

EDUCATION

Impact of a Network System for Providing Proper Inhalation Technique by Community Pharmacists

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Objective. The availability of many types of inhalers in the treatment of asthma has resulted in a wide range of prescription choices for clinicians. With so many devices available, however, there is some confusion regarding their proper use among both medical staff and patients. Since 2007, Kitano Hospital and Kita-ku Pharmaceutical Association, Osaka, Japan, have provided a network system for delivering instruction on correct inhalation technique through community pharmacists. We examined the clinical effects of this network system. **Methods.** Our measurements included the manner in which community pharmacists instruct patients with asthma, the frequency of asthma exacerbations, patients' adherence to inhalation therapy using a 5-point Likert scale questionnaire, and patients' health status both prior to this system and at 4 years after. **Results.** Usable information was obtained from 53 community pharmacists and 146 patients with asthma at baseline and from 60 community pharmacists and 148 patients at 4 years. When compared with baseline values, significant improvement was found in pharmacists' instruction and significant decreases were observed in the frequency of asthma exacerbations (1.4 ± 1.6 vs. 1.0 ± 1.4 times/yr, $p = .042$) and emergency room visits (0.5 ± 1.0 vs. 0.2 ± 0.5 times/yr, $p = .004$). Adherence to the inhalation regimen significantly increased (4.0 ± 0.7 vs. 4.2 ± 0.8 , $p = .041$), but health status was unchanged. **Conclusions.** Our network system may improve asthma control and adherence to inhalation regimens.

Keywords adherence, asthma, asthma control, education, quality of life

INTRODUCTION

Currently, more than 10 types of inhalers are available for the treatment of asthma. The availability of so many types of inhalers has resulted in a wide range of prescription choices for clinicians. With so many devices available, however, there is some confusion regarding their proper use among both medical staff and patients. In practice, many patients make a number of critical errors in using an inhaler device. A poor technique can markedly reduce the proportion of drug that reaches the lung, resulting in a poor outcome of asthma therapy in terms of not only suboptimal asthma control, but also an increased risk of emergency department visits and death due to asthma exacerbations (1–3). Instruction on inhalation technique results in a more efficient use of inhalers (4–6). After the initial instruction, however, patients' inhalation technique quickly declines unless further instruction is delivered (7), suggesting that instruction on inhalation technique needs to be repeated at regular intervals. Repeated instruction on correct use of inhalers affects both inhalation technique and clinical outcomes (7, 8). Our previous cross-sectional study showed that repeated instruction on inhalation technique contributes to adherence

to therapeutic regimens and found a significant positive relationship between adherence to the inhalation regimen and asthma control and quality of life (QOL) (8).

Currently, asthma management programs (including instruction on correct inhaler technique) are mainly provided in a hospital setting and/or by physicians. Community pharmacists also are in a position to provide repeated instruction, as they can engage the patient every time an inhaler is dispensed. Several pharmacy-based asthma care models have been implemented, and a variety of positive outcomes have been demonstrated (7, 9, 10). This study evaluates the long-term effects of a network system for delivering proper inhalation technique through community pharmacists and sharing the information concerning patients' inhaler use among prescribers and community pharmacists.

MATERIAL AND METHODS

Study Subjects

A total of 176 consecutive outpatients with asthma at baseline were recruited from the respiratory clinic of Kitano Hospital Medical Research Institute, Osaka, Japan; 173 of them were available for the 4-year assessment. Asthma was diagnosed according to the 2004 version of the Global Initiative for Asthma guidelines (11). Subjects were eligible for participation in the study if they met the following criteria:

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- (1) age of 16 years or older;
- (2) regular clinic visits every 1–3 months;
- (3) asthma diagnosed by a respiratory physician;
- (4) prescribed inhaled medicines (inhaled corticosteroids (ICS) or both ICS and long-acting β_2 -agonist) for at least 12 months; and
- (5) no change in asthma medication for 3 months.

Informed consent was obtained from all participants, and the research protocol was approved by the institutional review board of Kitano Hospital Medical Research Institute.

