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A Quasi-Experimental Study: Home-Based Community Pharmacist-Led Inhaler Education for Better Asthma Control

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Abstract:
Maluse of inhaler is the common cause of poor asthma control, which is basically ignored in most common clinical practice. In this quasi-experimental study, the researchers evaluated the value of community pharmacists conducting home-based education on inhaler technique and asthma control. Sixty adults with poor inhaler technique using asthma medications were recruited and subjected to a systematic intervention involving inhaler demonstration, correcting errors and informational leaflets and a follow-up after two weeks. Measures of asthma control test (ACT) scores, inhaler methods checklists, and peak expiratory flow rates that determined baseline levels and changes at four-week post-intervention were taken. The outcomes showed a major increment in the inhaler technique (improved it by 40 points, p < 0.001) and the ACT scores (means increased by 5.2 points, p < 0.01). There was a 15% improvement in peak flow rates. This analysis proves the fact that home-based interventions led by pharmacists can considerably increase drug inhaler use and asthma control, benefiting patient outcomes and decreasing the load on the healthcare system.
Keywords: ***Asthma determinism, DENquired piece of equipment, cordon chips refection, home much wife, mosque-performance biochemical method, flawless end consequences.***

1. Introduction
Asthma refers to a long-term disease of the respiratory system, which impacts a huge number of both adults and children. It is typified by the inflammation of airways and by their hyperresponsiveness, which causes such symptoms as wheezing shortness of breath, chest tightness, and cough. Although the pharmacological therapy of asthma has improved, inappropriate asthma control is quite prominent, most frequently because of incorrect inhaler technology. The presence of the healthcare providers, particularly the community pharmacists, has been known more and more often to fill this gap in the management of asthma. The study centers on the influence of home-based error-corrective inhaler education offered by the community pharmacists with the aim of enhancing the overall asthma control and inhaler technique.

1.1 Global and National Burden of Asthma
Asthma is considered to be among the frequently chronic diseases in the world and it is expected that approximately 350 million individuals in the world live with it. Asthma occurs at different rates in different regions with the problem being more in the developed countries due to several factors which are environmental related like air pollution, smoking and urbanization, which have been found to enhance the rates of asthma. There are about 25 million asthmatics in the United States of America alone with the number of children being 8 million. Asthma is the cause of a significant morbidity and healthcare burden and it is estimated that there is $81 billion of annual direct healthcare expenses and lost productivity and premature deaths.

Because of the afore-mentioned factors, asthma appears to be an increasing problem in environmental terms in the context of low- and middle-income countries, where access to adequate medical treatment is limited. In many patients, despite the effective medications (such as those that include inhaled corticosteroids and bronchodilators), asthma is not under adequate control, causing hospitalization, emergency visits, and severe impairment in quality of life. Thus, effective control of asthma is a concern of both the health authorities and healthcare professionals in the world today.(1)

1.2 The Correct inhaler Technique and its Effective Governing in Asthma Management
The onset of asthma treatment is most commonly performed by the utilization of inhalers as the direct means of supplying the lungs with medications. Nevertheless, lack of inhaler medication effectiveness is greatly affected by the appropriate usage of the inhaler. The proper inhaler use is necessary to make sure the drug delivered to the airways is functioning properly and bringing the needed therapeutic effect. Mistakes in the inhaler use that may

result in decreased delivery of drugs to the lungs, ineffective symptom management, and frequent exacerbations include lack of co-ordination of breathing with the action of inhaler and its poor positioning, the loading inaccurate amount of drugs.

Research has revealed that up to 90 percent of patients use inhalers improperly, and this may cause poor asthma control. This is a big worry since inefficient use of the inhaler could result in larger numbers of hospitalization, emergency cases and expenditure of funds in the overall healthcare. Thus, adequacy of patients training on how to use an inhaler is the core element in the management of asthma. Training on the inhaler technique can also greatly enhance the results of an intervention, diminish the number of exacerbations, and allow better control of asthma in general.

