Effect of Therapeutic Guidelines for Bronchial Asthma on Adult Patients' Knowledge, Practice, Compliance, and Disease Severity

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Abstract: Asthma places a large burden on affected patients and their families. Although asthma is a major cause of patient disability and in rare cases causes premature death, asthma morbidity and mortality are largely preventable when patients and their families are adequately educated about the disease and have access to high quality health care. That is, poor outcomes for patient asthma, such as hospitalizations and deaths, are at least partially sensitive to the quality of ambulatory health care. Aim of the study: to assess asthmatic adult needs, designing therapeutic and nutritional guidelines, and evaluating their effectiveness on improvement of the knowledge, practices, and severity of bronchial asthma as well as patient's therapeutic compliance. The research hypotheses were that asthmatic adult patients receiving the designed guidelines will have significant improvements in their knowledge, practices, severity of asthma, and compliance to therapeutic regimen. Design: a quasi experimental research design was used with pre-post assessment of outcome. It involved four steps; pre-guidelines, guidelines implementation, post-guided and follow up. Setting: The study was conducted in the outpatient clinic of bronchial asthma at Zagazig University Hospitals and Helwan University Hospitals. Subjects: The study was carried out on (60) a convenience sample of asthmatic adults consecutively recruited from the study setting, uses of inhaler. Patients with other chronic diseases were excluded. Tools: Four tools were used for data collection, 1- An Interview form, 2- An Observation check list, 3- A Compliance assessment form 4- An Asthma severity assessment scale. Results: There were statistically significant effect of bronchial asthma on patient's daily life activities, work, psychology, self-image, diet and sleep. There was Improvement in knowledge, practice, decreased level of severity of asthma and therapeutic compliance after guidelines implementation. There was a positive coefficients change in knowledge score and guidelines intervention. Also there were negative coefficients change in the severity score of bronchial asthma and Educational level and Knowledge score. The study concludes that the developed guidelines have a significant positive impact on asthma patients' knowledge, practices, therapeutic compliance, and disease severity. This success is attributed to that the guidelines are based on needs assessment and integrate updated technology. Therefore, these guidelines should be adopted as an essential component of the care provided to asthma patients. Continuous follow-up together with selecting the optimal treatment options for each individual patient are recommended. The long-term effects of following the guidelines need to be further studied.
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1. Introduction

Bronchial Asthma (BA) is one of the most frequent chronic and recurrent diseases. In the last few years the incidence of the disease has been on the rise virtually everywhere. It is estimated that an average of 8% of the world population suffer from bronchial asthma. Although exact epidemiological data are lacking, its prevalence is estimated to be approximately 5.5% of the general population. Most people develop it before the age of 30 years *(Payne et al., 2003; Payne et al., 2004)*. In Cairo, Egypt, the prevalence of bronchial asthma was reported to be 9.4% *(Georgy et al., 2006)*.

According to the Global Initiative for Asthma guidelines final update *(Global Initiative for Asthma [GINA], 2009)* BA is clearly defined as a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. This inflammation is associated with airway hyper responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment *(Paul and O'Byrne1, 2009)*. Common risk factors for asthma symptoms include exposure to allergens (such as those from house dust mites, animals with fur, cockroaches, pollens, and molds), occupational irritants, tobacco smoke,

respiratory infections, exercise, strong emotional expressions, chemical irritants, some foods, and drugs such as aspirin and beta blockers *(Chakir et al., 2003; Tarek, 2007)*.

Guidelines are written strategies or protocols for health care delivery that are developed to facilitate clinical decision-making and to provide patients with critical information concerning the different treatment options available *(Expert Panel Report 3, 2007)*. The BA guideline is intended for health care professionals, including family physicians, nurses and social workers providing primary health care to patients with bronchial asthma. It includes practical and evidence-based information about diagnosis, outpatient management and prevention of the disease in adults *(Rabe et al., 2004)*.