Study Design

A prospective pre-post non-equivalent group study was carried out between November 2006 and December 2010. In April 2007, we implemented a network system of community pharmacists instructing patients on correct inhalation technique. The information concerning patients' inhaler use was shared among prescribers and community pharmacists. The clinical effects of this network system on the manner in which community pharmacists instruct patients with asthma, the frequency of asthma exacerbations, patients' adherence to inhalation therapy, and health-related quality of life (HRQL) were examined at baseline and at 4 years.

Methods

A network system for providing proper inhalation technique (NEPPIT) has been in place since April 2007 through cooperation between Kitano Hospital and Kita-ku Pharmaceutical Association, which consists of 81 community pharmacies in the northern area of Osaka, Japan. The main component of this system is an educational program for community pharmacists, aimed at providing instruction on correct and consistent inhalation technique to patients. Through the program, all pharmacists received general information regarding the pathophysiology of asthma and chronic obstructive pulmonary disease (COPD), inhaled medication such as ICS and β_2 -agonists, adherence to inhalation therapy, and inhalation technique. This educational program emphasized correct inhaler technique through lectures, role playing, and skills training for each inhaler device. We provided the participants with materials for instruction such as training inhalers with placebo and checklists for the inhalation technique of each device. After training, they were able to demonstrate and give instruction on the correct inhaler technique for all of the devices. Subsequently, they were certified and registered as inhalation technique instructors and were encouraged to instruct patients on proper inhaler technique at regular intervals (at least every 6 months). Certified pharmacists were asked to instruct patients in a private or semi-private area. To keep up with the new trends in inhalation therapy, the validity of this certificate was limited to 2 years and certified pharmacists were encouraged to attend our further educational program within 2 years.

Asthma patients in the study were provided a pocket-sized booklet with detailed instructions on correct inhaler use and answers to common questions and concerns that patients have about using inhalers. Prescribers and

community pharmacists asked patients to carry this booklet and show it to pharmacists for the purpose of checking their inhaler technique. Certified pharmacists were to check the patients' inhalation technique at regular intervals and report status to prescribers using a checklist and by entering comments in the booklet.

Outcome Measurements

Questionnaire for Community Pharmacists. Community pharmacists were asked to complete the following questionnaire before the program started and 4 years after.

- (1) Does your pharmacy always have device trainers and demonstrators to instruct patients on proper inhalation technique?
- (2) Does your pharmacy always have spacers for metered-dose inhalers (MDI)?
- (3) How many patients do you instruct in inhalation technique in a month?
- (4) Have you been giving inhalation technique instruction at the initial prescription? If yes, how? Multiple answers [verbal instruction, demonstration, written instruction (i.e., manufacturer's pamphlet), other methods of instruction] were acceptable.
- (5) Have you been giving repeated instruction after the initial prescription?

Asthma Exacerbations. Information on the frequency of asthma exacerbations and emergency room (ER) visits was obtained from the patient's medical record for the 12 months preceding the questionnaire administration. Exacerbation of asthma was defined as the presence of at least one of the following features (8, 12): increase in symptoms such as dyspnea, wheezing, and cough; increased use of inhaled β_2 -agonists; and the need for a short course of oral corticosteroids.

Self-Reported, Medication-Adherence Questionnaire for Patients with Asthma. The Self-Reported Medication-Adherence Questionnaire was administered as described previously (8, 13–15). This adherence questionnaire is an adaptation of a scale originally developed by Morisky and colleagues (16, 17). This scale included four questions concerning the use of inhaled controller medications.

There were five response options for each question. During the last 3 months have you

- (1) Been careless about using your inhaler?
- (2) Ever forgotten to use your inhaler?
- (3) Ever stopped using your inhaler because you felt better?
- (4) Used your inhaler less frequently than your doctor prescribed because you felt better?

Responses were

Most of the time	Some of the time		None of the time	
1	2	3	4	5

The self-reported adherence score was calculated from the mean score of the responses to the four questions (8, 13–15). Increases in the scores reflect better adherence to the inhalation regimen; missing responses were excluded from analysis. Previous research has shown that self-reported adherence using this questionnaire correlates well with adherence determined by pharmacy claims data (13). Pharmacy refill data were not used because most of our patients have been recommended by the doctors to increase the dosage under certain conditions, for example, if they had a cold, which would result in oversupply or false satisfactory adherence.