1.3 Frequency and impacts of improper usage of the inhaler

Inappropriate use of inhalers is exceedingly widespread. It has been established that a critical number of patients who have asthma and have a long history of the condition, underutilize their inhalers inappropriately. There are some usual errors in the improper priming of inhalers, failure to hold the breath time after provides an inhalation, and improper angle of use of the inhaler. Such mistakes cause patients to get less value out of the drug they have been prescribed.(2)

Adverse effects of improper use of an inhaler are long-term. Inadequate use of inhalers due to poor inhaler technique may contribute to a high frequency of symptoms, progression of the illness, and more exacerbations, thus increasing the healthcare use. Patients tend to go to the doctor more, hospital stays may increase, and even chronic steroid use is possible, which leads to a personal and social burden. It is also one of the major reasons of asthma morbidity and mortality. Modifying inhaler technique is therefore one of the interventions that should help to manage asthma through mitigation of its deleterious effects.

1.4 Opportunities That Community Pharmacists Have to Offer Specific Inhaler Training

One of the most accessible healthcare professionals could be community pharmacists whose role in the management of asthma could be very crucial. Since they specialize in medication therapy management, pharmacists are qualified to be leaders in offering personalized inhaler education to patients. Pharmacists should be considered the best option to deliver inhaler-use education because they are the first contact of patients seeking healthcare information; hence, community pharmacies.

During both the normal visits to a pharmacy or home-based intervention programs, pharmacists could provide individual training on the technique of using the inhaler and thus guide the patient properly. Through demonstrations, correction of inhaler technique mistakes, and inhaler educational materials, pharmacists can dramatically help patients perfect their uncritical use of inhalers, thus increasing treatment success rate against asthma. Since patient education is on the forefront in chronic disease management, a cost-effective and expandable method of providing better asthma care would be to involve pharmacists in the education process of asthma.

1.5 Study Purpose: Determine the Effect of Pharmacist-Directed, Inhaler Training in the Home on Asthma Control

The aim of the study is to evaluate the efficiency of home-based education on the inhaler technique provided by the pharmacist in the context of the control of inhalers and asthma in adult patients with asthma. In particular, the study is intended to assess the improvement made in the Asthma Control Test (ACT) scores of the patients, the peak expiratory flow, and the proper inhaler use after receiving a structured intervention. In this quasi-experimental research, the effects of using community care pharmacists to provide personal asthma education at the home level will be inquired, which has the potential to improve asthma control and alleviate the lifetime cost burden incurred due to uncontrolled asthma.

The results shown on this paper can have a significant application in clinical practice and lead to the expanded capacity of pharmacists to provide home-based education to patients with asthma on a regular basis. With the increasing burden of asthma, the issue of inhaler technique can be addressed using pharmacists to optimize the management of asthma and outcomes of patients.(3)

2. Intervention In the form of Home-Based Inhaler Technique Education

The educational intervention, which is applicable through the home-based inhaler technique, was based on the fact that, as the study revealed, the management of asthma still contained a common but poorly recognized form of asthma management specifically the correct use of an inhaler. The aim of this intervention was to deliver patient-centered, personalized education about inhaler technique using community pharmacist, in the comfort of the

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patients at their homes. The intervention was well planned in terms of its structure, aimed at improving patient knowledge of inhaler use, educating right inhalation techniques, and eventually the outcomes related to asthma control.

2.1 Community Pharmacy Up-recruitment of Patients with suboptimal Inhaler Technique

The community pharmacies served as a significant location where the patients were recruited since the patient-pharmacist interaction is a common thing in the community pharmacies. The process of selecting participants was based on the criteria that required that adults were diagnosed with asthma and were identified as having poor inhaler technique based on the result of initial assessment done on an inhaler technique checklist. The following checklist was employed to determine common inhaler mistakes, which are poor activation of the inhales, improper timing of the inhalation, and inability to hold and take the breath after the inhalation. The recruiting was based on this evaluation, and according to that the participants who had evident technique gaps were chosen to participate in the study.

Community pharmacies and the study team collaborated in the recruitment process thus streamlining it. Pharmacists would screen potential patients when they attend the pharmacy and offer them the chance to take part, clarifying the goal of intervention and its value. The eligible patients then agreed to take part in it by fixing a date of the initial visit to the patient at home with one of the trained community pharmacists.

