

## ASSESSMENT OF INHALERS TECHNIQUE PROPER USE FOR PATIENTS WITH CHRONIC RESPIRATORY DISEASES IN PRIMARY AND SECONDARY CLINICS IN BABYLON CITY

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### ABSTRACT

**Objective:** Although the inhalers are the preferred method of medications delivery, evidences suggest that many patients are unable to use their inhalers effectively due to improper technique so patients must know the right way of their inhaler use. The aim of the study is to assess the patient's ability to use their inhalers properly, identify the most common error made, assess the benefit of single education session, compare the property of the use between the primary and secondary clinics patients, determine which type of the inhaler devices is associated with more errors, and to identify the association between the inhaler technique and the disease control.

**Methods:** Non-randomized interventional study was done on 100 inhaler users of three inhaler types (metered-dose inhaler [p MDI], Turbuhaler, or Handihaler) for chronic respiratory diseases. Inhaler technique was evaluated by a scoring system before and after single session of training.

**Results:** It had been shown that the current education about inhalers techniques was not sufficient. The response to single session of education was higher with high level of education, urban area, and specialized respiratory center. Better disease control with the better score. After training, the younger patients have higher score.

**Conclusion:** We conclude that we need to stress on the most reported defect, metered-dose inhaler had the lowest mean score; therefore, it needs more training. Furthermore, single class of training can be beneficial but need follow-up to see if this effect can be maintained.

**Keywords:** Inhaler, Proper technique, Chronic respiratory diseases, Babylon city.

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### INTRODUCTION

Inhalers have the benefit of transmission of drug directly to the lungs with lower systemic side effect to use the lungs as a way for distribution of the drug systemically [1,2].

Pulmonary delivery is a special way for delivering the medication systemically because the huge capacity of the alveoli which allows fast absorption in addition to the lacking of the first pass metabolism, profuse blood supply, and delicate blood-air wall [3].

In spite of being a good delivery way, most of the patients dislike inhaler and regard it as stigma in their live, the issue of diversity and perspectives of stigma has been addressed in various chronic illnesses including asthma. The stigma in asthma has caused considerable negative repercussions on social support, patients' daily functioning, and quality of life of asthma patients [4].

Like other medicines, not responding to the prescribed drugs can yield from bad adherence. In medication delivered by inhalers, bad adherence can result from no use, irregular or overuse of the inhaler or bad inhaler use technique [2,3].

Factors affect effectiveness [5]:

1. Efficacy of the drug.
2. How they are used which mean appropriate prescription, patients adherence and the use of the inhaler device adequately.

Patients more likely for improper use of the inhaler are as follows [5,6]:

- Children.
- Older adults.
- People with severe airflow limitation.
- Patients have more than the type of inhaler device.

Whatever the prescribed inhaler type, the patients at any age are unusual to practice the device properly unless adequate instructions are given, as practical demonstration and regular checking of the inhaler technique [6,7].

Moreover, benefits of inhaled therapy can be limited by inadequate inhalation maneuvering and inhaler handling. The main problem with inhalers is the inhalation technique, especially with pressurized metered-dose inhalers [8].

When used properly, inhalers give the smallest suitable dose of the medication to the target sites in the lungs directly, associated by more rapid starting of action of that medication with less systemic distribution that reduces the disadvantages of the drug.

Improper inhaler technique decreases the drug delivery to the lungs, wastes medication, affect the disease control, decreases life quality, increases admissions to the emergency units, and higher treatment costs [9]. National Review of Asthma Deaths in 2014 recorded not understanding along with improper inhaler use might contribute to the large number of asthma deaths during 2012.

Temporal adherence depends on the patient perceptions of his disease, satisfaction in the treatment, the cost of the medication, and healthcare access [10,11]. While the adherence to the technique is due to lack of or forget the instructions [12].

Smart inhalers are an exciting new development that is being studied in clinical trials. They depend on Bluetooth technique to help the patients to remember to use their treatment and gather data to help guide care. In the future, smart inhalers could monitor and even correct a patient's inhalation technique [13].

Several studies have demonstrated that patients training on inhaler technique correct not only the technique but also compliance with the medications and, chiefly, the control of the disease [14,15].

An useful way is the evaluation, the inhaler use technique of the patients by matching the steps of their technique to a list particular to their inhaler type followed by giving them written directions around their mistakes (as sticker on the device) [16].

Even after attaining the proper technique by training, the patients may miss these abilities by 2-3 months, inhaler technique should be reassessed and teaching should be done again frequently [17].

