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EFFECT OF SIMULATION IN TRAINING PHARMACY STUDENTS ON CORRECT INHALER TECHNIQUE

Abstract:

Objectives: To assess the effect of engaging pharmacy students in a simulated situation in which they counsel real asthma patients on their inhaler technique for Dry Powder Inhalers (Accuhaler and Turbuhaler) and Metered Dose Inhaler (MDI).
Methods: This was a single blinded repeated measures parallel group design study, conducted in 2011, involving all 5th year students enrolled in the Clinical Pharmacy and Therapeutics course unit. All students were assessed on their inhaler technique at baseline based on previously published checklists for Accuhaler (ACC, 9 steps), Turbuhaler (TH, 10 steps) and MDI (9 steps). Students were randomly allocated to 2 Interventions, Intervention A 'supervised hands-on education in groups + Peer assessment/education'; and Intervention B 'supervised hands on education in groups + Peer assessment + simulated scenario counseling a real asthma patient. Patient counseling involved students in groups of 6, assessing three asthma patients on inhaler technique (each on one of the devices) then delivering an education (verbal information + physical demonstration) till the patient performed all steps in each checklist correctly. Student assessments on inhaler technique skills were repeated one week post-intervention.
In addition, this is the first study to investigate students' perceived barriers to demonstrating correct inhaler technique and future performance of their pre-education role in this area.
Results: At baseline, none of the students in Intervention A (n =54) and Intervention B (n =55) performed correct technique for the three devices. One week following intervention, a significantly higher proportion of students in Intervention B demonstrated correct technique for the DIS, TH and MDI (60.0%;70.9%;69.1%) vs. Intervention A (27.8%;40.7%;42.6%, $p<0.005$,Chi Square test).
Barriers perceived by the students towards their role in this area included mostly lack of practical training during undergraduate studies and lack of knowledge about the importance of this topic. No significant difference between the two Interventions was found with regards to the reported perceived barriers.
Conclusion: Engaging pharmacy students with real asthma patients in a simulated scenario involving correct inhaler technique education can result in better student inhaler technique demonstration skills. Engaging pharmacy students in targeted practical training in this area would fulfill the needed highlighting of its importance and provide the skills required.

Keywords:

Simulation, pharmacy education, inhaler use

JEL Classification: I20, I21, I23

Introduction and literature review

Asthma is affecting 30 million people around the world.(Global Initiative for Asthma (GINA) - Global Strategy for Asthma Management and Prevention - Revised Workshop Report 2012) Although numerous inhalers are available on the market for the management of this disease, to achieve effectiveness of this therapy, correct inhaler technique is vital.(Basheti et al. 2007; Basheti et al. 2008)

Metered dose inhalers (MDIs) and Dry powder inhalers (DPIs) are two forms of the inhaler therapy available for asthma. Diskus (DIS) and Turbuhaler (TH) are the most commonly used out of the DPIs.(Roche and Huchon 2000) Incorrect inhalation technique is common for the MDIs (Guidry et al. 1992; Erickson et al. 1998) and the DPIs.(Basheti et al. 2007; Basheti et al. 2008) In Jordan, majority of patients and pharmacists failed to demonstrate the correct use of these devices.(Khassawneh et al. 2008; Basheti et al. 2011) Similar results were found around the world.(Fink 2005; Basheti et al. 2011) Incorrect inhaler technique can lead to sub-therapeutic doses of the medication and suboptimal benefits from the therapy (Giraud and Roche 2002) leading to increased emergency visits and higher costs.(Giraud and Roche 2002; Fink and Rubin 2005)

Pharmacists have shown to have positive effects on asthma patients' clinical and humanistic outcomes following delivering education.(Basheti et al. 2009) Patients come back to the pharmacy for their inhaler refill (repeat prescription), (Yousef et al. 2008) without doctor's prescription, giving the pharmacist the opportunity to assess and counsel on inhaler technique use on continuous basis.

But pharmacists are not fulfilling their role when it comes to patient education on inhaler technique. lack of knowledge and skills required by the pharmacists to educate patients on correct inhaler technique has been identified as one main barrier (Henry et al. 1993), (Kesten et al. 1993), (Pronk et al. 2002). It has been suggested that a lack of knowledge naturally decreases confidence, and prevents pharmacists from delivering education (Vainio et al. 2001). In addition, pharmacists have been found to be unaware of the importance of repetitive counseling on inhaler technique for asthma patients (Erickson SR 2000). Hence, they may only deliver inhaler technique education to their patients when they are first dispensed an inhaler (Wiederholt et al. 1992), (Schommer and Wiederholt 1994), (Hibbert 2000), (Basheti et al. 2005). Another related barrier is pharmacists' belief that not all patients are in need of inhaler technique education. They believe that older patients and younger children, patients prescribed with newly introduced inhalers, spacer devices and high dose corticosteroid inhalers need more help in inhaler education (Hibbert 2000). Therefore, pharmacists are aware of special needs groups, but do not understand the nature of the problem in the general asthma community.

Pharmacists' lack of motivation to deliver inhaler technique education is another important issue and could be a clear barrier to patient counseling. One community pharmacy study shed light on

the fact that community pharmacists are not willing to participate in inhaler technique educational interventions (Wilcock 2002). In addition, it has been acknowledged that the content and amount of information provided by pharmacists to their patients is directly dependent on their motivation to deliver that counseling (Mason and Svarstad 1984), (Vainio et al. 2001).

Lack of inhaler placebos at the community pharmacies present another barrier, as pharmacists require placebos in order to be able to demonstrate to their patients correct inhaler technique (Osman et al. 1999).

Other barriers hindering pharmacists from fulfilling their role in inhaler technique education may include business pressures, perceived high implementation costs, time constraints, lack of private counseling areas in the pharmacy, limited well trained support personnel, profit driven rather than patient-care oriented practice, pharmacists' belief that patients require product oriented image and fast service and the perception of the pharmacists that their advice may not be welcomed by their patients (Raisch 1993), (Odedina et al. 1995), (Osman et al. 1999), (Hibbert 2000), (Saini et al. 2001), (Pronk et al. 2002). Potential damage to the inter-professional relationship between pharmacists and physicians could also prevent the pharmacists from delivering this role, believing that delivering this type of service could lead to conflict (Hibbert 2000).