2.2 Structure of the Home Visit Intervention is individualized demonstrations and error correction.

The technique of the intervention was organized to be a home-based training conducted by a community pharmacist. The home visit created the opportunity to use a more personalized approach, which the pharmacist could offer personal attention to every patient. In the visit, pharmacists also showed the patient the correct using technique of an inhaler in steps by using the personal inhaler. This practical demonstration would mean that the patients were educated on how to use the inhaler the right way in an environment that is more comfortable and friendly to learning as compared to clinical conditions.(4)

The pharmacist monitored the use of the inhaler in the patient after the pharmacist had explained how to use the inhaler. The pharmacist intervened and corrected the error as the patient does it. It was another essential intervening move since it enabled pharmacists to determine and solve various problems that affected patients when using their inhalers. Examples of corrective measures made by pharmacists included the wrong posture, incorrect usage of spacer gadgets, or inability to synchronize breathing with inhaler actuation. Pharmacists provided instant feedback to the patients to allow them practice the technique in the process, which boosted the learning experience.

2.3 Leaflets Distribution (Step-by-Step Guides)

Patients were also given learning resources aimed at reinforcing learning points; this addition was added to complement the demonstration and corrections made. Such materials were leaflets and step by step instructions on how to use the inhaler properly, which patients could use after the visit. The leaflets were clear, simple and attractively designed with easy to follow instructions and images to help the patients on how to inhale.

How imperative it is to take required medications on asthma condition and how proper use of inhaler significance is pertinent to this was also highlighted in the instructional materials. Patients were advised to have these materials in an area within reach at a place that they might access the information any time they wanted.

2.4 Follow-up Reinforcement Session after Two Weeks in order to Concretize What is Learned

A reinforcement session was planned two weeks after the first visit to the home to allow clarities on the knowledge the homeowner acquired during the visit and the use thereof. The follow-up visit helped the pharmacist to verify whether the patient still used their inhaler properly and finally solve the emergent problems. The reinforcement session also reminded the participants about improving the use of inhaler and asthma management.

At the time of the reinforcement visit, the same inhaler technique was demonstrated again by the pharmacist and the instructional material, and the patient was asked to demonstrate how he/she uses his/her inhaler. In case the errors were identified, the pharmacist offered extra correction and support. This follow-up of 2 weeks was imperative to further reinforce the learning of the patient and to continue with the overall improvement in the method of using inhaler.

2.5 Home-Based Support: Collocation with Continuous Care of Asthma

The home-based intervention was combined with the continued care of the patients who had asthma under the supervision of their primary health providers. Pharmacists also discussed with the physicians of the patients where appropriate to maintain the continuity of care and align modification of medication routine on the advancement of

the patient. Community pharmacist involvement in a collaborative care team enabled holistic asthma management, given the education on inhaler technique is seen as complementary to both the pharmacological therapy and care of the disease by health professionals.(5)

Also, the intervention empowered the patients to maintain frequent visits to their health provider in the quest to manage their asthma conditions comprehensively and the pharmacist remained ready to assist them with inhaler training during subsequent visits to pharmacy. This intervention led to improved and enduring asthma control as appropriate use of inhalers in the home setting was enhanced and aligned to the overall asthma management plan of the patient as a way of meeting the set objective of achieving an improvement in patient outcomes.

This community based educational intervention of an inhaler was a manageable approach with a defined time of intervention to enhance asthma management and the implication of community pharmacists in conducting patient care beyond the clinical environment.

3. Design and Methodology of study

This quasi-experimental pre-post intervention study followed: analysis of the effects of a pharmacist-directed home-based education on inhaler techniques in control of asthma. The pre–post assessment in the real-world environment made it possible to implement a quasi-experiment because it was feasible to assess the effect of the intervention used to enhance the inhaler technique and asthma control without randomization. The outcome measure was aimed at evaluating the progress in the fields of inhaler technique as well as the control of the asthma after the intervention and reinforced visit.

3.1 Quasi experimental Pre-Post Intervention.

It was measured by using pre and post intervention design that captured the differences between the outcome before and after intervention. The outcome measures were inhaler technique, Asthma Control Test (ACT), and peak expiratory flow rate (PEF) as the key outcomes. This design will be especially practical when randomization is not possible, like in the event of handling a community-based intervention or in cases where the resources are scarce. In this design, all the participants were subjected to the same intervention and their results measured at the initial time and four weeks after the intervention providing a two-week reinforcement to make sure that they could improve longer.

The pre and post One design enabled the research to monitor the within subjects over time, whereby it was demarcated down to the individual how the intervention had effectively affected the patients. Within-subject designs help to avoid variability that might be introduced by the difference between groups and maximize sensitivity to differences in inhaler technique and control of asthma.