Health-Related QOL Questionnaire. The St. George Respiratory Questionnaire (SGRQ) is designed to measure the impact of chest disease on HRQL. Responses to the 50 items can be aggregated into a total score with three sub-scores for symptoms, activities, and impacts, ranging from 0 to 100.

Symptoms: measuring distress caused by respiratory symptoms;

Activity: measuring the effect of disturbances to mobility and physical activity; and

Impact: quantifying the psychosocial impact of the disease (18–20).

Increases in the scores reflect worsening of health status. The Japanese version of the SGRQ has been validated (21).

Analysis

Values are expressed as mean ($\pm$ SD). The data were analyzed using Stat View 5.0 (SAS Institute, Cary, NC, USA). Comparisons between groups were made with the Mann–Whitney *U*-test, Fisher's exact probability test, or the chi-square test for univariate analysis. A value of $p < .05$ indicated statistical significance.

RESULTS

Effects of Our Network System on Community Pharmacists

A total of 253 pharmacists from 56 of 81 pharmacies in Kita-ku Pharmaceutical Association, Osaka, Japan, participated in our educational program during the 4-year survey period. A questionnaire survey was performed for 53 pharmacists (33 pharmacies) at baseline and 60 pharmacists (34 pharmacies) at 4 years. The effects of our network system on community pharmacists are shown in Table 1. At 4 years, the percentage of pharmacies always stocking device trainers and demonstrators to objectively check and maintain the correct inhalation technique (54–85.3%, $p = .003$) or spacers for MDI (60.6–94.1%, $p = .004$) was significantly higher than at baseline. Our system had a significant effect on the manner of pharmacists' giving instruction on inhalation technique to patients. As compared with baseline values, frequency of giving instruction on inhalation technique to patients significantly increased

TABLE 1.—Effects of the educational program on community pharmacists.

	Baseline	4 years	<i>p</i> -value
Community pharmacists	53	60	
No. of pharmacies represented	33	34	
No. of pharmacies stocking device trainers and demonstrators	18 (54.5%)	29 (85.3%)	.003
No. of pharmacies stocking spacers for MDI	20 (60.6%)	32 (94.1%)	.0004
Frequency of inhaler technique instruction (/pharmacist/month)	2.0 $\pm$ 1.7	7.0 $\pm$ 10.1	.001
No. of pharmacists giving manufacturer's pamphlet alone or no instruction	31 (58.5%)	11 (18.3%)	<.001
No. of pharmacists giving verbal instruction and demonstrations on inhalation technique at initial prescription	23 (43.3%)	44 (73.3%)	.0003
No. of pharmacists giving repeated instruction on proper inhalation technique	23 (43.3%)	48 (80.0%)	<.001
Frequency of patients' pharmacy visit (/yr) ^a	6.9 (4–23)	6.6 (4–21)	.37

Notes: MDI, metered-dose inhaler.

^aMean (range).

(2.0 $\pm$ 1.7 to 7.0 $\pm$ 10.1, $p = .001$), and proportion of pharmacists providing a demonstration and verbal teaching of inhalation technique was significantly higher (43.3–73.3%, $p = .0003$) as compared to those giving written instruction alone or no instruction (58.5–18.3%, $p < .001$). The number of pharmacists giving repeated instruction on correct inhalation technique to patients after initial instruction was also higher at 4 years than at baseline (43.3–80.0%, $p < .001$).

Comparison of Asthma Patients' Characteristics at Baseline and at 4 Years

Of the 176 patients at baseline and 173 at 4 years, 146 (83%) and 148 (86%), respectively, responded with usable information. There were no differences in age and gender between respondents and non-respondents in each survey period (data not shown). Respondents tended to be middle-aged and female at both study points. No differences were found in any of the items measured by this questionnaire (Table 2). At 4 years, 91.2% of patients visited the NEPPIT-certified community pharmacies at regular intervals and the remaining patients visited other pharmacies.

Comparison of Outcome Measures at Baseline and at 4 years

Four years after the start of our network system, there were significant decreases (vs. baseline) in the frequency of asthma exacerbations ($p = .04$) and ER visits ($p = .004$), and a significant increase in the proportion of asthma patients adherent to inhalation therapy ($p = .04$) (Table 3). There were no significant differences in SGRQ scores.