Asthma can often be diagnosed on the basis of a patient's symptoms and medical history. Measurements of lung functions by spirometry or Peak Expiratory Flow (PEF) meters provide an assessment of the severity, reversibility, and variability of airflow limitation, and help confirm the diagnosis of asthma *(Global Initiative for Asthma [GINA], 2009)*. Traditionally, BA is classified according to severity into intermittent, mild persistent, moderate persistent or severe persistent depending on the grade of symptoms, airflow limitation, and lung function variability. However, it is important to recognize that asthma severity involves both the severity of the underlying disease and its responsiveness to treatment. In addition, severity is not an unvarying feature of an individual patient's asthma, but may change over months or years *(El-shafey, 2006)*.

The goal of BA care is to achieve and maintain control of the clinical manifestations of the disease for prolonged periods. When asthma is controlled, patients can prevent most attacks, avoid troublesome symptoms day and night, and keep physically active. To reach this goal, the asthmatic patient can learn how to avoid risk factors, take medications correctly, understand the difference between "controller" and "reliever" medications, monitor their status using symptoms and, if relevant, PEF. They should also be able to recognize dangerous signs indicating that their asthma is worsening and take action or seek medical help as appropriate *(Tarek, 2007)*.

To improve the control of BA and reduce the needs for medication, patients should follow certain instructions. Although physical activity is a common cause of asthma symptoms, patients should not avoid exercise. Common strategies for avoiding allergens and pollutants include staying away from tobacco smoke, avoiding drugs, foods, and additives if they are known to cause symptoms, and reduce or preferably avoid exposure to occupational sensitizers *(Ali et al., 2010)*.

Treatment reliever medication should be prescribed for quick relief of symptoms as needed. Patients also require one or more regular controller medications, which keep symptoms and attacks from starting. According to *Global Initiative for Asthma [GINA], (2009)* guidelines, inhaled glucocorticosteroids are the cornerstone treatment in BA. They demonstrate high efficiency in reducing asthma symptoms, frequency and severity of exacerbations, decreasing airway hyperresponsiveness, controlling airway inflammation, as well as improving lung functions and the quality of life (QOL) of patients. They were also associated with lower mortality. Long-acting Beta2 agonists showed great asthma control outcomes together with a marked reduction in the need of rescue medications and an overall improvement in asthmatics QOL *(Nuhoglu et al., 2005)*.

Compliance or adherence refers to patient's accurate abiding to a prescribed regimen of treatment in terms of taking medication, following diet, exercising, or undergoing other lifestyle changes. It is an observable behavior that can be measured *(Bastable, 2003)*. Inadequate compliance to the recommended plan remains a significant problem facing health care professionals. Many reports emphasize the impact of lack of compliance on the morbidity and mortality associated with BA. It has also been associated with increasing costs of care *(Gorman et al., 2002)*.

Ongoing monitoring is essential to maintain control and establish the lowest step and dose of treatment to minimize costs and maximize safety. Typically, patients should be seen one to three months after the initial visit, and every three months thereafter. As severe asthma attacks may be life threatening, patients and health care providers should not underestimate the severity of an attack. Treatment requires close supervision. Fortunately asthma can be effectively treated and most patients can achieve good control of their disease *(Tarek, 2007)*.

Achieving asthma control is the focus of asthma management *(Rodrigo, 2005)*. Achieving day-to-day asthma control is indicated by the absence of symptoms, minimal use of reliever medication, normal activity levels, and lung function values close to normal. A second objective is to minimize future risks to the patient by ensuring the absence of asthma exacerbations, the prevention of accelerated decline in lung function over time, and no side effects from medications *(Rabe et al., 2004)*.

Nonetheless, many patients lack the knowledge and self-care abilities that they need to

achieve their health goals. The nurse who is a skilled educator should take the lead in improving patients' compliance. The responsibilities of the nurse include ensuring that the patient understands the regimen and arranging needed follow-up *(Taylor et al., 2001)*.