For the majority of pharmacists, their first inhaler educational experience is in pharmacy schools. (Toumas et al. 2009) At Applied Science university in Jordan, this education is delivered to last year students during the Clinical Pharmacy and Therapeutics II course unit. As a part of the objectives of this course unit, students practice the use of the gadgets for different therapeutic areas during the tutorials every week.

At Applied Science University (ASU), as educators we know that a disconnect still exists between the tutorial room and the real patient-pharmacy environment. All bachelor of pharmacy students used to take the clinical practice course in the second semester of their fifth-year (final year), consistently expressed dissatisfaction with the lack of actual practice experience during this course and the undergraduate studies in general. Hence, the instructors decided to incorporate new educational methodologies into this course.

With regards to demonstrating the correct use of the inhaler devices, different educational strategies have been trialled in the pharmacy schools to enable students have the needed skills, from physical demonstration training, to hands-on educational workshops (Lee-Wong and Mayo 2003) and computer based learning tutorials.(Toumas et al. 2009) However, none of the mentioned strategies gave the results needed, namely pharmacists competent in patient training.(Toumas et al. 2009).

Health care professionals providing education to asthma patients require training to acquire and maintain the skills necessary to deliver education. The provision of this training is important and can be achieved through different ways to achieve proficiency (McDonald and Gibson 2006).

Many studies have investigated different methods of educating health care professionals on correct inhaler technique (O'Connell et al. 1992), (Verver et al. 1996), (Rebuck et al. 1996), (Jackevicius and Chapman 1999), (Cain et al. 2001), (Lee-Wong and Mayo 2003). The methods used included hand-outs, videotapes on correct inhaler technique, and hands on experience with placebo inhalers (O'Connell et al. 1992). Other more intense methods involved a brief instructional one-on-one training session on the proper use of the inhalers until optimal use was achieved (Rebuck et al. 1996), (Cain et al. 2001), (Lee-Wong and Mayo 2003).

Time of these sessions ranged between 1 hour "hands-on teaching session" (Jackevicius and Chapman 1999), to two 45 minute (small group sessions) (Amirav et al. 1995) to 2.5 hours (Verver et al. 1996).

Assessments were repeated at one to three months after the education was delivered and results showed significant improvement in inhaler technique in the majority of studies (O'Connell et al. 1992), (Amirav et al. 1995), (Cain et al. 2001), (Lee-Wong and Mayo 2003).

Looking more closely at different modes used in these interventions, O'Connell et al (O'Connell et al. 1992) educated nurses and trained medication aids caring for elderly residents in nursing homes on correct inhaler technique. The education involved a lecture, a videotape and practice with inhalers. Education resulted in a significant improvement in the verbalization of correct inhaler technique immediately after the program. Two months after the education, participants still showed significant improvement in inhaler technique demonstration when compared with baseline, however there was a trend towards a decrease in the technique demonstration with time indicating the importance of repeating the education periodically (O'Connell et al. 1992).

Amirav et al (Amirav et al. 1995) developed, implemented, and evaluated the effects of a physician-targeted educational program on inhaled therapy. Physicians were provided with a summary of theoretical and practical information and with devices for practice (a placebo pMDI, InspirEase and AeroChamber holding chambers, and the AeroChamber device with mask). Physicians attended two sessions where each session included review of an educational monograph, demonstration of proper technique and practice with the different devices. Physicians were assessed on their inhaler technique (using a checklist) and theoretical knowledge (using a 25 multiple-choice questionnaire). After the program, physicians significantly improved in their inhaler technique skills and theoretical knowledge.

Rebuck et al (Rebuck et al. 1996) educated post graduate physicians on correct inhaler technique in one brief structured educational intervention with hands-on education. Results revealed a significant improvement in the inhaler technique scores. However, 8 months after the education, 59% of the physicians were found to demonstrate poor technique. This again highlighted the importance of periodic re-training on correct inhaler technique in order to maintain effective patient educators (Rebuck et al. 1996). This was further highlighted by Reznick et al (Resnick et al. 1996) who delivered education on correct inhaler technique to paediatric house-staff physicians through a single inhaler training session. Technique was also found to deteriorate after 2 months.

Jackevicius and Chapman (Jackevicius and Chapman 1999) compared a 1 hour hands-on individual-coaching session with feedback (an intense education) to written material describing inhaler use. Results revealed that directly after the intervention, the intervention group improved significantly more than the control group for all devices. This improvement was short lived however, as after three months of education, scores in both groups declined with the intervention group being slightly and not significantly better than the control group. Erickson et al (Erickson et al. 2003) compared two modes of education on inhaler technique to pharmacy students and found that the computer-based tutorial or the lecture-based groups had significantly greater knowledge of pMDI technique and could better assess incorrect technique when presented with a standardised inhaler-use scenario than a control group (no educational intervention on pMDI technique was delivered to the control group). Lee-Wong and Mayo (Lee-Wong and Mayo 2003) also compared two modes of education on inhaler technique to doctors and found that one-on-one training was far more effective than the use of lecture formats and handout information.

From the above studies, it can be concluded that it is important to use a one-on-one training session with hands on education when it comes to educating health care professionals on correct inhaler technique. Inhaler technique competency also needs to be assessed and corrected after education on a regular basis to keep it optimal.