TABLE 2.—Comparison of patient characteristics at baseline and at 4 years.

	Baseline	4 years	<i>p</i> -value
Number of patients	146	148	
Age (yr)	57.0 (15.4)	58.7 (14.5)	.40
Male/female	58/88	58/90	>.99
Asthma severity			.94
Mild	43 (29.5%)	45 (30.4%)	
Moderate	71 (48.6%)	73 (49.3%)	
Severe	32 (21.9%)	30 (20.3%)	
Duration of asthma (yr)	15.4 (13.9)	13.2 (14.0)	.08
Daily dose of ICS (μg)	840 (430)	810 (410)	.55
Type of inhaler (MDI:DPI: MDI+DPI)	38:87:21	44:93:11	.14
Frequency of clinic visits (/yr)	6.9 (3.6)	6.6 (3.4)	.37
No. of patients regularly visiting a certified pharmacy	—	135 (91.2%)	

Note: ICS, inhaled corticosteroid expressed in equivalent doses of beclomethasone dipropionate; MDI, metered-dose inhaler; DPI, dry powder inhaler.

TABLE 3.—Comparison of outcome measures in asthma patients at baseline and at 4 years.

	Baseline	4 years	<i>p</i> -value
Number of patients	146	148	
Frequency of exacerbations (/yr)	1.4 (1.6)	1.0 (1.4)	.042
Frequency of ER visits (/yr)	0.5 (0.9)	0.2 (0.5)	.004
Overall mean adherence score	4.0 (0.7)	4.2 (0.8)	.041
SGRQ scores			
Symptoms (0–100)	38.3 (25.1)	35.9 (18.6)	.80
Activities (0–100)	26.3 (21.9)	23.4 (23.8)	.16
Impacts (0–100)	20.3 (16.4)	19.1 (16.2)	.53
Total (0–100)	26.2 (16.9)	24.1 (17.3)	.29

Note: ER, emergency room; SGRQ, St. George Respiratory Questionnaire.

Comparison of Patient Characteristics and Outcomes Between Asthma Patients Who Visited a Certified Pharmacy and Those Who Did Not (at 4 Years)

There were no significant differences in patient characteristics and outcomes between those who visited a certified pharmacy ($n = 135$) and those who visited a usual care pharmacy ($n = 13$). There was a trend toward a lower frequency of asthma exacerbations and higher medication adherence in the patients who visited a certified pharmacy as compared with those who did not (Table 4).

DISCUSSION

A prospective study with measurements at baseline and after 4 years was performed. Our NEPPIT for community pharmacists resulted in a qualitative and quantitative change in regard to pharmacists' instruction to asthma patients, and subsequently, a possible reduction in the frequency of asthma exacerbations and ER visits, and an improved adherence to inhalation therapy.

Our study revealed the actual status of inhalation technique instruction that asthma patients were receiving from community pharmacists. Surprisingly, at baseline, the

TABLE 4.—Comparison of asthma patient characteristics and outcomes at 4 years between patients visiting the certified pharmacy and those visiting the usual care pharmacy.

	4 years		<i>p</i> -value
Community pharmacy	Certified	Usual	
Number of patients	135	13	
Age (yr)	59.0 (14.3)	57.3 (15.1)	.63
Male/female	53/82	5/8	>.99
Asthma severity			.11
Mild	43 (31.9%)	2 (15.4%)	
Moderate	63 (46.7%)	10 (76.9%)	
Severe	29 (21.5%)	1 (7.7%)	
Duration of asthma (yr)	12.7 (13.2)	14.8 (17.5)	.58
Daily dose of ICS (μg)	820 (420)	750 (290)	.75
Type of inhaler (MDI: DPI: MDI+DPI)	38:87:10	6:6:1	.38
Freq. of clinic visits (/yr)	6.9 (3.8)	6.0 (1.9)	.68
Freq. of exacerbations (/yr)	0.96 (1.3)	1.6 (1.5)	.09
Freq. of ER visits (/yr)	0.15 (0.49)	0.24 (0.63)	.39
Overall mean adherence score	4.2 (0.7)	3.9 (0.8)	.08
SGRQ scores			
Symptoms (0–100)	35.6 (18.3)	40.5 (20.7)	.30
Activities (0–100)	22.6 (22.6)	25.6 (25.6)	.64
Impacts (0–100)	17.9 (16.5)	24.0 (13.5)	.06
Total (0–100)	23.3 (17.2)	27.1 (15.6)	.29