Rationale and aim of the study

Despite all advances in the management of asthma, the morbidity and mortality rates are increasing. Both the nurse as well as patients play a pivotal role for the under treatment and mismanagement of the disease. This causes concern in the field of asthma care. Unless the patient possesses basic knowledge about the ailment and its management, there is no likelihood to make the best use of the available facilities. This study was planned with the aim to assess asthmatic adult needs, designing therapeutic and nutritional guidelines, and evaluating their effectiveness on improvement of the knowledge, practices, and severity of bronchial asthma as well as patient's therapeutic compliance. The research hypotheses were that asthmatic adult patients receiving the designed guidelines will have significant improvements in their knowledge, practices, severity of asthma, and compliance to therapeutic regimen.

2. Subjects and Methods

Research design, setting, and sample:

The study was conducted in the outpatient clinic of BA at Zagazig and Helwan University Hospitals. A quasi experimental research design was used with pre-post assessment of outcomes. The study was carried out on a convenience sample of 60 asthmatic adults consecutively recruited from the study settings. Patients using inhalers and those with other chronic diseases were excluded.

Data collection tools:

Four tools were used for data collection, namely an interview form, an observation checklist, the asthma severity scale, and a patient compliance form. The interview form was constructed by the researchers and consisted of four parts. The first part covered patient's personal characteristics as well as the duration of the disease, past and present complaints, and therapy and diet followed. The second part included questions about patient' knowledge of asthma definition, diagnostic measures, symptoms and signs, follow-up schedule, and prevention. The third part involved patients knowledge about the therapies used in BA, as the types, routes, side effects, drugs that aggravate an asthma attack, how to use inhaler, and how to practice deep breathing and coughing exercise. The fourth part was concerned with patient's dietary knowledge and the types of food that can precipitate the attack. The form included a total of 55 closed and multiple choice questions. Patients' responses to knowledge questionnaire were checked with model answered and given 1 point if correct and 0 if incorrect. The points were summed up and converted into a percent score. A total score of 50% or higher was considered as satisfactory knowledge.

The second tool was an observation checklist: designed to assess actual asthmatic patient's practice regarding deep breathing, coughing exercise, use of inhaler and incentive spirometry. The form was developed based on *Hashem (2000)*, *Elshamy (2002)*, *Kamal (2004)*, *Temple (2006)*, and *Elkin (2007)*. The actual practice was compared with standardized procedures. Accordingly, subjects were given 1 point if the step was correctly done and zero if incorrect. The points were summed up and converted into a percent score. A total score of 60% or higher was considered adequate practice.

The compliance assessment form was adopted from *Lenfant and Khaltoev (1995)* to assess asthmatic patient's therapeutic compliance. Factors associated with non-compliance were classified into medication related and non medication related. The last tool was the asthma severity assessment scale. It was adopted from *Emery et al. (1996)* to assess asthma severity according to the criteria set by the National Asthma Educational Program guidelines. Both daytime and nocturnal symptoms were scored as follows: once per week or less (score 0), 2-6 time per-week (score 1), daily (score 2). Oral corticosteroids use was scored as follows: no corticosteroid use (0), sometimes during acute attacks (1), usually during acute attacks (2), and daily (3) even without shortness of breath. Spirometry was scored as follows: forced expiratory volume (FEV1) >80% of predicted value (0), 60-80% of predicted value (1), <60% of predicted value (2). These three scores were summed up to give on overall score of asthma severity levels. These scores were categorized into mild (0-2), moderate (3-5), and severe score (6-7).

Pilot study:

A pilot study was conducted on ten asthmatic adult patients selected from the same study settings to check and ensure the clarity, applicability, and relevance of the tools, to identify any difficulties with their application, and to estimate the time needed to completion of the tools. Modifications of the tools were done according to pilot results to reach to the finalized form. Subjects who shared in the pilot study were not included in the main study sample.

Administrative design and ethical considerations:

The necessary official approvals were obtained from the Heads of the outpatient Departments, and from the General Directors of Zagazig and Helwan University Hospitals. Letters of request were issued to them from the Faculties of Nursing at Zagazig and Helwan Universities explaining the aim of the study and its procedures.