All healthcare providers should be involved in this teaching practice: Primary healthcare doctors, lung consultants, physiotherapists, nurses, and pharmacologists.

To confirm beneficial inhaler use:

- Choose the most suitable device for the patient depending on well, joint and physical state and the financial issues also.
- Check inhaler procedure at every occasion with the checklist. Ask the patients to display to you their inhaler use.
- Correct using a physical demonstration, giving consideration to wrong steps and reassess the technique.
- Confirm that you have a definite list to each type of the inhalers (Global Initiative for Asthma 2017).

In this study up to our knowledge, it is the 1<sup>st</sup> study to correlate the chronic respiratory disease control with the inhaler technique and to compare between three types of inhalers and with tow specialty levels clinic in Iraq.

## METHODS

This study is conducted in the centers which is secondary specialized center (Marjan Medical City Respiratory Outpatient Clinic) and non-specialized centers which are the primary healthcare centers in Babylon city during the period from the 1<sup>st</sup> January to the 1<sup>st</sup> August.

A randomized interventional study was done on 100 inhaler users (metered-dose inhaler [p MDI], Turbuhaler, or Handihaler) who were diagnosed previously to have asthma or chronic obstructive pulmonary disease by physicians according to the clinical data, pulmonary function test, and radiological imaging.

After informed consent, the use of each inhaler device was evaluated by asking the patients to demonstrate their inhalation technique using their inhaler device. We asked them to say each step as they performed it. Hence, that all the steps could be clearly observed. We performed special checklist for each type of inhaler involved in this study (Turbuhaler, p MDI, and Handihaler as shown in Tables 1-3, respectively) according to the National Asthma Council Australia was measuring the essential steps required for adequate drug delivery for each inhaler device and we gave a score for each step according to the importance of the step in delivering the medication to the lungs. The scoring system was viewed on respiratory committee in Babel city and it was acceptable. We used questioner about demographic data include age, gender, education level, duration of the use of the inhaler, the residence, and the type of the center. We asked them about their subjective evaluation of their symptoms control using asthma control test (ACT) score for asthmatic patients and chronic obstructive pulmonary disease (COPD) assessment test (CAT) score for patients with COPD. Then, we showed them the proper technique of the inhaler use using empty inhaler devices gave them instructions and reevaluated their use of the inhalers by the same scoring system. We compared the score before and after education.

## Inclusion criteria

The patients 18 years old or older using p MDI, Turbuhaler, or Handihaler for 6 months duration or more who were not in exacerbation and were clearly diagnosed to have asthma or COPD.

**Table 1: The using steps for Turbuhaler**

S. No.	Steps	Checklist score
1	Unscrew and remove cover	1
2	Check dose counter	2
3	Keep inhaler upright while twisting grip without shaking	2
4	Twist around and then back until click is heard	3
5	Breathe out gently, away from the inhaler	1
6	Place mouthpiece between teeth without biting and close lips to form good seal. Do not cover the air vents	2
7	Breathe in strongly and deeply	3
8	Hold breath for about 5 s or as long as comfortable	2
9	Remove inhaler from mouth	1
10	Breathe out gently away from the inhaler	1
11	If an extra dose is needed, repeat steps 2-10	1
12	Replace cover	1
	Total	20

**Table 2: The using steps for MDI**

S. No.	Steps	List score
1	Remove cap	1
2	Hold inhaler upright and shake well	3
3	Breathe out gently, away from the inhaler	1
4	Put mouthpiece between teeth without biting and close lips to form good seal	2
5	Start to breathe in slowly through mouth and, at the same time, press down firmly on canister	3
6	Continue to breathe in slowly and deeply	4
7	Hold breath for about 5 s or as long as comfortable	2
8	While holding breath, remove inhaler from mouth	1
9	Breathe out gently, away from the inhaler	1
10	If an extra dose is needed, repeat steps 2-12	1
11	Replace cap	1
	Total	20

MDI: Metered-dose inhaler

## Sample size

The sample size was estimated according to the following equation:

$$n = \frac{1.96^2 * p(1-p)^2}{d^2}$$

Where: n=sample size, p=the proportion=5% (which is the prevalence of chronic respiratory disease in Iraq according to Iraq Family Health Survey 2006/7)

d=relative precision=0.05. Hence, the total sample size which is required according to this equation will be:

$$n = \frac{1.96^2 * 0.05(1-0.05)^2}{0.05^2}$$

Ethical approval:

- Study was discussed and approved by the ethical committee in Babylon University, College of Medicine.

- Patient’s verbal consents were obtained before interviewing after explaining of the study to them.
- Official agreement was obtained from Babylon Health Directorate.

