



An online survey detected knowledge gaps and cost-saving opportunities in asthma maintenance treatment among allergists, pulmonologists, ENTs and primary care

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ABSTRACT

Background: In April 2017 the Mexican Asthma Guidelines (GUIMA) were published. Before the launch, physicians' knowledge was explored related to key issues of the guideline.

Methods: A SurveyMonkey[®] survey was sent out to board-certified physicians of 5 medical specialties treating asthma. Replies were analyzed per specialty against the GUIMA evidence-based recommendations. We present the treatment part here.

Results: A total of 364 allergists (ALLERG), 161 pulmonologists (PULM), 34 ENTs, 239 pediatricians (PED) and 62 general practitioners (GPs) replied to the survey and 247-83-14-135-37 respectively finished it. Spirometry is not routinely indicated when asthma is very probable by ALLERG 54%, PULM 47%, ENT 39%, PED 65%, GP 64%. A fictitious case proposed to the physicians with intermittent asthma was erroneously treated with ICS by ALLERG 9%, PULM 11%, ENT 28%, PED 10%, GP 11%. The mild persistent case received mistakenly ICS-LABA by ALLERG 25%, PULM 26%, ENT 33%, PED 27%, GP 23%. The first-line option for moderate persistent asthma was ICS (median dose) instead of ICS (low)+LABA for ALLERG 29%, PULM 25%, ENT 17%, PED 27%, GP 23% and in severe asthma maintenance treatment PULM 20%, ALLERG-ENT-PED-GP 22-34% failed to indicate LABA. Concerning the guidelines' recommendation to use one inhaler for maintenance & rescue in moderate-to-severe asthma, PULM 45%, ALLERG-ENT-PED-GP 56-80% ($p < 0.00001$), erroneously indicated ICS-salmeterol could be used, instead of ICS-formoterol. Oral β_2 or

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theophylline are no longer recommended, but PULM 37% and ALLERG-ENT-PED-GP 42-62% ($p < 0.01$) still indicate their use. In severe asthma 61-73% of physicians consider adding LTRA to the treatment; only PULM38%, OTHERS12-25% consider adding tiotropium ($p < 0.001$) and 3-17% consider adding omalizumab, both guideline recommended add-ons. As for asthma in pregnancy, most surveyed are not aware budesonide is the 1st line option ICS. Finally, 81-97% of the group-members recognized allergen immunotherapy, as a viable add-on, in line with GINA/GEMA/GUIMA recommendations.

Conclusions: An online survey could detect knowledge-gaps related to asthma treatment. Interestingly, surveyed physicians tended to over-treat the milder asthma cases, thus clearly leaving room for cost-savings. Caution should be taken in the promotion of the SMART (single-maintenance-and-reliever-treatment) approach, which can only be done with ICS-formoterol. Many physicians opt for other combinations not apt for this approach. Among all surveyed specialties there is ample room for improvement in mild and severe asthma management.

Keywords: Asthma treatment, Inhaled corticosteroid, Long-acting beta agonist, Education, Spirometry, Theophylline, Tiotropium bromide, Omalizumab, Allergist, Pulmonologist, Pediatrician

BACKGROUND

Asthma is a complex disease and, based on ongoing research knowledge about its diagnosis and treatment, it is constantly evolving, as are the recommendations in guidelines.¹⁻⁵ Worldwide, numerous asthma guidelines exist, some with a more solid evidence-base than others. However, even the best-known asthma guidelines do not agree on all points among one another. For local indications on how to diagnose and treat asthma, transculturation of the fused evidence of the best global guidelines might be the best way to go. General rules on how to develop such kind of formal transculturation of guidelines have been formulated in the ADAPTE tool.⁶ This tool was used in the development of the Mexican Asthma Guidelines (GUIMA, by its Spanish initials).⁷ As such, GUIMA is a formal transculturation of the three highest-ranking asthma guidelines, according to Appraisal of Guidelines for Research & Evaluation Instrument (AGREE-II), adapted to the Mexican reality by a multidisciplinary team of experts. During its developmental process, clinical questions were formulated for each of the steps of the framework of the approach of an asthmatic patient. Interested in the baseline knowledge and point of view of physicians of different specialties treating asthma, GUIMA coordinators conducted an online survey (SurveyMonkey®) among

specialists and primary care physicians based on the clinical questions, just before the launch of GUIMA. We here analyze the replies related to asthma treatment in adults for each of the five groups: allergists, pulmonologists, ENT physicians, pediatricians and general practitioners, and we discuss the outcomes in light of guideline recommendations.