Before the initial interview, an oral consent was secured from each subject after being informed about the nature, purpose, and benefits of the study, as well as any potential side effects. Patients were also informed that participation is voluntary and about their right to withdraw at any time without giving reasons. Confidentiality of any obtained information was ensured through coding of all data. The researcher reassured patients that the data will be used only to improve their health and for the purpose of the study.

Study maneuver:

After securing official permissions to carry out the study, the researchers met with the potential participants in the outpatient clinics. The aim of the study was explained to them and their informed consent was secured before collecting data. The fieldwork was carried out along a period of twelve months (January 2010 till January 2011), three days weekly. Every patient was interviewed for about 30-45 minutes. Every researcher interviewed five patients per day.

Based on actual educational needs assessment of the patients and guided by relevant literature, the researchers developed the guidelines. They included theoretical background about asthma definition, types, triggers, signs and symptoms, diagnoses, prevention, medical, nursing and self-care management, nutritional guidelines, as well as compliance and follow-up schedule. The theoretical part was presented in two sessions using different teaching strategies as lectures, discussions, and media as posters and videos. The program had five practical sessions that involved demonstration and re-demonstration on diaphragmatic deep breathing and coughing exercises, steps for using the inhaler, nebulizer, spirometry and positioning by using real objects. Moreover, colored booklets were designed by the researchers and distributed to each patient or accompanying relative. Teaching was carried out individually by the researchers for each patient with one of his/her family member to help in following the program guidelines at home. During the five practical sessions, each patient was assessed in performing the prescribed guideline.

The evaluation of the guidelines' effect was carried out using the aforementioned tools. Each patient was evaluated three times during the study: immediately upon presenting to the outpatient asthma clinic (pre-test), immediately after implementation of the guidelines (post-test), and two months after implementation of the guidelines (follow-up).

Statistical analysis:

Data entry and statistical analysis was done using SPSS 16.0 statistical software package. Qualitative categorical variables were compared using chi-square or Fisher exact tests as suitable. To identify the independent predictors of knowledge and asthma severity scores, logistic regression analysis was used. Statistical significance was considered at p-value <0.05.

3. Results

Table shows that the age of the patients ranged between 22 and 80 years, with mean±SD 48.7±3.7 years. Two thirds (66.7%) of the patients were females and from rural areas, and more than three quarters (76.2%) were married and illiterate. Only less than one third (31%) of the patients were employed, with mostly sufficient income (59.5%). Only 14.3% of them were smokers. The duration of asthma ranged between 5 and 35 years, with a mean of 17.0±1.4 years.

As seen in Table 2, about two thirds (64.3%) of the patients' total knowledge was unsatisfactory before implementation of the guidelines. The worse knowledge was regarding exercises, which was unsatisfactory among all the studied patients. The post guidelines phase showed a statistically significant improvement in patient's knowledge ($p<0.001$), with all patients having satisfactory knowledge in almost all areas and in total knowledge. This improvement persisted during the follow-up period with no decline in any of the areas of knowledge ($p<0.001$). Similarly, the table indicates that all the patients had total inadequate practices before the guidelines. The post guidelines phase showed statistically significant improvement in patients' practices ($p<0.001$), with all the patients except one (97.6%) having adequate practice. As in knowledge, the improvement in practice persisted throughout the follow-up. Only the area of use of nebulizer did not demonstrate a significant improvement after guidelines implementation ($p=0.27$).

Concerning the effect of BA on patients' life, Table 3 shows statistically significant decreasing effects on patients' daily life activities, work, psychology, self-image, and diet ($p<0.001$). The decline even continued during the follow-up phase. The table also demonstrates statistically significant improvements in patients' sleep and resting positions during asthma at the post and follow-up phases

(p<0.001). It is evident that for more than half of the patients the sleep and resting positions were the semi-sitting in the pre guidelines phase. At the post phase, about two thirds assumed the lying down position; and this rose to almost all patients at the follow-up phase.