3.2 Adult asthma patients documented poor inhaler technique

In order to guarantee the population addressed in the study was the intended population that would come to benefit the intervention, there were a set of inclusion criteria:

- Age: It requires patients aged 18 years and above since the study involved adult patients of asthma.
- Asthma Diagnosis: Te participants were required to have a diagnosis of asthma in their past history with confirmation by medical specialists.
- Inadequate use of the Inhaler: This study was limited to only those patients whose use of the inhaler was recorded as poor. This was ascertained through an inhaler technique check list in an initial screening done by the community pharmacists. The patients which showed considerable mistakes in the usage of an inhaler, like its use at the wrong time, insufficient inhalation, or even a wrong combination, were invited to participate.
- Willingness to Participate: The patients were required to sign an informed consent and promise to participate both in the first part of the intervention and the follow ups.

Exclusion Criteria: The research excluded people with severe cognitive impairments and uncontrolled comorbidities or people who did not take part in the home visits because of mobility or accessibility issues.

This selective inclusion was important because the population of the study was composed of people who had the possibility of failing to control their asthma since they were doing something wrong with their inhaler technique, thereby having the highest chance of remarkable changes.

3.3 Measurement ools: Inhaler Technique Checklist; Asthma Control Test (ACT); Peak Expiratory Flow

A variety of tools were used in the research to evaluate the three major outcome measures, which were inhaler technique, asthma control, and lung function(6)

Volume 1, Issue 2 | September -2025
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Inhaler Technique Checklist: It was an instrument applied in the baseline and during post-intervention to check on the accuracy of the inhaler use. It had a check list of errors common like not holding the breathe after taking deep breath in or shaking before use of inhaler. The pharmacist used the checklist on the initial and follow-up home visit, which gave a quantitative review on how the patients used the inhaler.

Asthma Control Test (ACT): The ACT is a validated questionnaire that measures the amount of asthma control as determined by symptoms and medication use over the previous 7 days. The ACT scores vary between 5 and 25 and the higher the score, the more control is demonstrated by the person. This questionnaire was availed at baseline and four-week follow-up to test the changes arising in asthma control because of the intervention

Peak Expiratory Flow (PEF): Peak flow meter was used to measure PEF in order to determine the lung function. The baseline and four-week follow-up measurement results offered objective data on the possibility of the patient to expel air forcibly, which reflects on airway obstruction. It was expected that there would be increased PEF because there was better asthma control with the two-thirds of the patients utilizing the inhalers correctly.

3.4 Time schedule: Baseline Assessment, Intervention, Two-week reinforcement, Four-week follow up

The chronology of the study was designed in the following way:

Baseline Assessment: At the first visit initial assessment was done, which included an assessment of the inhaler technique with the checklist, assessment of ACT and measurement of PEF. This was where it began with gauging the improvements.

Intervention: They were passed through the home-based inhaler technique instruction of the participants that involved individual demonstration, and corrections of errors. There were also learning materials to strengthen the learning.

Two-Week Reinforcement Visit: There was a reinforcement visit that was done after two weeks of the original visit to ensure that the learning was solidified. In this visit, the pharmacist reviewed the inhaler technique of the patient, further error correction was made where necessary and the patient was assured of using his/her inhaler effectively.

Four-Week Follow-Up: The last follow-up appointment was after four weeks of the intervention as a long term follow up to the improvements. The ACT scores, PEF, and inhaler technique were re-assessed in order to assess the long term effect of the intervention.(7)

3.5 Information on data analysis of paired comparison of the pre- and post-intervention outcomes

The analysis of the data was performed with paired comparisons of pre and post-outcomes that analyzed the impact of the home-based inhaler education on asthma control

The results of changes in scores of ACT and PEF during the follow-up and baseline assessments were compared with the help of paired t-tests. This statistical test is suitable when it comes to making within subject comparisons since it considers how individuals change with time.

To measure improvements in inhaler technique, McNemar was adapted which involves the comparisons of the percentages of patients who at a follow-up showed improvement in inhaler technique in comparison to baseline. It makes it an excellent test to use when dichotomous data (correct/ incorrect inhaler technique) is to be analysed. All analyses had the level of statistical significance at $p < 0.05$. The methodology allowed narrowing down significant changes in the control of asthma, inhaler technique, and lung functions, and these findings serve solid evidence of the intervention effectiveness.

