effectiveness to detect nonadherence to inhaler devices among patients with asthma [29]. Information provided by these two methods is likely to be complementary as different aspects of nonadherence are explored by these methods. The combination of both tools is recommended in the last edition of the Spanish clinical practice guideline for the management of asthma [8^o].

CONCLUSION

Among the various methods potentially applicable in clinical practice to assess therapeutic adherence to inhaled medications, some are not recommendable due to its low reliability (direct question during medical consultation) and others because they are complex and relatively expensive (electronic devices, blood drug levels). Therefore, in the routine clinical setting, it is advisable to use validated questionnaires self-completed by the patient as they are simple and cheap, with an acceptable reliability (although they are not the most sensitive). The TAI is the only questionnaire specifically designed and validated to determine adherence to inhaler devices in adult patients with asthma or COPD. The questionnaire allows identifying nonadherence and to establish the level of nonadherence and non-adherent behaviour pattern, which is clinically relevant to implement strategies tailored to specific needs of the individual patient. The association of validated self-report questionnaires and electronic pharmacy dispensing records is probably one of the methods with the most advantageous cost-benefit ratio.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

1. World Health Organization. Adherence to long-term therapies. Evidence for action. World Health Organization, 2003; Available at: <http://apps.who.int/iris/bitstream/10665/42682/1/9241545992.pdf>. [Accessed 29 June 2017]
2. Clepper I. Noncompliance, the invisible epidemic. *Drug Top* 1992; 17:44–65.
3. Bozek A, Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma* 2010; 47:162–165.
4. Cecere LM, Slatore CG, Uman JE, *et al.* Adherence to long-acting inhaled therapies among patients with chronic obstructive pulmonary disease (COPD). *COPD* 2012; 9:251–258.
5. Engelkes M, Janssens HM, de Jongste JC, *et al.* Medication adherence and the risk of severe asthma exacerbations: a systematic review. *Eur Respir J* 2015; 45:396–407.
6. Ismail A, Corriveau D, Vaillancourt J, *et al.* Impact of adherence to treatment with tiotropium and fluticasone propionate/salmeterol in chronic obstructive pulmonary diseases patients. *Curr Med Res Opin* 2014; 30: 1427–1436.
7. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management and prevention of COPD. Global Initiative for Chronic Obstructive Lung Disease; 2017; Available at: <http://goldcopd.org/>. [Accessed 26 June 2017]
- Update consensus report for the diagnosis, management, and prevention of chronic obstructive pulmonary disease.
8. Global Initiative for Asthma (GINA). 2017 GINA report, global strategy for asthma management and prevention. Available at: <http://ginasthma.org/2017-gina-report-global-strategy-for-asthma-management-and-prevention/>. [Accessed 26 June 2017].
- Update consensus report for the management and prevention of asthma.
9. GEMA. Guía Española para el Manejo del Asma (Spanish guideline for asthma management). Ed. Luzan5; 2017; Available at: <http://www.gemasma.com>. [Accessed 26 June 2017]
- Update Spanish guideline for the management of asthma.
10. Rodríguez Chamorro MA, García-Jiménez E, Amariles P, *et al.* Review of tests used for measuring therapeutic compliance in clinical practice. *Aten Primaria* 2008; 40:413–418.
11. Rotta ET, Amantéa SL, Froehlich PE, Becker A. Plasma concentrations of salbutamol in the treatment of acute asthma in a pediatric emergency. Could age be a parameter of influence? *Eur J Clin Pharmacol* 2010; 66:605–610.
12. Patel M, Pilcher J, Travers J, *et al.* Use of metered-dose inhaler electronic monitoring in a real-world asthma randomized controlled trial. *J Allergy Clin Immunol Pract* 2013; 1:83–91.
13. Dweik RA, Boggs PB, Erzurum SC, *et al.* An official ATS clinical practice guideline: interpretation of exhaled nitric oxide levels (FeNO) for clinical applications. *Am J Respir Crit Care Med* 2011; 184:602–615.
14. Van Steenis M, Driesenaar J, Bensing J, *et al.* Relationship between medication beliefs, self-reported and refill adherence, and symptoms in patients with asthma using inhaled corticosteroids. *Patient Prefer Adherence* 2014; 8:83–91.
15. Culig J, Leppée M. From Morisky to Hill-bone; self-reports scales for measuring adherence to medication. *Coll Antropol* 2014; 38:55–62.
16. Haynes RB. A critical review of the determinants of patient compliance with therapeutic regimens. In: Sackett DL, Haynes RB, editors. *Compliance with therapeutic regimens*. Baltimore: John Hopkins University Press; 1976. pp. 24–40.
17. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care* 1986; 24:67–74.
18. Barnestein-Fonseca P, Leiva-Fernández J, Vidal-España F, *et al.* Is it possible to diagnose the therapeutic adherence of patients with COPD in clinical practice? A cohort study. *BMC Pulm Med* 2011; 11:6.
19. Quigley-Fernandez B, Tedeschi JT. The bogus pipeline as lie detector: two validity studies. *J Pers Soc Psychol* 1978; 36:247–256.
20. Batalla Martínez C. Hypertension and compliance with therapy. *Aten Primaria* 2004; 34:397–398. (Article in Spanish).
21. Cohen JL, Mann DM, Wisnivesky JP, *et al.* Assessing the validity of self-reported medication adherence among inner-city asthmatic adults: the Medication Adherence Report Scale for Asthma. *Ann Allergy Asthma Immunol* 2009; 103:325–331.
22. Thompson K, Kulkarni J, Sergejew AA. Reliability and validity of a new Medication Adherence Rating Scale (MARS) for the psychoses. *Schizophr Res* 2000; 42:241–247.
23. George J, Kong DC, Thoman R, Stewart K. Factors associated with medication nonadherence in patients with COPD. *Chest* 2005; 128:3198–3204.
24. Svarstad BL, Chewning BA, Sleath BL, Claesson C. The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient Educ Couns* 1999; 37:113–124.

25. Plaza V, Fernández-Rodríguez C, Melero C, *et al.* Validation of the 'test of the adherence to inhalers' (TAI) for asthma and COPD patients. *J Aerosol Med Pulm Drug Deliv* 2016; 29:142–152.

The study reports the process of development and validation of a specific questionnaire to assess adherence to inhaled medications, to grade the degree of adherence, and to classify the type of nonadherent behaviour.

26. Plaza V, López-Viña A, Entrenas LM, *et al.* Differences in adherence and nonadherence behaviour patterns to inhaler devices between asthma and COPD patients. *COPD* 2016; 20:1–8.

27. Hansen RA, Kim MM, Song L, *et al.* Comparison of methods to assess medication adherence and classify nonadherence. *Ann Pharmacother* 2009; 43:413–422.

28. Allin S, Bayoumi AM, Law MR, Laporte A. Comparability of self-reported medication use and pharmacy claims data. *Health Rep* 2013; 24:3–9.

29. Giner Donaire J, Torrejón Lázaro M, Peiró Fábregas M, *et al.* Evaluation of the therapeutic adherence to inhalers in asthma patients by the electronic record of the Pharmacy and the TAI (Test of Adhesion to Inhalers). Preliminary study. *Arch Bronconeumol* 2016; 52:1–387.