Patients in the study sample have also demonstrated statistically significant improvements regarding the severity of their asthma. As Table 4 shows, there were improvements in the frequency of the attacks, the use of oral cortisone, and the pulmonary function tests both after the implementation of the guidelines and at the follow-up phases. Overall, 88.1% of the patients had moderate to severe asthma at the pre-guidelines phase. This decreased to 38.1% at the post phase, and down to 35.7% at the follow-up phase (p<0.001).

Table 5 displays the best fitting multiple linear regression model for the change in patients' knowledge score throughout the study phases. The only statistically significant independent predictor of the knowledge score was the program implementation, while patient's age, sex, education, residence, and duration of illness had no influence. The model r-square indicates that the program explains 92% of the improvement in knowledge score. As regards the change in asthma severity, the same table shows that the educational level and the knowledge score were the statistically significant independent negative predictors of the severity score. Meanwhile, patient's age, sex, residence, and duration of illness had no significant influence on the severity. The model explains 49% of the improvement in asthma severity as indicated by the value of r-square.

Regarding the factors underlying patients' non-compliance with medications, Table 6 shows statistically significant decreases in all medical and non-medical reasons at both at the post and follow-up phases, compared to the pre-program phase (p<0.001). Some of the factors even disappeared at the follow-up phase such as difficult use of atomizer, concern for side effects as addiction, and cost and dislike of drugs.

4. Discussion

This study aimed at evaluating the effectiveness of therapeutic and nutritional guidelines for bronchial asthma developed by the researchers based on assessment of adult asthmatic needs, on patients' knowledge, practices and therapeutic compliance, as well as on the severity of their asthma. The findings revealed significant improvements in these outcomes, which lead to acceptance of the research hypotheses regarding the effectiveness of the guidelines.

Table 1. Socio-demographic characteristics and duration of bronchial asthma among patients in the study sample (n=42)

	Frequency	Percent
Age (years)		
<50	22	52.4
50+	20	47.6
Range	22.0-80.0	
Mean±SD	48.7±13.7	
Sex:		
Male	14	33.3
Female	28	66.7
Marital status:		
Unmarried	10	23.8
Married	32	76.2
Education:		
Illiterate	32	76.2
Educated	10	23.8
Job status:		
Unemployed/house wife	29	69.0
Employed	13	31.0
Living:		
With family	38	90.5
Not with family	4	9.5
Residence:		
Rural	28	66.7
Urban	14	33.3
Income:		
Insufficient	17	40.5
Sufficient	25	59.5
Smoking		
No	36	85.7
Yes	6	14.3
Duration of asthma (years)		
<10	15	35.7
10+	27	64.3
Range	5.0-35.0	
Mean±SD	17.0±1.4	

The study sample involved 60 adult asthmatic patients. Those who pursued all the intervention phases were 42, i.e. a dropout rate of 30%. This is often encountered in follow-up studies and is known as cohort attrition, which is on the limitations of longitudinal studies *(Booker et al., 2011)*. However, in the present study, the dropouts were not due to reasons related to the intervention or the disease outcomes, as most of the dropouts were just reluctant to come for follow-up and were not different from those who continued.

The study sample was representative of the population of adult asthmatic patients attending

outpatient clinics. It covered a wide range of duration of the disease, between 5 and 35 years. The representativeness was also evident from the preponderance of female patients in the sample, which is an often cited finding in asthma research. In this regard, *Niitsuma et al. (2004)* reported that bronchial asthma was slightly more frequent among females compared to males.

According the present study, patient's knowledge about asthma was deficient before introducing the guidelines, with only about one third of them having satisfactory knowledge. This was particularly evident in relation to knowledge about exercise, which has a lot of misconceptions among asthmatic patients *(Martínez-Gimeno, 2009; Williams et al., 2010)*. This lack of knowledge can be attributed to the lack of educational programs and unavailability of information resources about the disease and its effect. It reflects a deficiency in providers' educational role.