Note: ICS, inhaled corticosteroid expressed in equivalent doses of beclomethasone dipropionate; MDI, metered-dose inhaler; DPI, dry powder inhaler; ER, emergency room; SGRQ, St. George Respiratory Questionnaire.

materials for instruction such as device trainers and placebo inhalers were not sufficient for pharmacies to provide the patients with correct inhaler technique. Furthermore, more than half of the pharmacists gave patients either medication leaflets alone or no instruction at all. Unfortunately, previous studies have shown that few pharmacists educate patients on the correct usage of inhalers and many pharmacists are not able to demonstrate the correct inhalation technique, especially in newer devices (22, 23). Our NEPPIT system improved the quality and quantity of pharmacists' instruction. Four years after the introduction of our network system, more pharmacies were stocking the materials for instruction, the frequency of pharmacists' instruction on inhalation therapy markedly increased, and the manner in which instruction was provided improved.

Improvements in community pharmacists' instruction seemed to be reflected in improved clinical outcomes in asthma patients. After the introduction of our network system, we found significant reductions in the frequency of asthma exacerbations and ER visits, and significant improvement in adherence to inhalation therapy. While interpreting these positive results, some possible explanations are considered. First, the method of educating the patient about inhaler technique may have affected asthma control. In our study, after 4 years the population of pharmacists who provided patients with a manufacturer's leaflet alone significantly reduced. Conversely, those who give verbal instruction and physical demonstration significantly increased. A variety of educational techniques are used for asthma education in general. Several studies have shown that written instruction alone (such as

the manufacturer's pamphlet) is the least effective method and is inferior to verbal instruction, regardless of inhaler type (24–26). Verbal instruction and technique assessment are effective methods to achieve proper inhalation technique (24, 27). Correct inhalation technique may improve asthmatic status, resulting in heightening of the patients' motivation to adhere to the therapeutic regimen (28, 29).

Second, repeated instruction by community pharmacists may play a key role. Instruction on inhalation technique apparently results in more efficient use of inhalers (6, 7), but the instruction must be repeated and the results checked at regular intervals (7). Patients who receive inhalation instruction at least once more after the initial instruction show a better inhalation technique as compared with those given a single inhalation lesson at the time they receive their prescription (30). It has been shown that repeated instruction on correct inhaler use affects not only the inhalation technique but also the clinical outcomes (8, 25). Our previous cross-sectional study demonstrated that asthma patients who received repeated instruction on inhalation technique by physicians showed better medication adherence scores and better medication adherence status, resulting in significantly less asthma exacerbations and better health status (8). In the present study, we confirmed these positive results in a prospective fashion, although health status remained unchanged.

A majority of publications in the past decade have reported that well-trained pharmacists could enhance the therapeutic outcomes, including the clinical, economic, and humanistic outcome measures, in patients with asthma (7, 9, 10, 31–34). Several well-designed studies have investigated the effect of pharmacist care for asthma patients (7, 9, 10, 35, 36). For example, Barbanel et al. conducted the first randomized trial to demonstrate the success of self-management advice from a community pharmacist with weekly telephone follow-up for 3 months (35). Mehuys et al. reported that community pharmacist intervention according to asthmatic status, focusing on promoting the optimal use of asthma medication (during a 6-month follow-up period), improved asthma control, inhalation technique, and medication adherence in adult asthma patients. They reported that patients in the intervention arm were about 15% more adherent to the therapeutic regimen than were patients receiving usual care (10). In another study, Basheti et al. demonstrated that a simple educational intervention for asthmatic patients regarding inhalation technique (2.5 minutes/patient/visit), repeated every 6 months, resulted in improvement of peak expiratory flow variability and QOL, as well as in improved inhaler technique. However, these outcomes tended to decline over the 3 months during which no further education was given (7). Thus, the short-term effectiveness of an educational program for community pharmacists in improving clinical outcomes of asthmatic patients has been established. However, sustained long-term effects remain a challenge. Bunting and Cranor reported the results of a 5-year study on the long-term outcomes of an educational program provided by community and hospital pharmacists and a trained educator, in