Simulation have been used in the health sciences field before, and have shown good results in optimizing students'' skills and knowledge.(Okuda et al. 2009; Clever et al. 2011) Students must learn to be systematic in their approach to patient counselling, and develop skills needed to deliver optimal education. A major challenge for medical undergraduates is the application of theoretical knowledge to the management of patients. Simulation-based workshops are a popular and effective method of continuing medical education for medical specialists and trainees. (Weller et al. 2003) Simulation has been widely used in undergraduate medical education and many simulation centres, found worldwide, are involved in undergraduate education(Morgan and Cleave-Hogg 2002). Although student opinion of simulation-based teaching is enthusiastic,(Gordon et al. 2001) evidence showing improved learning outcomes is incomplete and the monetary cost is very high (Girard and Drolet 2002).

No previous study has been conducted to examine the effectiveness of simulation in the world of pharmacy. The aim of this study is to evaluate student perceived barriers preventing them from demonstrating the correct use of the inhaler devices following their current in-school education. Secondly, to evaluate the effect of simulation on students' inhaler technique demonstration skills for the three inhaler devices MDI, DIS, and TH.

Methods

This was a repeated measures parallel group design study and was approved by the Applied Sciences University Ethics Committee. It was conducted during the Therapeutic and Clinical

Pharmacy II tutorial classes in 2011. Study included all students enrolled in these classes in the 5th year of the ASU Bachelor of Pharmacy curriculum.

Students were randomly assigned to 6 tutorials, 3 hours each, conducted throughout the week. Each student attended one of the tutorial classes, which was held for 10 weeks (one semester). Over this 10-week period, tutorials were conducted in respiratory health, cardiovascular disease, endocrinology, infectious diseases, and in the areas of communication, barriers to communication, counseling, and patient perspectives to illness.

Each tutorial was facilitated by one tutor (community pharmacist) and one lecturer (IB, PhD in Clinical Pharmacy and expert in inhaler technique education. Problem-based learning approaches for pseudo cases, as well as appropriate hands-on and small group activities were used in the tutorials. Information regarding inhaler devices were given in written format and explained orally during the relevant topic tutorial. Students were evaluated through an end-of-semester oral assessment, multiple-choice and written examinations, and throughout semester tutorial participation.

Baseline assessment

Following completion of the therapeutic lecture on respiratory diseases, all students in the 5th year of the program were requested to participate in the study. Students received the package insert product information for each device and were given 15 minutes to read the written material provided in order to prepare to demonstrate their technique. At this stage, participants were not instructed on how or what to do with the placebo devices, nor how to use the written information provided. All students underwent baseline inhaler technique assessment for the three devices based on a specific previously published step checklist for each inhaler device (Table 1).

Assessment variability was avoided by having only one assessor for all students, pre and post-intervention.

Inhaler technique was assessed in the same way for the DIS, TH and MDI, however using 9/10-step checklists specific for each of the three inhalers (Table 1). Each item in the checklists represented one step associated with drug administration. Certain steps in the checklists for each inhaler were identified as 'Essential Steps', based on previous literature (van der Palen et al. 1998), (Basheti et al. 2005) and described as steps, if incorrectly performed, little or no medication would reach the lung.

Students were required to demonstrate (using placebo inhalers), how they would usually demonstrate to their patients their inhaler technique based on the following statement: "Show me how you would normally demonstrate the use of the DIS/TH/MDI to your patients, from the start to the finish. This placebo inhaler does not contain any active medication". Students received one point for each item (step) performed correctly. Based on this, students received a score out of "9 or 10", which related to the number of steps they were able to perform correctly.

'Correct DIS Technique' indicated a "score of 9/9". 'Correct TH Technique' indicated a "score of 10/10". 'Correct MDI Technique' indicated a "score of 9/9" (reported elsewhere).

'Correct DIS Essential Technique' indicated a score of 3/3. 'Correct TH Essential Technique' indicated a score of 4/4. 'Correct MDI Essential Technique' indicated a score of 3/3 (based on correctly performing the Essential Steps identified in the checklists as in Table 1).

Table1. Inhaler technique checklists

Nine-point Diskus Technique Checklist
Step. Description/Action
1. Open Inhaler*
2. Push lever back completely*
3. Exhale to residual volume
4. Exhale away from mouthpiece
5. Place Mouthpiece between teeth and lips
6. Inhale forcefully and deeply*
7. Hold breath for 5 seconds
8. Exhale away from mouthpiece
9. Close inhaler

Ten -point Turbuhaler Technique Checklist
Step. Description/Action
1. Remove the cap from the Inhaler*
2. Keep inhaler upright*
3. Rotate grip until a click is heard*
4. Exhale to residual volume
5. Exhale away from mouthpiece
6. Place mouthpiece between teeth and lips
7. Inhale forcefully and deeply*
8. Hold breath for 5 seconds†
9. Exhale away from mouthpiece
10. Close inhaler

Eight -point MDI Technique Checklist

Step. Description/Action

1. Remove mouthpiece cover and shake*
2. Hold inhaler upright
3. Exhale to residual volume
4. Keep head upright or slightly tilted
5. Place mouthpiece between teeth and lips
6. Inhale slowly and press canister*
7. Continue slow and deep inhalation*
8. Hold breath for 5 seconds
9. Close inhaler

*Described by van der Palenet all and Basheti et al as **Essential Steps**

†Note that this step is not included in the product insert, but appears in the Turbuhaler instruction on the Global Initiative for Asthma (GINA) Web site (http://www.ginasthma.com), and in the checklist published by van der Palen et al and Basheti et al. See text for m

Questionnaire completion

Following assessment, students were required to complete a questionnaires designed to collect data regarding their baseline demographic characteristics, their asthma knowledge, and perception regarding their role in patient education on inhaler technique, and barriers leading to their suboptimal demonstration skills. The asthma knowledge questionnaire (AKQ) comprised 18 true/false questions about asthma and its treatment, exactly as published by Kritikos et al,(Kritikos et al. 2005) with the exception of question 12 (about an Australia-specific incentivized General Practitioner program); the AKQ score is therefore presented as mean score (SD) out of 17. English is the official language of education for all healthcare professionals in Jordan; hence the questionnaire was administered in English (Appendix 1).