After implementation of the guidelines, patients' knowledge demonstrated significant improvement, which was confirmed through multivariate analysis, which indicated that the implementation of intervention was the only statistically significant independent predictor of the knowledge score. This asserts the assumption that the lack of knowledge was due to lack of educational activities provided to these patients, and indicates that the meeting of patients' information needs would fill this gap of knowledge. In agreement with this, *Rai et al. (2007)* mentioned that the asthmatic patient needs knowledge about the disease process, precipitating factors, treatment, preventive measures, and guidelines for self-care and use of ventilator aids. This further highlights the importance of developing and implementing guidelines for increasing patient's knowledge about management of asthma attack in order to maintain health and prevent complications.

On the same line, *Temple (2006)* stated that asthma self-management education is essential to provide patients with the skills necessary to control asthma and improve outcomes. Therefore, health care providers should reinforce and expand key messages such as the patient's level of asthma control, inhaler techniques, and self-monitoring. The author also emphasized the importance of use of a written asthma action plan by all members of the health care team. This can help effective treatment so that most patients can achieve good control of their disease *(Paul and O'Byrne1, 2009)*.

Patients' practices and compliance related to asthma have also improved after implementation of the present study guidelines. The improvement has even been sustained after a two-month follow-up. This improvement involved performance of exercises and compliance to follow-up. Although the use of nebulizer has also improved, it did not reach statistical significance probably because it was already high at the pre-intervention phase. This success of the guidelines may be attributed to the fact that the procedures were practiced under supervision and guidance of the researchers, with demonstration and re-demonstration, using real objects. This is in agreement with *Milani et al. (2004)* and the *Expert Panel 3 (2007)* who emphasized the importance of training and reinforcing correct techniques before patients are discharged home, with provision of written asthma action plans, peak flow meters, spacer devices, deep inspiration, slow expiration and coughing technique as has been done in the current study.

The positive effects of the present study guidelines were not only limited to patients' knowledge and practices, but also extended to their compliance, and various aspects of their life. For instance, asthma may have deleterious effects on patients' daily life activities, work, self-image, psychology, and diet. It may also prevent patients from lying down during rest or sleep at the time of the attacks. All these aspects have shown improvements among patients in the current study secondary to implementation of the guidelines. The findings are in agreement with *Rai et al. (2007)* who clarified that the application of treatment guidelines for bronchial asthma can achieve minimal or nil day time and night time symptoms, prevent acute exacerbations, and attain normal or near normal lung function, thus improving the overall quality of life.

The present study assessed the effect of implementation of the guidelines on the severity of asthma using objective measures such as the pulmonary function tests, in addition to patients' reporting of the frequency of the attacks and the oral use of cortisone. The result of the study indicated significant improvements in all these criteria of disease severity, which extended through the follow-up phase. Furthermore, the multivariate analysis confirmed the effect of the guidelines on the improvement of the disease severity, but through improvement in patient's knowledge. This confirms the importance of improving knowledge, which will be reflected on compliance, practices, and consequently on disease severity. Patient's education had also a significant positive impact on the severity of asthma, which is in line with *Brooten et al. (2003)* who showed that higher education would diminish the severity of the disease, and also encourage better therapeutic compliance.

Table 2. Knowledge, practice, and compliance related to bronchial asthma among patients in the study sample throughout study phases.