METHODS

The aim of the study was to describe the knowledge of physicians of different specialties in relation to asthma, and its diagnosis and treatment, and to see if specialty-specific knowledge gaps exist. Just before the launch of the guideline, questions were uploaded into an online survey system, Survey Monkey. (See eFile 1 for the part of the questionnaire on asthma treatment. Some of the questions were literally taken from the clinical questions from GUIMA, others were GUIMA concepts re-structured into 4 clinical cases describing, respectively, patients with intermittent asthma and mild, moderate and severe persistent asthma. A link to the survey was sent out to the membership by the presidents of national societies of the different medical specialties that had participated in the creation of GUIMA. With others, a link to the survey was published on the society's website.

Diagnosis of asthma is:	% correct answers (n)					P*
	Allerg (N = 283)	Pulm (N = 106)	ENT (N = 18)	Ped (N = 161)	GP (N = 44)	
Very likely: Correct answer: <i>When spirometer available: do spirometry, start treatment immediately afterwards.</i> <i>No spirometer: start treatment</i>	32.5 (92)	43.4 (46)	50 (9)	27.3 (44)	31.8 (14)	Pulm-Allerg < 0.05; Pulm-Ped < 0.01
Often answered: Start treatment	54.1 (153)	47.2 (50)	38.9 (7)	64.6 (104)	63.6 (28)	
Likely Correct answer: Document obstruction or reversibility, and only if positive start treatment	26.9 (76)	32.1 (34)	16.7 (3)	27.3 (44)	31.8 (14)	NS
Often answered: <i>When spirometer available: do spirometry, start treatment immediately afterwards.</i> <i>No spirometer: start treatment</i>	51.6 (146)	56.6 (60)	50 (9)	45.3 (73)	43.2 (19)	
Not very likely Correct answer: Search for differential diagnoses	60.4 (171)	56.6 (60)	38.9 (7)	62.7 (101)	75 (33)	NS

Table 1. When to start asthma treatment, depends on the likelihood of the clinical diagnosis of asthma (based on symptoms, signs and medical history). Allerg = allergist, Pulm = pulmonologist, ENT = ear-nose-throat specialist, Ped = pediatrician, GP = general practitioner. *p-values for differences between groups in the ratio of colleagues that gave a certain answer per specialty (Pearson's Chi-square test)

Each specialty had a link to its own data set collection. As such we created 5 data collection groups: allergists, pulmonologists, ENT specialists, pediatricians and general practitioners. After the initial posting, reminders were sent out on several occasions over the course of a month. On the day of the guideline launch the survey was closed to assure GUIMA would not influence colleagues' replies. Results of the section on maintenance treatment of adults with asthma, asthma in pregnancy/lactation, and exercise-induced asthma shall be presented here descriptively per specialty. As not all colleagues completed the questionnaire, analysis was done on a question-base, including all replies received per question. Intergroup differences in the ratio of physicians with the correct reply per specialty were compared per question with Pearson's chi-square tests, if necessary with Yates' correction, using a two-tailed test. $P < 0.05$ was considered statistically significant. For groups

comparisons chi-square for 2×5 contingency tables were used.

RESULTS

A total of 364 allergists (ALLERG), 161 pulmonologists (PULM), 34 ear-nose-throat specialists (ENTs), 239 pediatricians (PED), and 62 general practitioners (GPs) responded to the questionnaire, though some only completed part of the questionnaire. Six-hundred twelve (612) physicians replied to the section on treatment, presented here, and 516 completed all questions (see eFile 2 and eFile 3 for the exact number of physicians replying to each question per specialty). The complete file with graphs of all replies per question and per specialty can be found in the online repository, eFile 3: 'Replies to SurveyMonkey® questions on asthma treatment per specialty' (Powerpoint file).

Severity of asthma:	% correct answers (n)					P*
	Allerg (n = 283)	Pulm (n = 106)	ENT (n = 18)	Ped (n = 161)	GP (n = 44)	
Step 1 treatment (Mild intermittent): The best answer: SABA rescue	29 (82)	34.9 (37)	11.1 (2)	36.6 (59)	27.3 (12)	NS
Possible answer, though high-cost: SABA + Ipratropium bromide rescue**	37.5 (106)	26.4 (28)	33.3 (6)	32.9 (53)	43.2 (19)	
Step 2 treatment (Mild persistent): The best answer: ICS (low dose) maintenance, SABA rescue	41 (116)	47.2 (50)	27.8 (5)	43.5 (70)	43.2 (19)	NS
Often wrongly answered: ICS + LABA maintenance and rescue	25.4 (72)	26.4 (28)	33.3 (6)	26.7 (43)	22.7 (10)	
Often wrongly answered: ICS (low dose) maintenance, SABA + Ipratropium bromide rescue**	24.4 (69)	16 (17)	33.3 (6)	24.2 (39)	20.5 (9)	
Step 3 treatment (Moderate persistent) The best answer: ICS(low dose)+LABA maintenance, SABA/same inhaler rescue	67 [51//16%] (143// 46)	74 [54//20%] (57// 21)	78 [56//22%] (10//4)	70 [54//16%] (87// 25)	75 [52//23%] (23// 10)	NS
Often wrongly answered:	29 (82)	24.5 (26)	16.7 (3)	27.3 (44)	22.7(10)	