Appendix 1

Please fill in your responses to the following questions

1) Name ----------

2) Place of pharmacy training ----------

4) Hospital Ward (if you trained in a hospital)----------

5) Age ----------

6) Gender (male, female) ---------

Have you ever personally used any of the above devices?

( ) Yes ( ) No

If yes, what for?

_____

_____

7- How confident do you feel in assessing/counseling patients with asthma and COPD on correct inhaler technique for the following devices:

MDI Very confident ---- Confident--- Not confident

Turbuhaler Very confident ---- Confident--- Not confident

Accuhaler Very confident ---- Confident--- Not confident

Asthma Knowledge Questionnaire

Please answer each of the following questions with a 'True' 'False' response or 'Not sure' if you've never heard of the information included in each question.

1. Asthma results from complex interactions among inflammatory cells, mediators, and other tissues in the airway.
2. Asthma can be triggered by aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDS) such as Nurofen.
3. After the patient has recovered from a severe asthma attack, he/she should be maintained on the same dose of oral corticosteroid permanently to control his/her condition.
4. The aim of asthma management is to empower health care professionals to take control of patient's disease.
5. Asthma episodes are associated with variable airflow obstruction that is often reversible with treatment
6. All people with asthma should have a long-acting beta2 agonist for symptom relief.
7. The inflammatory process in asthma does not cause permanent changes in the airways.
8. Multiple actuations of aerosol devices before inhaling from a spacer will result in more effective medication delivery.
9. The most common problem with Dry Powder Inhaler (DPI) use is incorrectly coordinating drug release and inhalation
10. It is a good idea to give cough syrups during an asthma attack to treat asthma-related cough.
11. The genetic predisposition for the development of IgE-mediated response to common aeroallergens is not a predisposing factor for developing asthma.
12. Inhaler nonsteroidal anti-inflammatories such as sodium cromoglycate (Intal) are recommended as initial preventative therapy for children with frequent episodic to mild persistent asthma
13. In some people with asthma, excise induced symptoms may be the only

manifestation of asthma.

14. When oral corticosteroids are initiated in an acute asthma attack, inhaled corticosteroids should be ceased to avoid any complications.
15. Dry Powder Inhalers (DPIs) require higher inspiratory flow rates than meted dose inhalers (MDIs)
16. Only nebulizers can be used in children< 2 years who have asthma.
17. Unlike short acting bronchodilators, eformoterol (Foradile, Oxis) effects usually last for 2 days.

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Accuhaler checklist 

Step no.	Action	Performed correctly?	
		✓ YES x No	Notes
1	Open inhaler		
2	Push lever back completely		
3	Exhale to residual volume		
4	Exhale away from mouthpiece		
5	Mouthpiece between teeth and lips		
6	Inhale forcefully and deeply		
7	Hold breath for 5 seconds		
8	Exhale away from mouthpiece		
9	Close inhaler		

Turbuhaler checklist 

Step no.	Action	Performed correctly?	
		✓ YES x No	Notes

1	Remove the cap from the inhaler		
2	Keep inhaler upright		
3	Rotate grip anti-clockwise then back until a click is heard		
4	Exhale to residual volume		
5	Exhale away from the mouth piece		
6	Place mouth piece between teeth and lips		
7	Inhale forcefully and deeply		
8	Hold breath for 5 seconds		
9	Exhale away from mouth piece		
10	Close inhaler		

MDI checklist 

Step no.	**Action**	**Performed correctly?**	
		✓ **YES x No**	**Notes**
1	Remove mouthpiece cover and shake		
2	Hold inhaler upright		
3	Exhale to residual volume		
4	Keep head upright or slightly tilted		
5	Mouthpiece between teeth and lips		
6	Inhaler slowly and press canister		
7	Continue slow and deep inhalation		
8	Hold breath for 5 seconds		
9	Close inhaler		

The questionnaire was evaluated by 3 clinical pharmacists, and then by pharmacy students (n=15) to test for clarity of questions and provide face validity. Test-retest reliability was also assessed. The questionnaire was administered on two occasions to 15 randomly selected graduate pharmacy students. The second testing took place two weeks after the first one. Test retest reliability was acceptable (0.93, Spearman's correlation coefficient (r)).

Interventions

Half of the tutorial groups (three out of the six) were randomly allocated to Intervention A (n=54) and to Intervention B (n=55). Eighteen students were in each tutorial class, and were grouped into 5-6 student groups randomly. Students practices inhaler technique demonstration skills based on their grouping. Students in Group A performed 'hands-on education in groups + peer assessment/education'. The intervention took about 20 minutes in total, with group work taking 10 minutes, and peer work taking another 10 minutes. Hands on education in groups involved students practicing the use of each of the devices and demonstrating the technique to the rest of the group, under the full supervision of an instructor. Importance of each of the steps and its clinical effect using visual aids was explained to each group by the researcher. Peer work involved students taking turns in reviewing and correcting each other on the inhaler technique using the step checklist for each specific inhaler device. Group B performed 'hands-on education in groups + peer assessment/education' + standardized asthma patient review and education. The intervention took about 35 minutes in duration. Fifteen minutes was spent on assessing and educating a real asthma patient. Each student spent about 5 minutes with a patient using one of the three inhaler devices.

Asthma patients who were self-administered inhaler preventative therapy by DIS, TH or MDI were recruited by the researcher, rotated among the three groups in each class. Simulation was performed in each class by asking each patient to 'act' certain mistakes in their inhaler technique according to a scenario preplanned by the researcher. Beside the steps patients were to demonstrate incorrectly during their first assessment, they were also asked to perform some incorrect maneuvers during their second and third assessments, so that the students would repeat the education till the patients performed the technique right. Students educated the patients using the specialized ''Show and Tell'' Inhaler Technique Education Protocol based on our previously published methods,(Basheti et al. 2007; Basheti et al. 2008) going through each step on the checklist to describe and demonstrate correct use. This cycle of assessment and counseling was repeated up to three times if necessary, until the patient had correct technique on all steps.

One week following delivery of the interventions, one to one student assessment by a blinded assessor to the intervention grouping of students was done for all participants in a random order, exactly as was done in the initial assessment.