	Time						X^2 Test (p-value) Pre-post	X^2 Test (p-value) Pre-FU
	Pre		Post		FU			
	No.	%	No.	%	No.	%		
Satisfactory knowledge (60%+) about:								
Definition/types	13	31.0	42	100.0	42	100.0	44.29 (<0.001*)	44.29 (<0.001*)
Time/season	21	50.0	42	100.0	42	100.0	28.00 (<0.001*)	44.29 (<0.001*)
Precipitating factors	13	31.0	42	100.0	42	100.0	44.29 (<0.001*)	44.29 (<0.001*)
Symptoms/signs	19	45.2	42	100.0	42	100.0	31.67 (<0.001*)	31.67 (<0.001*)
Complications	13	31.0	42	100.0	42	100.0	44.29 (<0.001*)	44.29 (<0.001*)
Management	19	45.2	42	100.0	42	100.0	31.67 (<0.001*)	31.67 (<0.001*)
Exercises	0	0.0	41	97.6	41	97.6	80.09 (<0.001*)	80.09 (<0.001*)
Total knowledge:								
Satisfactory	15	35.7	42	100.0	42	100.0	39.79	39.79
Unsatisfactory	27	64.3	0	0.0	0	0.0	(<0.001*)	(<0.001*)
Adequate practice (60%+) and compliance:								
Use nebulizer	32	76.2	36	85.7	36	85.7	1.24 (0.27)	1.24 (0.27)
Comply to exercise	7	16.7	42	100.0	42	100.0	60.00 (<0.001*)	60.00 (<0.001*)
Exercise performed:								
Deep breathing	2	28.6	34	81.0	34	81.0	Fisher	Fisher
Coughing	5	71.4	8	19.0	8	19.0	(0.01*)	(0.01*)
Comply to FU	2	4.8	40	95.2	41	97.6	68.76 (<0.001*)	72.47 (<0.001*)
Total practice:								
Adequate	0	0.0	41	97.6	41	97.6	80.09	80.09
Inadequate	42	100.0	1	2.4	1	2.4	<0.001*)	(<0.001*)

(*) Statistically significant at p<0.05

Table 3. Effect of bronchial asthma on patients throughout study phases

	Time						X^2 Test (p-value) Pre-post	X^2 Test (p-value) Pre-FU
	Pre		Post		FU			
	No.	%	No.	%	No.	%		
Effect of asthma on:								
Daily life activities	36	85.7	20	47.6	7	16.7	13.71 (<0.001*)	40.07 (<0.001*)
Work	38	90.5	16	38.1	8	19.0	25.10 (<0.001*)	43.25 (<0.001*)
Psychology	30	71.4	12	28.6	8	19.0	15.43 (<0.001*)	23.26 (<0.001*)
Self-image	27	64.3	9	21.4	9	21.4	15.75 (<0.001*)	15.75 (<0.001*)
Diet	38	90.5	21	50.0	6	14.3	16.46 (<0.001*)	48.87 (<0.001*)
Sleep position:								
Lying down	3	7.1	27	64.3	40	95.2	35.70	65.43
Semi-sitting	25	59.5	15	35.7	2	4.8	(<0.001*)	(<0.001*)
Stooping	14	33.3	0	0.0	0	0.0		
Resting position:								
Lying down	10	23.8	28	66.7	41	97.6	20.93	48.02
Semi-sitting	21	50.0	14	33.3	1	2.4	(<0.001*)	(<0.001*)
Stooping	11	26.2	0	0.0	0	0.0		

(*) Statistically significant at p<0.05

Table 4. Changes in bronchial asthma severity among patients in the study sample throughout study phases

	Time						X^2 Test (p-value) Pre-post	X^2 Test (p-value) Pre-FU
	Pre		Post		FU			
	No.	%	No.	%	No.	%		
Frequency of attacks/week:								
1	0	0.0	23	54.8	24	57.1	31.67	33.60
2+	42	100.0	19	45.2	18	42.9	<0.001*	<0.001*
Oral cortisone use:								
None	8	19.0	18	42.9	18	42.9	5.57	5.57
Sometimes with attacks	34	71.0	24	57.1	24	57.1	0.02*	0.02*
Pulmonary function tests (% of predicted):								
>80%	3	7.1	20	47.6	23	54.8	24.23	27.47
60-80	20	47.6	19	45.2	16	38.1	<0.001*)	(<0.001*)
<60	19	45.2	3	7.1	3	7.1		
Severity index:								
Mild	5	11.9	26	61.9	27	64.3		
Moderate	27	64.3	16	38.1	15	35.7	22.55	24.43
Severe	10	23.8	0	0.0	0	0.0	(<0.001*)	<0.001*)

(*) Statistically significant at p<0.05

Table 5. Best fitting multiple linear regression model for the change in knowledge and severity scores throughout study .