ICS (mid dose) maintenance, SABA rescue						
Step 4 treatment (Severe persistent) The best answer: ICS(mid dose)+LABA maintenance, SABA/same inhaler rescue	58 [42//16] (119//46)	71 [48//23] (51//24)	56 [28//28%] (5//5)	58 [39//19%] (62//31)	52 [34//18] (15//8)	NS
Often wrongly answered: ICS (high dose) maintenance, SABA rescue	30 (84)	20 (21)	22 (4)	29 (46)	34 (15)	
Question on maintenance OCS treatment	Allerg (N = 253)	Pulm (N = 87)	ENT (N = 16)	Ped (N = 138)	GP (N = 40)	
Switch patient from OCS to inhaled treatment. The best answer: Substitute OCS for ICS(mid dose)+LABA or ICS(high dose)+LABA	44 (111)	75 (65)	44 (7)	47 (65)	41 (16)	Pulm-Allerg or Pulm-Ped <0.0001; Pulm-GP <0.001
Often wrongly answered: Substitute for ICS(low dose)+LABA	32 (81)	14 (12)	13 (2)	26 (36)	38 (15)	NS

Table 2. First choice treatment options for clinical cases of adult patients with different grades of asthma severity. Allerg = allergist, Pulm = pulmonologist, ENT = ear-nose-throat specialist, Ped = pediatrician, GP = general practitioner.*p-values for differences between groups in the ratio of colleagues that gave a certain answer per specialty (Pearson's Chi-square test).**A combination product exists of salbutamol plus ipratropium bromide in a soft mist inhaler (Combivent Respimat®)