**RESULT**

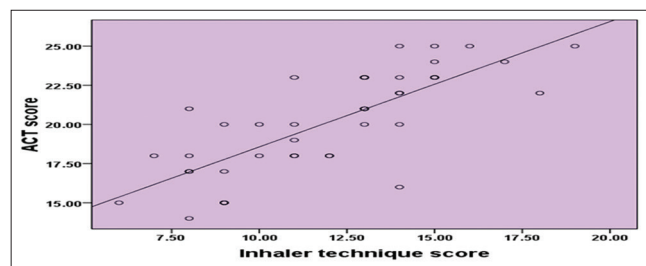
The study was done on 100 inhaler users distributed as shown in Tables 4-10, Figs. 1 and 2. Fig. 2: Correlation between inhaler technique score before instructions and chronic obstructive pulmonary disease (COPD) assessment test score for COPD patients.

**DISCUSSION**

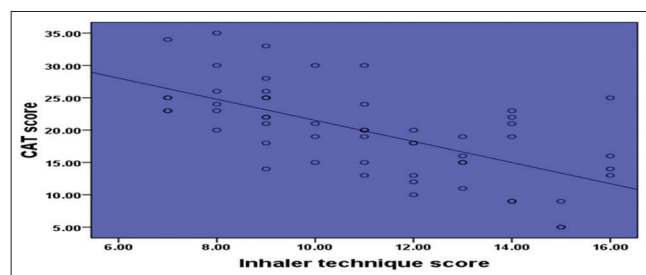
Many evidences from randomized clinical trials have shown that patients’ inhaler technique can be improved by education from a health professional [18] or other individual being trained about the proper use of the inhaler [19].

The percentage of mistakes differs largely among the studies, relating to the study standards, inhaler type, the patient education level, and other factors. However, many studies have found that the rate of incorrect use was about 90% [20]. In this study, there was significant association between the higher score (before and after training) and the higher level of education ( $p \leq 0.001$ ), urban residence ( $p = 0.001, 0.013$ ), attendance of the specialized respiratory center ( $p = 0.012, 0.015$ ), and the use of the Handihaler type of inhaler ( $p = 0.01, 0.003$ ). Furthermore, there was significant relationship between the higher score of the technique of the inhaler use and the disease control as evaluated by ACT score for asthmatic patients and CAT score for COPD patients ( $p < 0.001$  for both diseases). There was no significant statistical relationship between the inhaler technique score with the age, gender, and the duration of the use of the inhaler.

A local study showed that patients with low level of education had more inhaler use mistakes and there was no significant association between the proper inhaler maneuver and gender of the patient or diagnosis of the disease [3], which are compatible with the results of the current study.



**Fig. 1: Correlation between inhaler technique score before instructions and asthma control test score for asthmatic patients. There was significant negative linear correlation between inhaler technique score and chronic obstructive pulmonary disease assessment test score ( $r = -0.638, p < 0.001^*$ )**



**Fig. 2: Correlation between inhaler technique score before instructions and chronic obstructive pulmonary disease (COPD) assessment test score for COPD patients. There were significant differences between means of inhaler technique score after giving instructions by age, residence, and educational level**

While in contrast to this study, they found that using Turbuhaler, older patients (>60 years old), and shorter duration of use were significantly associated with poor inhaler technique these differences may be due to different standards, selection criteria, sample size, and shorter time.

**Table 3: The using steps for Handihaler**

S. No.	Step	Checklist score
1	Open cap	1
2	Flip open mouthpiece	1
3	Remove capsule from blister and place in chamber	1
4	Close mouthpiece in chamber	1
5	Press green piercing button in once and release (do not shake)	3
6	Breathe out gently, away from the inhaler	1
7	Place mouthpiece between teeth without biting and close lips to form a seal	2
8	Breath in slowly and deeply, so capsule vibrate	3
9	Keep breathing as long as possible	2
10	While holding breath, remove inhaler from the mouth	1
11	Breath out gently, away from the inhaler	1
12	Repeat steps from 7 to 11 take the full dose	1
13	Open mouthpiece and remove capsule	1
14	Close mouthpiece and cap	1
	<b>Total</b>	<b>20</b>