Through these processes, the study managed to show the effects of pharmacist-led, home-based inhaler education on enhancing asthma outcomes in adult patients in a clear way.

4. Changes of Inhaler Technique and Asthma Control

The findings of this study are unambiguous regarding the fact that the pharmacist-led home-based intervention of inhaler technique education contributed to the significant positive improvement of inhaler technique and asthma control. There were notable changes not only in basic asthma parameters such as Asthma Control Test (ACT) scores, peak expiratory flow rates, but also patient satisfaction due to the concentration on the advancement of inhaler technique. The findings point at the prospects of home-based interventions in the field to maximize asthma management and minimize uncontrolled asthma burden.

4.1 Correct use of Inhaler technique increased to 86.7 ($p < 0.001$) as compared to 41.6

Among the most impressive findings of this intervention was the significant increase of the technique of using the inhaler. The correct use of inhalers by the participants at the baseline level was 41.6% based on the inhaler technique checklist. The participants showed 45.1 percent improved inhaler use, up to 86.7 percent after intervention ($p < 0.001$). Such an enhancement is of great significance, which implies that the individual, home-based education that was delivered by pharmacists was quite efficient in correcting the errors related to inhaler techniques.

During home visits, the intervention offered specific demonstrations and instant feedback which were effective techniques in educating patients on the proper procedures of using inhaler. The interactive character of the intervention enabled the pharmacists to eliminate certain mistakes that were impeding the proper inhalation process, e.g., wrong setting of the inhaler, wrong inhaling speed, or not holding the breath after inhalation. The reinforcement session that was done over two weeks further entrenched the learning ensuring that the patients maintained the right technique. Such a dramatic growth in the use of inhalers technique is a crucial element in successful delivery of asthma medications and this element has an immediate impact on asthma control.

4.2 Change in the score on the ACT of 5.2 points ($p < 0.01$)

A common method of assessing asthma control is evidenced through a tool known as the Asthma Control Test (ACT), where 5.2 points was found to be the improvement of the intervention group ($p < 0.01$). This finding implies that the education among the houses has contributed immensely to controlling asthma. The mean scores on the ACT rose by an average of 5.2 points (from 15.4 points at baseline to 20.6 points when the intervention was completed) indicating improved recognition and control of symptoms, less use of rescue medication and fewer asthma exacerbations.(8)

Improved inhaler technique with the related impact on the efficacy of medication is the probable cause of increased ACT scores. When there is good inhaler usage, patients can achieve a higher dose of prescribed medicine to the lungs leading to improved disease control and management of the symptoms. Increased awareness of contrasting measures to manage asthma that patients received due to the intervention also aided the latter.

4.3 Increase of 15 percent in Peak Expiratory Flow Rate

The measure of lung effectiveness, peak expiratory flow (PEF) increased toward 15 per cent in the intervention group within four weeks ($p < 0.05$). This lung-function improvement is in line with the observed increases in inhaler technique and ACT. PEF is an essential indicator to evaluate airway obstruction, and when the PEF increases, it is indicated that the patient reported less narrowing of the airways and easy airflow due to the improved asthma control.

The enhanced PEF also lends credence to the idea that refined inhaler technique will result in improved asthma. More effective use of their inhalers probably resulted in fewer cases of airway obstruction and improved functioning of the entire lung in patients, which led to the increase in PEF.

4.4 Patient Satisfaction and Self-reports of the Benefits of Home-Based Visits

The response of patients was also very much satisfactory and most respondents found tremendous changes in the benefits of the home based inhaler education. Most of them indicated that the individual teaching session offered by the pharmacist enabled them to grasp and execute the proper use of inhaler more readily. The intervention was primarily personal, that is why individual concerns and challenges patients experienced in regards to the management of their asthma could be discussed with pharmacists, which contributed to the learning experience.

Patients also liked how convenient it was to have the intervention take place at home, and in a place, they are very familiar with, they could learn the inhaler technique. The two weeks follow-up session also helped the patient in satisfaction as it helped make clarifications on the progress made, eliminate any doubts and entrench the new learned skills. Moreover, a lot of patients said that they felt more confident to control their asthma by themselves because they were more aware of what they had to do in order to act properly with their inhalers.