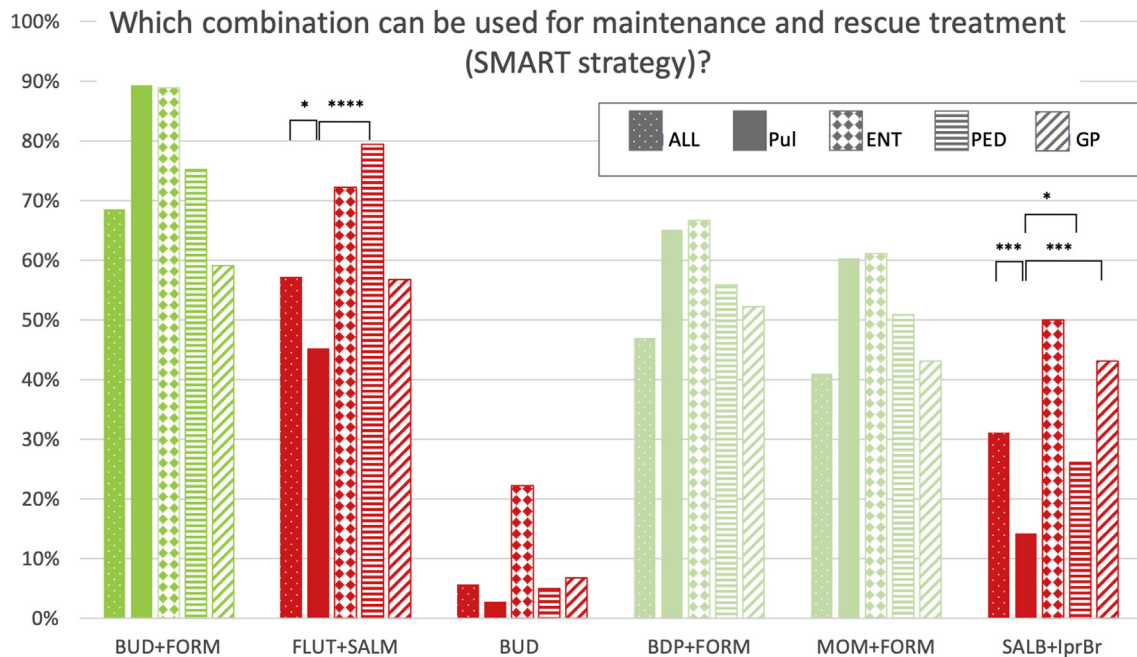


Fig. 1 Knowledge of SMART treatment among physicians of different specialties: allergists, pulmonologists, ENT-physicians and primary care doctors. Physicians were questioned in the online survey about the SMART approach (Single device for Maintenance and Rescue Treatment). The SMART approach should only be indicated with a combination inhaler of an inhaled corticosteroid plus a long-acting bronchodilator with a fast onset of action (formoterol), not with salmeterol or inhalers without a corticosteroid. Color codes: Correct options: green, Alternative options: light green, wrong options: red. P-values were calculated for group differences per item in the ratio of colleagues that gave a certain answer per specialty using chi-square 2×5 contingency tables for wrongly using FLUT + SALM for SMART treatment: $p < 0.0001$ and in wrongly using SALB + Ipratropium bromide combination for SMART treatment: $p < 0.0005$. Statistically significant differences between specialties in each item (Pearson's Xi-square): * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$. Allerg = allergists (n = 283), Pulm = pulmonologists (n = 106), ENT = ear-nose-throat specialists (n = 18), Peds = pediatricians (n = 161), GPs = general practitioners (n = 44); BUD = budesonide, FLUT = fluticasone, FORM = formoterol, lpr.Br = ipratropium bromide, SALB = salbutamol, SALM = salmeterol

Spirometry before starting asthma treatment

First we tried to unravel when physicians decide to start asthma treatment and if they routinely take a spirometry before doing so, as GUIMA and other international guidelines and asthma strategies such as GINA indicate. For ease of reading we will refer to all these documents together as "guidelines" from here onward. When asthma is very likely, spirometry is not routinely indicated and asthma treatment is started right away by more than half of the clinicians surveyed, see [Table 1](#). This is against the guidelines' recommendations of always trying to do spirometry before starting treatment, even when the asthma diagnosis is very likely. Pulmonologists do better than allergists ($p < 0.05$) or pediatricians ($p < 0.01$). However, when asthma is likely, guidelines and other similar documents recommend to not start treatment until airflow obstruction or its reversibility has been documented. Among all

groups surveyed, error rates are high as only 16-32% indicated they would do so. The majority of those surveyed in all groups would just start treatment.

First choice of asthma treatment in fictitious cases with different grades of asthma severity

Next, we presented clinical cases of patients with different degrees of asthma severity and asked the surveyed physicians to select their first-line treatment. A 30-year old male with asthma, described to the physicians as suffering from intermittent asthma, was erroneously treated with inhaled corticosteroid (ICS) by about 10-15% of the responding doctors. However, the most frequent treatment election by more than a third of the physicians was the combination of 2 fast and short-acting bronchodilators - salbutamol with ipratropium bromide - available in Mexico in a soft mist inhaler (Combivent Respimat[®], Boehringer

Ingelheim), which is a valuable alternative to salbutamol monotherapy, though much more expensive, see Table 2.

The mild persistent case received the correct treatment (ICS maintenance, short-acting beta agonist [SABA] rescue) by less than half of the doctors in each specialty. All others opted for the effective but more expensive options. The first-line choice for moderate-persistent asthma was ICS(-median dose) instead of ICS(low)+long-acting beta agonist (LABA) for 1 out of 4 responders, and in severe asthma maintenance treatment PULM20%, ALLERG-ENT-PED-GPs 22-34% failed to indicate LABA (NS). According to guidelines it is recommendable to try to reduce oral corticosteroids for maintenance treatment, by changing to ICS (median dose)+LABA, or eventually ICS(high dose)+LABA. In this severe asthma scenario pulmonologists were better informed (compared to GPs: $p < 0.001$; compared to allergists and pediatricians: $p < 0.0001$).

Concerning the guidelines' suggestion to use one inhaler for maintenance and rescue in moderate-to-severe asthma (Single-Maintenance-

And-Rescue-Treatment, SMART approach), 45-80% of the doctors per specialty erroneously indicated ICS-salmeterol could be prescribed, or the salbutamol plus ipratropium bromide instead of ICS-formoterol, see Fig. 1. In both cases the pulmonologists were better informed (comparing against the other specialties with $p < 0.05$ to $p < 0.0001$, see figure legends). Although the percentage of ENT doctors not replying correctly was high, the differences did not reach statistical significance because of the low n.