**Table 4: Distribution of patients according to sociodemographic variables**

Sociodemographic characteristics		
Age (years)	(48.12±18.59)	(19–79)
Gender		
Male	48	48%
Female	52	52%
Total	100	100%
Residence		
Urban	49	49%
Rural	51	51%
Total	100	100%
Educational level		
Uneducated	14	14%
Primary	34	34%
Secondary	35	35%
Higher education	17	17%
Total	100	100%
Diagnosis		
Asthma	43	43%
COPD	57	57%
Total	100	100%
Centers		
Specialized	60	60%
Non-specialized	40	40%
Total	100	100%
Duration of use		
6–12 months	46	46%
>12 months	54	54%
Total	100	100%
Type of inhalers		
Turbuhaler	33	33%
MDI	31	31%
Handihaler	36	36%
Total	100	100%

COPD: Chronic obstructive pulmonary disease, MDI: Metered-dose inhaler

**Table 5: The percentage of the error in patients using Turbuhaler for each step**

Turbuhaler	Steps	Error (%)
1	Unscrew and remove cover	0
2	Check dose counter	60
3	Keep inhaler upright while twisting grip without shaking	63
4	Twist around and then back until click is heard	15
5	Breathe out gently, away from the inhaler	93
6	Place mouthpiece between teeth without biting and close lips to form good seal. Do not cover the air vents	39
7	Breathe in strongly and deeply	60
8	Hold breath for about 5 s or as long as comfortable	81
9	Remove inhaler from mouth	3
10	Breathe out gently, away from the inhaler	36
11	If an extra dose is needed, repeat steps 2-10	0
12	Replace cover	0

**Table 6: The percentage of the error in patients using MDI for each step**

MDI	Steps	Error (%)
1	Remove cap	0
2	Hold inhaler upright and shake well	67
3	Breathe out gently, away from the inhaler	83
4	Put mouthpiece between teeth without biting and close lips to form good seal	25
5	Start to breathe in slowly through mouth and, at the same time, press down firmly on canister	19
6	Continue to breathe in slowly and deeply	90
7	Hold breath for about 5 s or as long as comfortable	70
8	While holding breath, remove inhaler from mouth	16
9	Breathe out gently, away from the inhaler	54
10	If an extra dose is needed, repeat steps 2-12	6
11	Replace cap	0

MDI: Metered-dose inhaler

This study so, the education about the technique was significantly effective. As show that the technique of MDI uses improved in the two groups that received training in contrast to the control group (p<0.001) [21].

In this study, we noticed that asthmatic patients had a higher but statistically non-significant mean score before and after training than patients with COPD which was similar to the results of some study [22]. While against other study [3] which showed that the COPD patients did better than asthmatic patients, but it was not significant statistically and this may be due to sample size.

The improvement of the score of the patients from urban area was more may be due to less healthcare services and specialized respiratory centers in rural area and they already had more mistakes before education, so they require more sessions of training.

**Table 7: The percentage of the error in patients using Handihaler for each step**

Handihaler	Steps	Error (%)
1	Open cap	0
2	Flip open mouthpiece	0
3	Remove capsule from blister and place in chamber	0
4	Close mouthpiece in chamber	2
5	Press piercing button in once and release (don't shake)	52
6	Breathe out gently, away from the inhaler	88
7	Place mouthpiece between teeth without biting and close lips to form a seal	2
8	Breath in slowly and deeply, so capsule vibrate	58
9	Keep breathing as long as possible	83
10	While holding breath, remove inhaler from the mouth	19
11	Breath out gently away from the inhaler	38
12	Repeat steps from 7 to 11 take the full dose	75
13	Open mouthpiece and remove capsule	16
14	Close mouthpiece and cap	2

There were significant differences between means of inhaler technique score before and after giving instructions

**Table 8: Mean differences of inhaler technique score before and after instructions**

Study variable	Study group	N	Mean±SD	Paired t-test	p value
Score	Before instructions	100	11.46±2.9	-31.353	<0.001*
	After instructions	100	19.05±1.26		

\*p≤0.05 was significant. There were significant differences between means of inhaler technique score before giving instructions according to the socioeconomic data. SD: Standard deviation

After education, we found that older patients had less mean score may be due to other factors related to older patients as they suffered from larger difficulties to use the device properly because of other comorbidities, lack of dexterity, and also older patients with COPD might had more progressed disease than younger patients with more airways limitation.

The higher educated people had a higher mean score which is consistent with previous study [23] because educated people could read the inhaler leaflet or search about the way of the use of their inhaler on the net.

Even after training, the educated patients and the patients attended the specialized respiratory center still had the highest score this might be explained as those patients already had a higher score before training than the less educated or the people attended the non-specialized center so, they got more benefit from a single session of training. In addition to that, most of the patients attended the specialized respiratory centers were using inhalers, so they might teach each other. Furthermore, the respiratory physician in the specialized centers might have more information about inhaler technique and the most common error of each type of inhalers.