207 asthma patients. They demonstrated that an educational intervention taking 30 minutes every 3 months resulted in improved pulmonary function, reduced asthma severity, better QOL, and less medical costs (37). In general, the list of components of an effective education for inhalation therapy is dauntingly long, and many medical staff members may fail to provide inhaler technique instruction because of a perception that it takes a long time. Although our educational program for community pharmacists is a simple one focused on “providing patients with correct inhaler use” and “checking patients' inhalation technique at regular intervals,” we confirm that its clinical impact and effect lasted for 4 years. Furthermore, during the 4-year study period, the community pharmacists who attended our educational program were from 70% of the community pharmacies in the northern area of Osaka. At 4 years, 91% of the asthma patients regularly visited these certified pharmacies. In these respects, our educational program may be as feasible as well as a practical model which can be applied to broader populations. Recently some medication-dispensing systems that have removed the pharmacist from patient contact, such as mail order pharmacies, drive-through pick-up window services, and technicians' dispensing of medications, were introduced to meet patients' demands for convenience and efficiency. However, such systems may not always apply to patients with conditions like asthma or COPD who require appropriate education in the correct handling of inhaler devices and need frequent follow-up to ensure that inhalers are used correctly.

Our network system was not sufficiently intensive to influence psychological factors, which in turn might have possibly influenced SGRQ scores. Although a more intensive program such as asthma self-management and pulmonary rehabilitation could have influenced humanistic measures like SGRQ, the workload and the limited time spent with each patient may not be practical for community pharmacists.

The present study has several limitations. First, patients were not randomized to usual or interventional care groups. In that setting, pharmacists would have had to follow up control subjects as well as intervention subjects and change their method of instruction accordingly. Although randomized clinical trials provide the least-biased assessment of program effectiveness, their application to actual practice is often uncertain. Even without randomization, it would make the study stronger to simply have a comparable group who did not go to certified pharmacists. Second, any pre–post study includes the risk of selection bias and threat of regression to the mean. Our study participants may not be fully representative of the overall general population of asthma patients and community pharmacists. There may be a selection bias in that only the most motivated pharmacists and patients were enrolled in the study. The threat of regression to the mean is an alternative explanation for the decreased ER visits and exacerbations of asthma patients. To address this, we examined the background of the patients who visited the certified pharmacy and those who did not. There was a

trend toward a lower frequency of asthma exacerbations and higher medication adherence in the patients who visited a certified pharmacy as compared with those who did not. However, that interpretation must be made cautiously due to the small number of the usual care patients and the subsequent lack of power. Third, we utilized a booklet to exchange information concerning patients' inhalation technique between prescribers and community pharmacists. Many patients did not always carry their booklet, suggesting that the improvement observed in clinical outcomes was related to the educational program for community pharmacists rather than to the sharing of information on patients' inhaler techniques and habits. Finally, during our study period, new asthma medications such as a combined inhaler device of ICS and β_2 -agonist, and an MDI for once-a-day administration of ICS have appeared on the market in Japan and may have affected patients' adherence to their therapy regimen. These drugs were prescribed to 21 (14%) of the 148 patients at 4 years. However, the treatment outcomes in patients, including adherence to inhalation therapy, frequency of asthma exacerbations and ER visits, and SGRQ scores, did not differ between patients who were given combination drug or MDI for once-a-day administration and those treated with other inhalers (data not shown).

In conclusion, this study demonstrated that our network system, including an educational program for community pharmacists to provide repeated instruction on correct and consistent inhalation technique to asthma patients, was effective for improving the pharmacists' instruction on inhalation technique and may have contributed to better asthma management outcomes. Our network system may be feasible in a practical setting and might be applicable to broader populations. Further comparative studies between communities are required to confirm the validity of this educational program for community pharmacists.

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DECLARATION OF INTEREST

The authors declare no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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