Next, the surveyed were confronted with a hypothetical case in which a patient over 6 years of age was not controlled on ICS(mid dose) plus LABA. In Fig. 2 the response options are depicted, and how physician-groups replied. Items with a statistically significant difference between specialty groups were: add tiotropium ($p < 0.0001$), add oral beta-2/theophylline or add mucolytics (both $p < 0.01$). For the correct response options a statistically significant difference between individual specialties was detected for adding tiotropium PULM38%, versus much lower response frequency among allergists ($p < 0.005$), pediatricians ($p < 0.0001$) and GPs ($p < 0.01$). For the incorrect

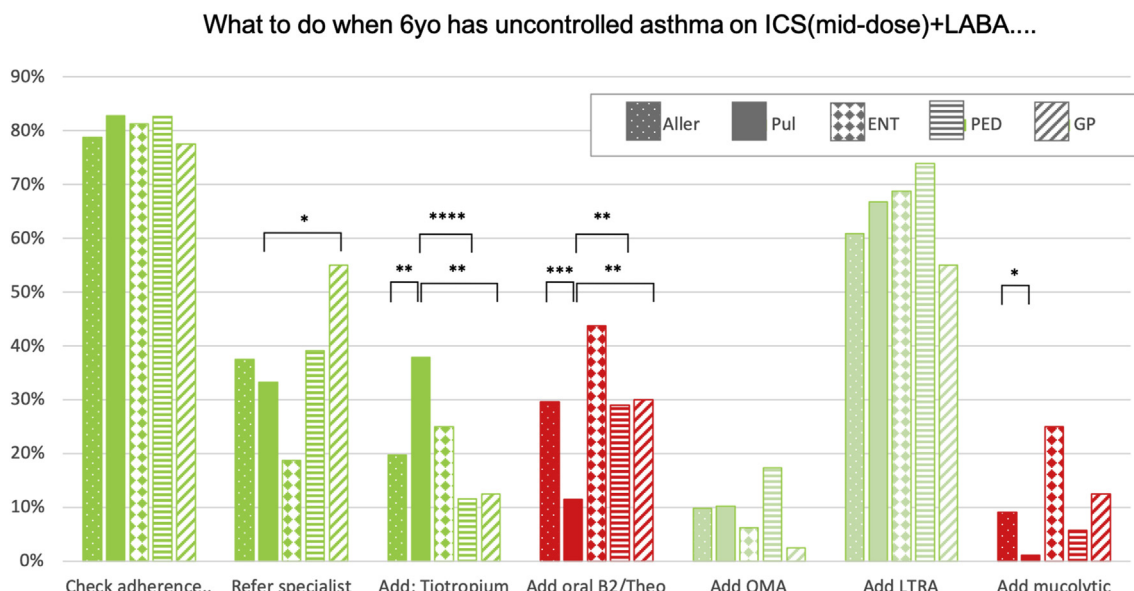


Fig. 2 Treatment of severe persistent asthma, going beyond step 4. Surveyed were confronted with a hypothetical case in which a patient over 6 years of age was not controlled on an inhaled corticosteroid (ICS) (mid dose) plus a long acting beta-agonist (LABA). Color codes: Correct options: green, Alternative options: light green, wrong options: red. P-values were calculated for group differences per item in the ratio of colleagues that gave a certain answer per specialty using chi-square 2×5 contingency tables for send to specialist: NS, add tiotropium: $p < 0.0001$, add oral beta-2 or theophylline: $p < 0.01$; add oral mucolytic: $p < 0.01$. And statistically significant differences between specialties in each item (Pearson's Xi-square): * = $p < 0.05$, ** = $p < 0.01$, **** = $p < 0.0001$. Allerg = allergists (n = 253), Pulm = pulmonologists (n = 87), ENT = ear-nose-throat specialists (m = 16), Peds = pediatricians (n = 138), GPs = general practitioners (n = 40), oral B2 = oral beta-2 agonist, THEO = theophylline, OMA = omalizumab, LTRA = leukotriene receptor agonist