The lowest mean score was for p MDI (10.35 ± 3.05) followed by Turbuhaler (11.39 ± 2.98) and then the Handihaler (12.47 ± 2.36)

**Table 9: The mean differences of inhaler technique score before instructions according to sociodemographic characteristics**

Study variable	Study group	N	Mean±SD	t-test	F-test	P value
Age (years)	60 or more	34	10.97±2.95	-1.213		0.228
	Less than 60	66	11.71±2.86			
Gender	Male	48	11.02±2.78	-1.461		0.147
	Female	52	11.86±2.97			
Residence	Urban	49	12.38±2.89	3.283		0.001*
	Rural	51	10.56±2.64			
Educational level	Uneducated	14	9.14±2.71		16.277	<0.001*
	Primary	34	10.58±2.55			
	Secondary	35	11.65±2.33			
	Higher education	17	14.70±1.86			
Duration of use (months)	6-12 months	46	11.82±2.84	1.166		0.247
	More than 1 year	54	11.14±2.94			
Diagnosis	Asthma	43	12.02±3.08	1.701		0.092
	COPD	57	11.03±2.7			
Type of unit	Specialized center	60	12.05±2.91	2.557		0.012*
	Non-specialized unit	40	10.57±2.67			
Type of inhaler	Turbuhaler	33	11.39±2.98		4.78	0.01*
	MDI	31	10.35±3.05			
	Handihaler	36	12.47±2.36			

\*p≤0.05 was significant. There was significant positive linear correlation between inhaler technique score and ACT score (r=0.776, P<0.001\*). COPD: Chronic obstructive pulmonary disease, MDI: Metered-dose inhaler, SD: Standard deviation, ACT: Asthma control test

**Table 10: Mean differences of inhaler technique score after instructions according to sociodemographic characteristics**

Study variable	Study group	N	Mean±SD	t-test	F-test	p value
Age (years)	60 or more	34	18.61±1.43	-2.323		0.024*
	<60	66	19.27±1.11			
Gender	Male	48	19.02±1.27	-0.22		0.826
	Female	52	19.07±1.26			
Residence	Urban	49	19.36±1.11	2.531		0.013*
	Rural	51	18.74±1.33			
Educational level	Uneducated	14	17.78±1.05		11.478	<0.001*
	Primary	34	18.82±1.35			
	Secondary	35	19.31±1.10			
	Higher education	17	20.00±0.00			
Duration of use (years)	6 months to 1 year	46	19.19±1.08	1.084		0.281
	More than 1 year	54	18.92±1.39			
Diagnosis	Asthma	43	19.32±1.12	1.961		0.053
	COPD	57	18.84±1.33			
Type of unit	Specialized center	60	19.31±1.04	2.491		0.015*
	Non-specialized unit	40	18.65±1.45			
Type of inhaler	Turbuhaler	33	19.27±1.008		6.242	0.003*
	MDI	31	18.41±1.60			
	Handihaler	36	19.38±0.93			

\*p≤0.05 was significant. COPD: Chronic obstructive pulmonary disease, SD: Standard deviation

before and after training. This is similar to older study [23]. Metered-dose inhaler was the hardest to apply because they need more motor synchronization than DPIs as the drawing of the medication from DPIs devices depend on the force of one's own breath [23].

In this study, we noticed that the low score of the technique of the inhaler use had a substantial influence on the control of asthma (ACT score) and COPD (CAT) score with p<0.001 for both groups which is compatible with other study [24].

The findings of this study were similar to other study which concluded that providing instructions by the prescriber is the most adjustable beneficial tool to decrease poor technique of inhaler use [24].

Furthermore, the findings of this study were near these of a study that concluded in spite of long period of inhaler use; the inhaler technique was inadequate and frequent assessing of technique of the use of the inhaler is essential [25,26].

#### Limitation of study

1. Shortage of time.
2. The convenient sample not presents all the community in Babylon city.

#### CONCLUSION AND RECOMMENDATION

1. The pMDI had the lowest mean score (before and after education), so the users need more training on the device.
2. In education need to stress on the most reported defects.
3. Single class of training can be beneficial but need follow-up to see this effect if can be maintained.
4. The most important step with good technique is the education not inhaler type or level of consultation.
5. The correlation of control with good technique is expected.
6. The low technique score is associated significantly with the lower education, people attending primary healthcare centers, and patients from rural area, so those patients need more educational sessions.
7. Elderly patients had more difficulties in the use of the inhaler after education than young patients so we should choose the suitable device to their abilities.

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