Logistical issues, such as the required tutorial rooms to conduct the study, were all addressed prior to study commencement. Inhaler placebos were made available by AstraZeneca (Amman, Jordan) and GlaxoSmithKline (Amman, Jordan).

EVALUATION AND ASSESSMENT

Data Analysis

Data were analyzed using the Statistical Package for Social Science (SPSS) version 17. The mean± standard deviation values and the 95% confidence interval (CI) were used to describe the normally distributed continuous data (normality of distribution was determined using the Kolmogorov-Smirnov test). Perceived students' barriers are presented as proportional data, analyzed using Pearson's Chi-Square test.

At both assessments, the number of students in each Intervention (A and B) with correct essential technique, (score for DIS 3/3, TH 4/4, and MDI 3/3) and differences between Interventions were compared using Chi squared test and independent sample T test.

Results

No significant difference between participants in Intervention A (n =54) compared to Intervention B (n =55) regarding age (p=0.23) was found, and all students were under the age of 23 years. Although randomization was used to allocate the students to group A and B, more female students were found in group A than group B (72.6% vs. 36.0, p=<0.001)

Perceived barriers

Barriers perceived by the students towards demonstrating correct inhaler technique and future performance of their role in this area included mostly lack of practical training during undergraduate studies and lack of knowledge about the importance of this topic (Table 2). No significant differences between group A and group B were found with regards to the reported perceived barriers.

Table 2. Perceived barriers by all students (Intervention A n=54, B, n=55) leading to their suboptimal demonstration skills following their initial in-class education.

For asthma knowledge (AKQ score out of 17), no significant differences between group A (8.96 ± 3.18) and group B (8.87 ± 2.25) were found (p=0.30, Independent Sample T test.

Effect of interventions

At baseline, there was no significant difference in the proportion of participants with correct essential technique for students in group A (20.7% (12/58)) compared to group B (12.5% (7/56)) for the DIS (p= 0.241). Following intervention, significant difference between the two groups was found, as more students in group B (98.2% (54/55)) performed correct essential technique compared to students in group A (79.6% (43/54; p=0.002).

For the TH, at baseline, few students in group A and B performed correct technique (group A: 0% (0/58); group B: 3.6% (2/55) with no sig differences between the groups (p=0.150).

Following the intervention, more students' in group B (92.7% (51/55)) than group A (75.9% (41/54)) performed correct essential technique (p= 0.016).

For the MDI, at baseline few students in both groups performed correct essential technique (group A: 8.8% (5/57); group B: 7.1% (4/56); p= 0.389). Following the intervention, majority of students in both groups performed better technique, but the number of students in group B with correct essential technique (94.5% (52/55)) was significantly better (p<0.001) than those in group A (53.7% (29/54)).

End of study scores showed significant improvement (p<0.001 for all inhalers for both groups) for all students in group A and B (Figure 1, 2 and 3), however students in group B performed significantly better than students in group A for DIS, TH and MDI (p<0.001 for all devices, Independent Sample T test).

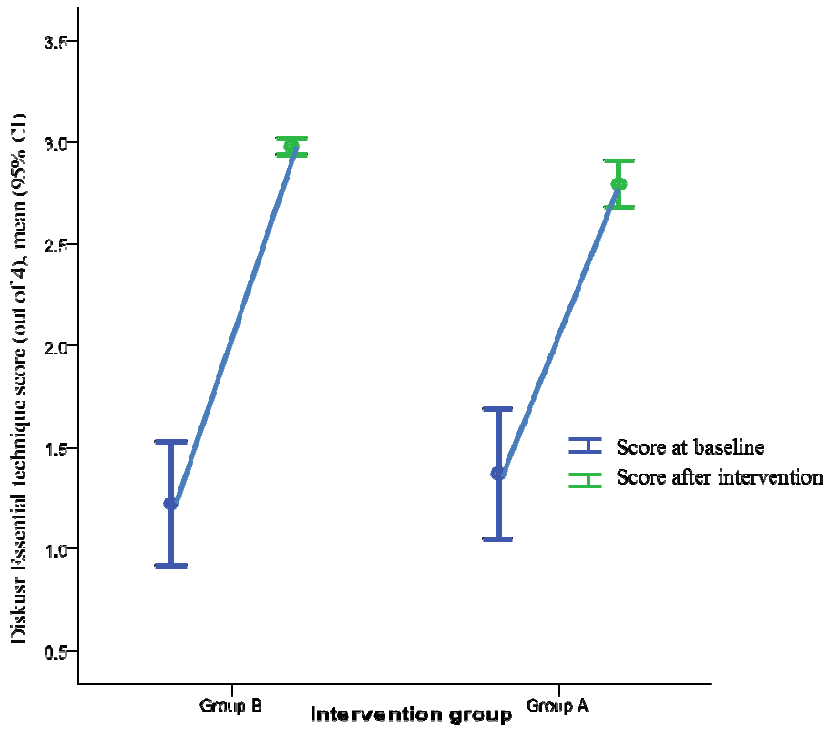

Figure 1. Essential technique score for Diskus for groups A (n= 54) and B (n=55) at baseline an end of study