	% correct answers (n)					P**
	Allerg (N = 247-253)*	Pulm (N = 83-87)*	ENT (N = 14-16)	Ped (N = 135-138)*	GP (N = 38-40)*	
Medication not recommended for use in asthma						
Oral beta-2 agonists	46*** (116)	61 (53)	50 (8)	46 (62)	43 (17)	NS
Oral theophylline	19 (47)	21 (18)	19 (3)	23 (32)	15 (6)	NS
Mucolytic agents	74 (187)	89 (77)	63 (10)	80 (111)	78 (31)	<0.05
Ketotifen	55 (139)	61 (53)	62 (10)	51 (71)	53 (21)	NS
Allergen immunotherapy						
Is indicated in patients with allergic asthma, specific IgE positivity and symptoms on exposure	90 (227)	97 (84)	81 (13)	96 (132)	88 (35)	NS
Reduces asthma symptoms	85 (215)	85 (74)	88 (14)	86 (118)	85 (34)	NS
Reduces medication need	79 (200)	77 (67)	88 (14)	80 (111)	73 (29)	NS
Reduces allergic inflammation	85 (216)	78 (68)	88 (14)	80 (111)	82 (33)	NS
WRONG: Allows stopping asthma medication 1y after AIT start	22 (56)	10 (9)	31 (5)	25 (35)	20 (8)	0.07
Exercise induced asthma is treated with:						
Recommended: Pre-exercise SALB or MONT	36 (90)	25 (21)	36 (5)	24 (32)	32	NS
Incomplete: Pre-exercise SALB	50 (124)	65 (54)	50(7)	64 (87)	57 (21)	NS
Suggested: ICS	11 (28)	10 (8)	14 (2)	12 (16)	11 (4)	NS

WRONG: Systemic CS	2 (5)	0 (0)	0 (0)	0 (0)	0	0 (0)	NS
Asthma during pregnancy. The most recommendable ICS is:							
BUD	46 (114)	46 (38)	36 (5)	44 (59)	38 (14)	NS	NS
Wrong: BDP	30 (73)	22 (18)	7 (1)	19 (26)	30 (11)	0.08	
Wrong: FLUT	24 (60)	33 (27)	57 (8)	37 (50)	32 (12)	<0.05	

Table 3. Some more details on medication and asthma and allergen immunotherapy and asthma. Specific medication in asthma and its indication in specific treatment groups. Allerg = allergist, Pulm = pulmonologist, ENT = ear-nose-throat specialist, Ped = pediatrician, GP = general practitioner. *The total number of replies is lower for the last issues presented here. For exact number of physicians replying each item, see eFile 2. **p-values for differences between groups in the ratio of colleagues that gave a certain answer per specialty (Pearson's Chi-square test). ***The darker, the higher the ratio of physicians answering wrongly: Dark grey shaded = less than 33% answered correctly, middle grey shaded = correctly answered by 33-66%, light grey = correct answered by 66-75%. No shading: more than 75% correct

items statistically significant differences between PULM and other individual specialties were found for adding an oral β 2-agonist or theophylline ($p < 0.01-0.001$) or an oral mucolytic (PULM vs. Allergists $p < 0.05$). In this severe asthma case 61-73% of the physicians consider adding a leukotriene receptor agonist (LTRA) to the management, but only 6-17% consider adding omalizumab.

Further details on asthma treatment: not recommended medication, immunotherapy, and medication in the pregnant patient

Next we asked for medication not recommended for asthma treatment (such as oral beta-2 agonists, theophylline, mucolytic agents and ketotifen), where there were little differences between specialties, but as a whole the percentage of wrong answers was high (= darker zones in Table 3). Then the questions on the indication and efficacy of allergen immunotherapy (AIT) in asthma, asthma in pregnancy, and the treatment of exercise-induced asthma followed. Not even half of the physicians in any specialty group replied correctly that budesonide is the most recommended ICS during pregnancy, as many erroneously pointed to fluticasone. Further details on the replies can be found in Table 3.

DISCUSSION

We documented the knowledge of different specialties related to the treatment of asthma in the adult patient. We included both asthma specialists (allergists and pulmonologists) and other groups of physicians who treat asthma. Focusing on issues with knowledge gaps, defined as less than 66% of the surveyed answering correctly, Table 4 indicates what aspects could be addressed in continuous medical education for all specialties or for sub-groups. Starting with the moment of initiating asthma treatment (Table 1), the use of spirometry to document lung function and reversibility should be emphasized more, as in all physician groups more than a third would not indicate spirometry before beginning treatment, when asthma is very likely. Even more important, if the diagnosis of asthma is likely, guidelines recommend to only start treatment when the spirogram is compatible with asthma or when reversibility has been documented

(eventually with a short course of steroids). Many responders replied differently.