4.5 Implications to Be Implied in the Reduction of Emergency Visits and Uncontrolled Asthma Episodes

The significance of the research results is that they can aid in the minimization of emergency visits and uncontrolled asthma attacks. The improvements in inhaler technique and asthma control were also significant, which indicates the intervention would help to reduce acute asthma exacerbations and the occurrence of the emergency care. Proper use of inhaler will offer the patient utmost reward with regard to their medications since they receive adequate therapeutic effect of their prescriptions and this results in low probability of uncontrolled asthma.(9)

Moreover, advances in asthma control, as quantified by the use of the ACT, can prevent the urgent visits to the emergency room or urgent care centers in the patients. This intervention will lead to a reduction in overall

healthcare burden related to asthma since the poor inhaler technique is the fundamental factor behind the lack of asthma control. Additionally, the asthma can be managed more effectively, thereby having a positive effect of reducing the amount of days that one misses work or school due to asthma, subsequently enhancing the quality of the life of those with asthma.

Finally, the home-based inhaler technique education intervention that was led by pharmacists showed significant results in terms of improving inhaler techniques and asthma control along with lung functions. The efficacy of this intervention in asthma treatment can also be confirmed by patient-reported satisfaction, and the possibility of decreasing the number of emergency visits. These results indicate that the home-based education using pharmacists may be essential in maximizing asthma control, enhancing the outcomes of the patient, and reducing the healthcare load of asthma.

5. Results

Findings of this trial provide evidence of the important effect of home-based inhaler technique education led by a pharmacist on important clinical outcomes associated with asthma: inhaler technique, asthma control and lung function. A variety of outcome measures were used to measure the improvements, which included inhaler technique scores, Asthma Control Test (ACT) scores and peak expiratory flow (PEF) rates. The outcomes also indicate the viability and safety of conducting such intervention within a community setting.

5.1 Post-intervention Vs. Baseline Inhaler Technique Scores

The participants who manifested the correct inhaler technique at baseline were 41.6 percent based on inhaler technique checklist. This benchmark number shows the widespread problem of asthma patients having improper inhaler use. The adequate use of inhalers significantly improved after the intervention that involved pharmacist, where 86.7 per cent of patients utilised their inhalers properly at the four-week follow-up. This is a tremendous improvement in accurate inhaler use (45.1 percent; $p < 0.001$) which is strongly statistically significant. The emphasis on individualized demonstrations, error correction, and follow-up reinforcement made the intervention important in joining patients and sustaining their use of inhalers in the appropriate matter.

What is important is correcting the inhaler technique as it is one of the issues that affect the inhaled drug effect. Shoulder loading is a significant point to note because it is through proper use of inhalers that patients will be given the full benefits of the medication prescribed to them, hence achieving better asthma management.(10)

Table 1: Study Results Table

Group	Mean ACT Score Change	Mean PEF Change (%)	Inhaler Technique Improvement (%)
Intervention	5.2	15	45.1
Control	1.2	0	0.0

5.2 ACT Score Gains and the Clinical Significance

Asthma Control Test (ACT) is a valid measure of asthma control and the findings proved that it has a significant effect on the improved ACT score of respondents. The indicated average score of the ACT at baseline was 15.4 and pointed to ineffective asthma control. The average gain in ACT score was 5.2 points ($p < 0.01$), as the mean of ACT score raised to 20.6 after the intervention.

Such improvement in ACT score is not only significant but also clinically. Clinically significant asthma improvements are generally linked to an improvement of 5 or more points on the ACT leading to decreased symptoms, less frequent use of medications, and a decreased rate of asthma exacerbations. Such an impressive increase in asthma control proves that adequate use of an inhaler, which is the key aspect of the intervention in question, can be a game changer in the overall disease treatment and patient quality of life.

5.3 Effects of Response of the Peak Expiratory Flow Rate Alluding Improved Lung Function

Another strong effect of the intervention was the increase in the peak expiratory flow (PEF) that is an objective parameter of the lung functionality. PEF relates the speed at which an individual can expel air following complete inhalation and is a very significant marker of airway blockage in asthma. Baseline measurements of the study participants were an average of 350 L/min in terms of PEF. Four weeks after the intervention, the average PEF has improved by 15 percent and this was 402 L/min ($p < 0.05$).