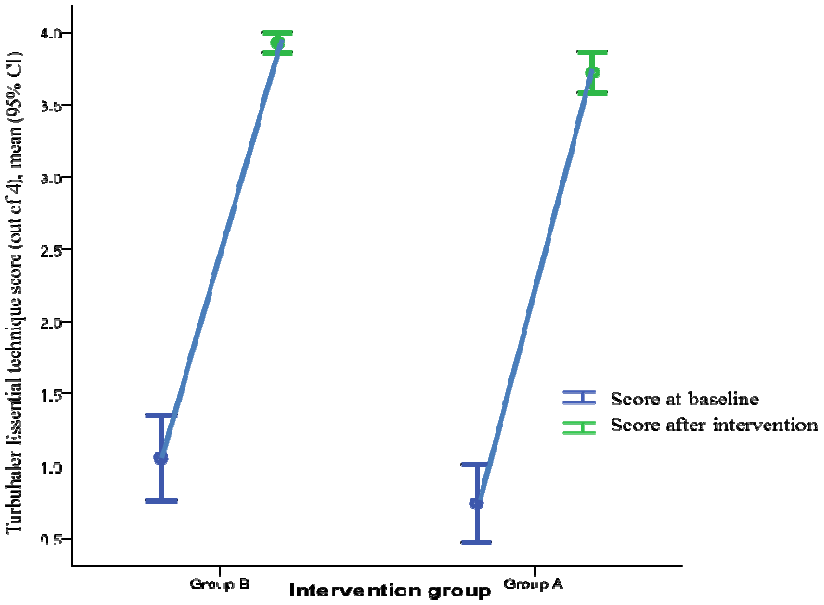

Figure 2. Essential technique score for Turbuhaler for groups A (n= 54) and B (n=55) at baseline and end of study.

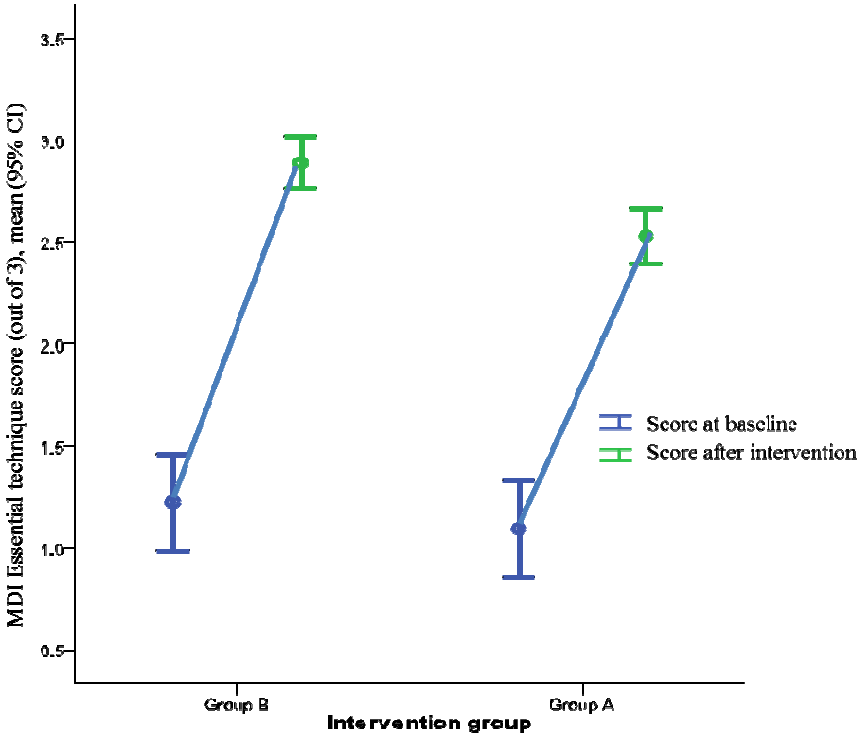

Figure 3. Essential technique score for Metered Dose Inhaler (MDI) for groups A (n= 54) and B (n=55) at baseline and end of study.

A significantly higher proportion of students performed correct essential technique for the DIS when compared to TH end of study (p= 0.048). Also, more students demonstrated the correct use of the TH end of study compared to the MDI (p= 0.005).

Discussion

It has been documented that pharmacists have a positive impact on patients' asthma management.(Basheti et al. 2007) Pharmacists however are not competent to deliver this education to their patients because they have not mastered the demonstration skills needed to train their patients.(Basheti et al. 2011) Inhaler technique education starts in the pharmacy school. Hence, preparing graduates with optimal skills in delivering inhaler technique education to asthma patients is an important aim. Through this study, it is shown that simulation is an effective educational methodology that can be used to create pharmacy graduates with optimal training skills on inhaler technique. The in-class simulation scenario integrating the assessment/education of asthma patients using inhaler device is a promising educational strategy, not just for inhaler devices, but for all other deices found in the world of pharmacy. The DIS, TH and MID have been commonly prescribed as preventative therapy both in Jordan(Khassawneh et al. 2008),(AL-Doghim 2007) and around the world,(Global Initiative for Asthma (GINA) - Global Strategy for Asthma Management and Prevention - Revised Workshop Report 2012) and incorporating them into the educational process of this study allowed for important comparisons not present in previous studies.(Toumas et al. 2009)

Success of simulation as an effective educational strategy that has been demonstrated previously in the education system of other medical sectors, such as medicine and nursing,(Clever et al. ; Okuda et al. 2009) and now, pharmacy can be added to the list. An important advantage of this educational approach is that it allows pharmacy students to observe certain mistakes in patients' inhaler technique, such as the hand position in TH loading and head tilting during inhalation with the MDI that cannot be taught as effectively otherwise.

Students identified barriers preventing them from demonstrating the correct technique of the inhaler devices following the education they used to receive in school. Lack of knowledge about the importance of the topic and insufficient in-class practice with the inhaler placebos emerged as the most important barriers. Acknowledging these barriers when educating pharmacy graduates is important.

Pharmacy students train in community pharmacies during their undergraduate studies. So it is expected for them to learn the technique for the inhalers and other devices in the pharmacy while training. Business pressures, time constraints, profit driven rather than patient-care oriented practices and their fear that that their advice may not be welcomed by the patients are all reasons hindering the students from practicing device demonstration technique while performing their training in the community pharmacy.(Raisch 1993), (Odedina et al. 1995), (Osman et al. 1999),

(Hibbert 2000), (Saini et al. 2001), (Pronk et al. 2002) This makes the use of simulation while in school an important alternative method.