In the context of asthma treatment (Table 2), in the public health sector cost-saving is of weight when advocating specific treatment options. As

such, the recommended rescue treatment in stable asthma is salbutamol. In Mexico, a combination bronchodilator exists of salbutamol plus ipratropium bromide in a soft mist inhaler (Combivent Respimat®), which might be a valuable option for

Question	R/S**	Answer
All		
When the diagnosis of asthma is very likely	R	<u>Spirometry available</u> : do spirometry, start treatment immediately afterwards. <u>No spirometry</u> : start treatment
When the diagnosis of asthma is likely	R	Document obstruction or reversibility, and only if positive → start treatment
Rx of intermittent asthma	R	SABA
Rx of mild persistent asthma	R	Maintenance ICS (low dose); rescue SABA
Rx of severe persistent asthma	R	ICS(mid dose)+LABA maintenance; rescue SABA or the same inhaler
Rx of severe persistent asthma, when uncontrolled on ICS (mid dose) + LABA	R	(ENT, PED, GPs): Refer to a specialist
	R	Add tiotropium
	S	Add omalizumab
Medication NOT recommended for asthma Rx by GUIMA	R	Theophylline, oral beta-agonist, ketotifen
Exercise induced asthma: pre-exercise treatment	R	Salbutamol or montelukast
ICS for use during pregnancy	R	Budesonide; not fluticasone
Allergists, ENTs, pediatricians and GPs		
To switch a patient from OCS to inhaled treatment	R	Substitute OCS for ICS (mid dose) +LABA
	S	Substitute OCS for ICS (high dose) + LABA
Combination treatment to use the SMART approach (one inhaler for maint and rescue)	R	4 + years: Budesonide + formoterol; 18 + years: beclomethasone + formoterol
	S	12 + years: Mometasone + formoterol
Allergists, pulmonologists, ENTs, pediatricians		
When the diagnosis of asthma is not very likely	R	Search for alternative diagnoses
	S	Document obstruction or reversibility, and only if positive → start treatment

Table 4. Suggestions for continuous medical education: issues related to the treatment of asthma in adult patients, with less than 66% answering correctly per specialty. *R/S = recommended, suggested. GUIMA = Guía Mexicana del Asma, ICS = inhaled corticosteroids, LABA = long acting beta-agonist; OCS = oral corticosteroids, Rx = treatment, SABA = short acting beta-agonist

rescue treatment, if the cost would not be considerably higher than that of salbutamol in MDI. Many physicians opted for this costly combination bronchodilator as rescue, though. Similarly, a notable number of physicians of all groups would treat a case of mild persistent asthma with the combination of ICS + LABA, again an option with at least double the price compared with simple ICS as maintenance treatment, enough for a mild persistent patient. When persistent asthma becomes moderate-to-severe, for most patients combining with a LABA enhances control, as compared to raising the ICS dose to even higher levels. This insight should be emphasized more in continuing medical education. Similarly, rescuing with the same inhaler (ICS + formoterol) in moderate-severe asthma reduces the frequency of asthma exacerbations,⁸⁻¹⁰ just as has been shown more recently for mild asthma as well.^{11,12} As such, it might be a good option over the long run, even though the short-term direct cost is higher than rescuing with SABA. Finally, all groups could improve knowledge concerning preferred add-on treatment options in severe asthma: tiotropium bromide and omalizumab (Fig. 2). GUIMA clearly recommends referring this kind of patient for specialist care, but for each specialty less than half of the surveyed thinks so. Historically asthma has been treated with oral medication, and in our region this is still frequent. So, it is not surprising that less than half of all surveyed recommend against oral beta-2 agonists, without differences between specialties. For theophylline, this percentage is even much lower (20%) (Table 3). These medications are no longer recommended in GUIMA, because of their high frequency of adverse effects and the equally effective and low-cost, but much safer alternatives available nowadays. Also, about 45% still believe ketotifen, much promoted for asthma treatment in the 1990s, is a valid option.

For allergic asthma, AIT can be a disease modifying auxiliary treatment, as an add-on to maintenance treatment for patients with allergic asthma. However, as there has been high heterogeneity among clinical trials with AIT in asthma,¹⁴ differences in allergens, dosing and administration route and interval, historically the evidence had been considered too low by GINA experts to make AIT part of the official treatment

algorithm. After the high-quality trials with house dust mite tablet sublingual immunotherapy (SLIT),¹⁵ followed by meta-analyses,¹⁶ this situation has changed, and since 2016 AIT in the form of house dust mite sublingual tablets is indicated in the GINA figure of treatment. Thus, AIT has also a place in the GUIMA asthma recommendations, and the majority of the surveyed agreed with that.