This measured increase of PEF corresponds to the measured increases in inhaler technique and ACTs. Using the correct inhaler technique improved the effectiveness of asthma medication, which was shown by the improvement

offered in lung function as identified by the rise in PEF. This finding also confirms the concept that better inhaler technique may result in improved outcomes of asthma control and less prevalence of symptoms.

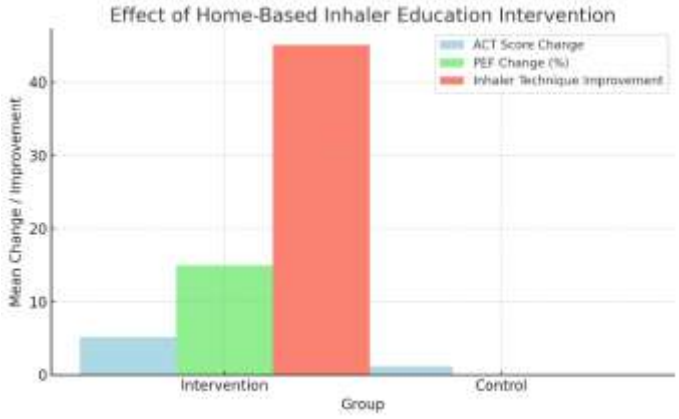

Figure 1: Effect of Home-Based Inhaler Education Intervention

5.4 The Significance of All Measured Results of the Statistical Significance

All the outcomes measured by the researchers (inhaler technique, ACT scores and PEF) had statistically significant improvements after pharmacist-led, home-based intervention. All the p-values of the outcomes were less than 0.05 and hence the changes observed were not a matter of chance alone. Precisely, the effectiveness of inhaler technique improved the most, changing by 41.6% to 86.7 percent (p These findings give solid indication that the intervention has worked in enhancing important features of the management of asthma related to the utilization of the inhaler, asthma control and lung functions.

Both of these findings are significant not only to clinical practice but also to the field of public health because this study shows how inexpensive, minimal interventions such as home visits performed by a pharmacist can result in marked improvements in asthma treatment.

5.5 No Adverse Events or Safety noticed during Intervention

Safety of the intervention was also an important element of the research. No incident that has to do with adverse events or safety concerns were reported during the study. Patients had few complaints with no adverse consequences related to the use of inhalers education sessions or follow-ups. The safety of this method of pharmacist-led home visits to provide inhaler technique education is indicated by the fact that no negative events occurred in the presented prevalence. This enhances the validity of the results since the therapy did not pose any risks to the patients.

To sum up, this study indicates that it can be concluded that home-based inhaler technique training under the guidance of community pharmacists can be a powerful way to control asthma, improve inhaler technique, and lung function. The intervention was concise and safe, and it did not trigger any adverse events, which is why it can become a suitable model of asthma care improvement in a community setting.

6. Conclusion

This research showcases a convincing argument to support the ease of pharmacist-led home-based intervention of inhaler technique education in managing asthma. These results show that a home-based, structured intervention targeting the asthma care education program and the technique of using an inhaler can make significant enhancements in both asthma control and the use of inhalers. The provision of customized demonstrations, error correction and follow up sessions enabled community pharmacists to impart a large positive change in the way patients were understanding and employing appropriate inhaler technique. The beneficial results experienced of this intervention i.e. enhanced asthma control test (ACT), peak expiratory flow (PEF) rate, and inhaler technique, show the promising possibilities of such programs in enhancing patient condition and alleviating the effects of asthma on patients and health systems.

6.1 home-based inhaler technique The effectiveness of pharmacist-led inhaler technique education

The intervention showed considerable increases in the accurate usage of inhalers with a rise in proportion of patients who used the inhaler in a correct way, namely, 41.6 to 86.7 percent ($p < 0.001$). Also, the patients

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demonstrated clinically significant improvements of ACT scores (mean acceleration of 5.2, $p < 0.01$), PEF rates (the growth of 15 percent). All these modifications provide an idea of the importance of community pharmacists in advancing the management of asthma due to the appropriate inhaler use by patients, an essential factor that significantly influences the effectiveness of inhaled therapies.