	Un standardized Coefficients		Standardized Coefficients	t-test	p-value
	Beta	Std. Error			
Knowledge score:					
Constant	45.65	1.05		43.471	<0.001*
Intervention	49.90	1.29	.961	38.796	<0.001*
r-square=0.92 *Model ANOVA: F=1505.12, p<0.001* *Variables excluded from model: age, sex, education, residence, duration of illness*					
Severity score:					
Constant	6.622	.407		16.268	<0.001*
Educational level	-.172	.056	-.199	-3.083	0.003*
Knowledge score	-.050	.005	-.667	-10.340	<0.001*
r-square=0.49 *Model ANOVA: F=58.52, p<0.001* *Variables excluded from model: age, sex, residence, duration of illness*					

Table 6. Reasons for non-compliance as reported by patients in the study sample throughout study phases.

	Time						X^2 Test (p-value) Pre-post	X^2 Test (p-value) Pre-FU
	Pre		Post		FU			
	No.	%	No.	%	No.	%		
Medical reasons:								
Not realizing importance of medication	26	61.9	6	14.3	12	28.6	20.19 (<0.001*)	9.42 (0.002*)
Non-practical diet regimen	27	64.3	9	21.4	5	11.9	15.75 (<0.001*)	24.43 (<0.001*)
Difficult use of atomizer	26	61.9	4	9.5	0	0	25.10 (<0.001*)	37.66 (<0.001*)
Concern for side effects as addiction	29	69.0	1	2.4	0	0	40.65 (<0.001*)	44.29 (<0.001*)
Cost of drugs	40	95.2	2	4.8	0	0	68.76 (<0.001*)	76.36 (<0.001*)
Dislike drugs	31	73.8	2	4.8	0	0	41.98 (<0.001*)	49.13 (<0.001*)
Non-medical reasons:								
Denial	33	78.5	6	14.3	7	16.7	34.89 (<0.001*)	32.26 (<0.001*)
Unclear treatment plan	38	90.5	10	23.8	7	16.7	38.11 (<0.001*)	46.00 (<0.001*)
Unrealistic expectations	35	83.3	4	9.5	2	4.8	46.00 (<0.001*)	52.60 (<0.001*)
Lack of guidance for self management	36	85.7	3	7.1	3	7.1	52.12 (<0.001*)	52.12 (<0.001*)
Dissatisfaction with health care	37	88.1	5	11.9	2	4.8	48.76 (<0.001*)	58.63 (<0.001*)
Poor training or follow up	40	95.2	3	7.1	3	7.1	65.23 (<0.001*)	65.23 (<0.001*)
traditional, beliefs about asthma and treatment	33	78.5	5	11.9	4	9.5	37.68 (<0.001*)	40.62 (<0.001*)
Family issues (smokers, pets)	38	90.5	7	16.7	5	11.9	46.00 (<0.001*)	51.89 (<0.001*)

(*) Statistically significant at p<0.05

The improvement in asthma severity revealed in the present study is quite plausible given the associated improvements in patients' knowledge, practices, and therapeutic compliance. Similar improvements in asthma severity have been reported secondary to interventions involving asthma guidelines *Ali et al. (2010)*, or naturopathy treatment *(Manjunath and Shirley, 2006)*. Furthermore, patients' therapeutic compliance has been shown to improve asthma severity *(Horvath and Wanner, 2006; Slats et al., 2006)*. The improvement in the different aspects of patients' life, including the psychological state could also have contributed to the decrease in disease severity. In congruence with this, *Bateman et al. (2008)* highlighted the importance of the psychological factors in asthma, which can play an important role in precipitating exacerbations and possibly act as a risk factor for an increase in disease severity.

Conclusion and recommendations

The study concludes that the developed guidelines have a significant positive impact on asthma patients' knowledge, practices, therapeutic compliance, and disease severity. This success is attributed to that the guidelines are based on needs assessment and integrate updated technology. Therefore, these guidelines should be adopted as an essential component of the care provided to asthma patients. Continuous follow-up together with selecting the optimal treatment options for each individual patient are recommended. The long-term effects of following the guidelines need to be further studied.

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