The AKQ is an internationally validated asthma knowledge questionnaire used for the assessment of the important information that should be recognized by the health care professionals.(Kritikos et al. 2005) It's an updated and validated questionnaire with current concepts of asthma and its management based on international asthma management guidelines. This questionnaire was used to assess student's baseline level of asthma knowledge. This assessment was perceived to be important in order to provide another baseline comparison between the groups beside their inhaler technique demonstration skills. Results showed no significant differences between the students in both groups, A and B, in line with their inhaler technique demonstration skills. In general, students showed suboptimal knowledge regarding essential asthma information at baseline. This assessment was completed following the completion of the in-school asthma therapeutic lectures, indicating that more attention needs to be provided regarding essential asthma information included in the questionnaire when delivering student education in this area.

This study sheds light on what has been previously argued in the world of education, written information is not effective in educating students on inhaler demonstration skills, nor is it effective in providing them with the skills needed to transfer their knowledge and skills to their patients. Students were given the product leaflets for each of the inhalers, and a placebo inhaler device for each, mimicking the real-life scenario in which pharmacists study independently the information about inhaler technique through the product information leaflets before patient counseling. Results of this study showed that majority of students were not able to demonstrate the correct use of these devices following this procedure.

Peer education on the other hand has been shown to be effective in promoting interchange of ideas between the students, providing an ideal opportunity for them to reflect critically on their practice, increasing their motivation by taking responsibility for their own learning.(Toumas et al. 2009)

In the checklists used to assess students' inhaler technique in this study, certain steps were identified to be 'Essential'. Therefore, the number of students with correct essential Technique was inspected in this paper. Correct Essential Technique is the correct demonstration of steps which if incorrectly preformed, little or no medication would reach the lung. Although not significant, the number of students demonstrating Correct TH and MDI essential technique at baseline (following reading the product information leaflets) was lower than the number of students demonstrating correct DIS essential technique at baseline (TH:3.6%, MDI:8.0%, DIS: 16.6%). This difference was significant end of study following the education, with significantly more students demonstrating correct essential technique for the DIS (88.9%) than for the TH (84.3%). Also, significantly more students demonstrated the correct use for the TH (84.3% than the MDI (74.1%). This may indicate that the newer devices, DIS followed by the TH, are easier

devices to demonstrate than the older MDI, indicating that more focus needs to be drawn towards the MDI when educating students on correct inhaler technique.

Engaging real patients in educating pharmacy students can be however time and resource expensive. From the student's perspective, assessing and educating the same asthma patient as their peers could have affected negatively the practicality of the simulation process. The extra improvements seen in Intervention B students' demonstration skills could have been due to simply observing the inhaler technique being demonstrated few more times as compared to Intervention A. It is suggested for future studies to allow the same time of education for both groups, to rule out any other factor that may affect the results beside simulation. Nevertheless, the better improvements seen in this study is strongly believed to be due to the simulation part of the education only, because a previous study conducted by the same research group at the University of Sydney has shown that repeat observation of inhaler technique demonstration by students is not enough to result in better skills in this area.(Toumas et al. 2009)

Conclusion

Important barriers to inhaler technique education has been identified in this study, which if addressed in the future, better student satisfaction will be reached. Simulation provides an effective education method that can result in pharmacy students with better essential inhaler technique demonstration skills, opening new perspective in the world of pharmacy education. Using simulation in therapeutic practical classes could be a potentially effective way to bridge important gaps between the classroom and the community. The evaluation of simulation in other therapeutic areas covering a wider range of medical devices would be useful. Assessing the long term effect of this educational strategy on student's skills and knowledge is also warranted.

References

AL-Doghim, I. (2007). "Evaluation of Inhalation Technique of Metered Dose Inhaler (MDI) and Dry Powder Inhaler - TurbuhalerR (DPI) among Pediatric Patients with Asthma." J J Appl Sci 9(1): 53-60.

Amirav, I., A. Goren, et al. (1995). "Physician-targeted program on inhaled therapy for childhood asthma." J Allergy Clin Immunol 95(4): 818-823.

Basheti, I. A., C. L. Armour, et al. (2008). "Evaluation of a novel educational strategy, including inhaler-based reminder labels, to improve asthma inhaler technique." Patient Educ Couns 72(1): 26-33.

Basheti, I. A., C. L. Armour, et al. (2009). "Long-term maintenance of pharmacists' inhaler technique demonstration skills." Am J Pharm Educ 73(2): 32.

Basheti, I. A., E. Qunaibi, et al. (2011). "User error with Diskus and Turbuhaler by asthma patients and pharmacists in Jordan and Australia." Respir Care 56(12): 1916-1923.

Basheti, I. A., H. K. Reddel, et al. (2005). "Counseling about turbuhaler technique: needs assessment and effective strategies for community pharmacists." Respir Care 50(5): 617-623.

Basheti, I. A., H. K. Reddel, et al. (2007). "Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists." J Allergy Clin Immunol 119(6): 1537-1538.

Cain, W. T., G. Cable, et al. (2001). "The ability of the community pharmacist to learn the proper actuation techniques of inhaler devices." J Allergy Clin Immunol 108(6): 918-920.

Clever, S. L., R. A. Dudas, et al. "Medical student and faculty perceptions of volunteer outpatients versus simulated patients in communication skills training." Acad Med 86(11): 1437-1442.

Clever, S. L., R. A. Dudas, et al. (2011). "Medical student and faculty perceptions of volunteer outpatients versus simulated patients in communication skills training." Acad Med 86(11): 1437-1442.

Erickson, S. R., A. Chang, et al. (2003). "Lecture versus Web tutorial for pharmacy students' learning of MDI technique." Ann Pharmacother 37(4): 500-505.

Erickson, S. R., A. Horton, et al. (1998). "Assessing metered-dose inhaler technique: comparison of observation vs. patient self-report." J Asthma 35(7): 575-583.

Erickson SR, L. H., Zarowitz BJ, Kirking DM. (2000). "Pharmacists' understanding of patient education on metered-dose inhaler technique." Annals of phamacotherapy 34(11): 1249-1256.