In other regions, knowledge concerning asthma treatment has been tested in the past, but generally among primary health care physicians or residents and nurses.^{13,14} In a questionnaire-based study conducted in the Kingdom of Saudi Arabia in 2015 among primary health care physicians and 3(rd) and 4(th) year family medicine (FM) residents based on the local, Saudi guidelines only 8% of the sample had good theoretical knowledge of asthma, while 41% had poor knowledge; only 23% had good knowledge of inhaler techniques.¹⁴ Guidelines might be a tool to improve these parameters, but their implementation is not always easy, as our Spanish colleagues showed. Already in 2008, a 15-item multiple choice test was conducted among Spanish pulmonologist, general practitioners (GPs), and respiratory nurses regarding their knowledge of and adherence to the Spanish asthma guidelines (GEMA). Seventy-two percent (771/1066) stated they were familiar with the guideline on the management of asthma (GEMA), while 36% admitted that they seldom or never followed guidelines, and for 30% the level of adherence to the GEMA was poor. The multivariate analysis revealed that low adherence was associated with coming from the geographic center or south of Spain, being a GP, unfamiliar with guidelines, or unconvinced of their utility and not using spirometry.¹⁵ Nigerian colleagues investigated asthma knowledge in their country in 2017. The greatest areas of knowledge gaps were similar to ours: diagnostic tests, asthma severity, and drugs. Gaps were observed regarding the use of the GINA strategy (6%) and prescribing combined inhaled steroid and long acting bronchodilator for patients who are not controlled on inhaled steroid alone (29%). Just as in our population, a large number (32%) of the respondents did not confirm the diagnosis of asthma by spirometry. Investigators concluded that only 8% of the respondents had a high

degree of knowledge and corresponding high-level asthma care.¹⁶

The weakness of the study presented here is its online aspects. As a result, we do not know the number of physicians to whom survey was sent. It is very well possible that the responding colleagues are those most interested in asthma, and thus form a positive selection. Our results thus probably over-estimate knowledge in general.

As we were cautious to close the survey before the GUIMA launch, we are planning to repeat the same survey 3 years post-guideline promotion to see if we are able to detect any impact on physicians' knowledge of the national asthma guideline, GUIMA. However, the real impact should be measured by real-life outcomes such as the sales figures for controller and rescue asthma medication and the health statistics, such as number of asthma deaths. Another issue that arises from this survey are the possible cost-savings, when guideline recommendations are followed, as we discussed above.

CONCLUSIONS

An online survey could detect knowledge-gaps related to adult asthma treatment. In all 5 specialties surveyed there is still ample room for improvement. There are only a few specialty-specific knowledge gaps, thus continuous medical education concerning asthma treatment can be standard for all physicians. When GUIMA concepts are brought into practice, there is a clear possibility for cost-saving. Finally, caution should be taken in the promotion of the "one-inhaler-for-all" approach, as many physicians do not understand the details of this treatment yet and erroneously opt for combinations with salmeterol, which is not apt for this approach.

List of abbreviations

Allerg: allergist; ENT: ear-nose-throat specialist; GP: general practitioner; GUIMA: *Guía Mexicana del Asma* (Mexican asthma guideline); ICS: inhaled corticosteroids; LABA: long acting beta-agonist; OCS: oral corticosteroids; Ped: pediatrician; Pulm: pulmonologist; Rx: treatment; SABA: short acting beta-agonist; LTRA: leukotriene receptor antagonists

Ethics approval

Ethics approval was not sought. Surveyed colleagues were informed the results would be published anonymously.

Consent for publication

Not applicable. The questionnaire we used is added as eFile 1 as well as all replies to all questions discussed in our paper (eFile 2).

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Authors' contributions

DLL and MRG formulated SurveyMonkey® questions, MFV, MCCS, JLP, JAOM, BRN, ECLE, JRL reviewed and corrected the questions. DLL conducted the SurveyMonkey® online survey, JCVG, MFV, MCCS, JLP and MRG helped to obtain replies. DLL elaborated the results and wrote the manuscript draft. MFV, MRG, MCCS, JLP, JAOM, BRN, ECLE, JRL, JCVG, JSP reviewed draft and suggested corrections.

Authors' information (optional)

All authors, but MRG, were part of the development group of GUIMA, DLL was general coordinator and BRN, MCCS and DLL section coordinators. JSP is Director of the National Institute of Respiratory Diseases and JCVG was president of the national society of pulmonologists, both entities were very closely related with the development of GUIMA. MRG, a young allergist, joined the group later and helped a lot with the survey. DLL, MRG, MCCS, JLP, JAOM and BRN are allergists. MFV, MCCS, ECLE, JRL, JCVG and JSP are pulmonologists.

Declaration of competing interest

DLL reports personal fees from Amstrong, Astrazeneca, Boehringer Ingelheim, Chiesi, DBV Technologies, Grunenthal, GSK, MEDA, Menarini, MSD, Novartis, Pfizer, Novartis, Sanofi, Siegfried, UCB., grants from Sanofi, Astrazeneca, Novartis, UCB, GSK, TEVA, Boehringer Ingelheim, Chiesi., outside the submitted work; none of the other authors have submitted any conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.waojou.2019.100084>.

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