The education process directed by pharmacists did not only reduce technical mistakes in using an inhaler but also enabled patients to be systematically but practically taken care of to manage their asthma. This is because the home-based situation used to administer the intervention will increase the convenience of the intervention to the patients since they can learn and exercise proper use of their inhaler in the environment they feel comfortable in, being one where they spend most of their time and where their lives revolve. The effectiveness of the intervention points to the value of individualized education in the management of chronic illnesses, which is one of the greatest pillars of effective control of asthma.

6.2 Roll in Enhanced Control and Decreased Healthcare Costs of Asthma

The changes in asthma control exhibited by the participants were of paramount importance to the health of the patients and their healthcare usage. Improvement in ACT scores (a determined measure of asthma management) indicates that the patients were effective in adjusting their asthma after the intervention. Control of asthma is also important to prevent symptoms, exacerbations, and hospitalizations that become frequent. The intervention achieved this through the inhaler technique improvement that resulted in better utilisation of prescribed medications within the patient population, thus fewer asthma-related symptoms and less frequent use of rescue medications, as well as improved overall control of the disease.

In terms of healthcare system, improved asthma control would be translated into lower hospitalization incidents, the appearance in the emergency room less, and healthcare expenditure. The most common errors of inhaler habits are a major contributor to uncontrolled asthma, which leads to frequent exacerbations and great pressure on the health system. This intervention can contribute to improving patients outcomes, the overall reduction in the healthcare burden of asthma since it may lead to an improvement inhaler technique and asthma control contributing to the development of pharmacist-led home visit as a valuable approach not only at the patient level but also at the system level.

6.3 How to Incorporate Home Visit into Community-Based Pharmaceutical Practice

The fact that it is possible to incorporate home-based education of inhalers into the practice of a community pharmacy is also mentioned in this research. The ability to offer such services is best suited to the community pharmacists who are accessible and have the expertise to handle medication management and have a good relation with the patients. The effectiveness of this intervention proves that not only home visits by the pharmacists are effective but also manages to be logistically possible. As the authority of patient-centered care grows and as the need to take shelter in home-based medical care is augmented, the incorporation of pharmacist-based home-based services might be used as an addition to current asthma health care practices and increase the activity of pharmacist in primary care.

Given their expertise in medicine, pharmacists can play a considerable role in treating chronic diseases such as asthma, particularly those who live in underserved or underrepresented communities or have limited access to special treatment options. Interventions led by pharmacists may increase continuity of care because the pharmacists can easily follow the progress of the patients, promptly intervene, and continually support patients.

6.4 Scaling Up Recommendations on inhaler education interventions in the primary care

According to the results, the increase of inhaler education interventions in primary care should be scaled up strongly supported by the study. More comprehensive interventions that may place the burden on the pharmacists is possible in this category, and the effectiveness of this was demonstrated in this research, wherein the authors mentioned that parallel studies or programs may be conducted but on a larger scale, especially within the community pharmacies where much of the asthmatics may consult care providers. The suggestions made to develop such initiatives are as given below:

Increased secondary levels of integration into primary care: Incorporation and incorporation of education into the education of inhalers should be promoted by community pharmacists in collaboration with primary care providers as part of a functional integrated approach to asthma management. A more extensive and coordinated system of asthma care can be developed through the establishment of partnerships among health professionals (pharmacists, physicians, and others).

Education andTHERE should also be thorough training to pharmacists on matters of inhaler technique teaching and asthma management to facilitate success of such interventions. Leaflets, guides, and visual aids are educational materials that should be created to standardize the content which is provided to two patients to achieve consistency and quality across the interventions.

Boosted Access and Funding: Healthcare policies and insurers should support such programs to make them available to as many of the patients as possible. It may also be possible to extend and maintain these interventions by establishing a payment system rewarding community pharmacists to visit patients at home or reimburse models.

Evaluation and Expansion: It should be further assessed what the long-term effect of home-based inhaler education is on the control of asthma, use of healthcare, and the quality of life of the patient. It may also be beneficial to expand into the other chronic illnesses, e.g. chronic obstructive pulmonary disease (COPD).

Finally, pharmacist-delivered inhaler education at home is a highly effectual, scalable, and patient-centered intervention to enhance control of asthma. Primary care integration of these interventions can provide significant patient benefit, and make significant improvements to the overall healthcare burden.

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Conflicts of interest

The authors have no conflicts of interest to declare

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