Fink, J. B. (2005). "Inhalers in asthma management: is demonstration the key to compliance?" Respir Care 50(5): 598-600.

Fink, J. B. and B. K. Rubin (2005). "Problems with inhaler use: a call for improved clinician and patient education." Respir Care 50(10): 1360-1374.

Girard, M. and P. Drolet (2002). "Anesthesiology simulators: networking is the key." Can J Anaesth. 49(7): 647-649.

Giraud, V. and N. Roche (2002). "Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability." Eur Respir J 19(2): 246-251.

Global Initiative for Asthma (GINA) - Global Strategy for Asthma Management and Prevention - Revised Workshop Report 2012 "Chapters 1-5." Available online at: http://www.ginasthma.org. Accessed May 2012.

Gordon, J. A., W. M. Wilkerson, et al. (2001). ""Practicing" medicine without risk: students' and educators' responses to high-fidelity patient simulation." Acad Med. 76(5): 469-472.

Guidry, G. G., W. D. Brown, et al. (1992). "Incorrect use of metered dose inhalers by medical personnel." Chest 101(1): 31-33.

Henry, R. L., C. A. Fitzclarence, et al. (1993). "What do health care professionals know about childhood asthma?" J Paediatr Child Health 29(1): 32-35.

Hibbert, D. (2000). "Patient and pharmacist views of asthma care in the community pharmacy." J Soc Admin Pharm 17(4): 202-208.

Jackevicius, C. A. and K. R. Chapman (1999). "Inhaler education for hospital-based pharmacists: how much is required?" Can Respir J 6(3): 237-244.

Kesten, S., K. Zive, et al. (1993). "Pharmacist knowledge and ability to use inhaled medication delivery systems." Chest 104(6): 1737-1742.

Khassawneh, B. Y., M. K. Al-Ali, et al. (2008). "Handling of inhaler devices in actual pulmonary practice: metered-dose inhaler versus dry powder inhalers." Respir Care 53(3): 324-328.

Kritikos, V., B. Saini, et al. (2005). "Innovative asthma health promotion by rural community pharmacists: a feasibility study." Health Promot J Austr 16(1): 69-73.

Lee-Wong, M. and P. H. Mayo (2003). "Results of a programme to improve house staff use of metered dose inhalers and spacers." Postgrad Med J 79(930): 221-225.

Mason, H. L. and B. L. Svarstad (1984). "Medication counseling behaviors and attitudes of rural community pharmacists." Drug Intell Clin Pharm 18(5): 409-414.

McDonald, V. M. and P. G. Gibson (2006). "Asthma self-management education." Chron Respir Dis 3(1): 29-37.

Morgan, P. J. and D. Cleave-Hogg (2002). "A worldwide survey of the use of simulation in anesthesia." Can J Anaesth. 49(7): 659-662.

O'Connell, M. B., J. M. Hewitt, et al. (1992). "Short- and long-term retention of a nursing home education program on metered-dose inhaler technique." Ann Pharmacother 26(7-8): 980-984.

Odedina, F. T., R. Segal, et al. (1995). "Providing pharmaceutical care in community practice: Differences between providers and non-providers of pharmaceutical care." J Soc Admin Pharm 12(4): 170-180.

Okuda, Y., E. O. Bryson, et al. (2009). "The utility of simulation in medical education: what is the evidence?" Mt Sinai J Med 76(4): 330-343.

Osman, L. M., C. M. Bond, et al. (1999). "Asthma Advice giving by community pharmacists." Int J Pharm Pract 7: 12-17.

Pronk, M., L. Blom, et al. (2002). "Community pharmacy and patient-oriented activities: the Dutch case." Patient Educ Couns 46(1): 39-45.

Raisch, D. (1993). "Barriers to providing Cognitive services " American Pharmacy 33(12): 54-58.

Rebuck, D., B. Dzyngel, et al. (1996). "The effect of structured versus conventional inhaler education in medical housestaff." J Asthma 33(6): 385-393.

Resnick, D. J., R. L. Gold, et al. (1996). "Physicians' metered dose inhaler technique after a single teaching session." Ann Allergy Asthma Immunol 76(2): 145-148.

Roche, N. and G. J. Huchon (2000). "Rationale for the choice of an aerosol delivery system." J Aerosol Med 13(4): 393-404.

Saini, B., I. Krass, et al. (2001). "Specialisation in asthma: Current practice and future roles " J Soc Admin Pharm 18(5): 169-177.

Schommer, J. C. and J. B. Wiederholt (1994). "Pharmacists' perceptions of patients' needs for counseling." Am J Hosp Pharm 51(4): 478-485.

Toumas, M., I. A. Basheti, et al. (2009). "Comparison of small-group training with self-directed internet-based training in inhaler techniques." Am J Pharm Educ 73(5): Article 85.

Vainio, K. K., M. J. Korhonen, et al. (2001). "The perceived role and skills of pharmacists in asthma management after in-house training." Pharm World Sci 23(1): 6-12.

van der Palen, J., J. J. Klein, et al. (1998). "Comparison of a new multidose powder inhaler (Diskus/Accuhaler) and the Turbuhaler regarding preference and ease of use." J Asthma 35(2): 147-152.

Verver, S., M. Poelman, et al. (1996). "Effects of instruction by practice assistants on inhaler technique and respiratory symptoms of patients. A controlled randomized videotaped intervention study." Fam Pract 13(1): 35-40.

Weller, J., L. Wilson, et al. (2003). "Survey of change in practice following simulation-based training in crisis management." Anaesthesia. 58(5): 471-473.

Wiederholt, J. B., B. R. Clarridge, et al. (1992). "Verbal consultation regarding prescription drugs: findings from a statewide study." Med Care 30(2): 159-173.

Wilcock, M. (2002). "The community pharmacist, the patient and their inhaler device - Time to work together?" PHARM PRACT 12(9): 356-362.

Yousef, A. M., A. G. Al-Bakri, et al. (2008). "Self-medication patterns in Amman, Jordan." Pharm World Sci 30(1): 24-30.