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Research

An active-learning laboratory on respiratory devices

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Abstract

Objective: To implement and evaluate an active-learning laboratory activity designed to teach second-year pharmacy students about the appropriate use of various respiratory devices including proper inhalation technique, device maintenance, and counseling points.

Methods: The laboratory session was divided into four small-group teaching stations: (1) nebulizers, (2) chronic obstructive pulmonary disease (COPD) exacerbation case and HandiHaler[®], (3) dry powder inhalers, and (4) metered dose inhalers and spacers. Students completed a pre-assessment and a post-assessment to measure changes in their respiratory device knowledge and confidence. McNemar's test and a paired *t*-test were used to determine statistical significance.

Results: Both the pre- and the post-assessments were completed by 131 of the 133 students enrolled (98.5%). The average score on pre-assessment knowledge-based questions was 52.7% (range: 10–90%). The post-assessment average score improved to 86.6% (range: 30–100%). Student's confidence improved in all of the four areas. All knowledge and confidence improvements were statistically significant ($p < 0.05$).

Conclusion: An active-learning approach facilitated students' gain in knowledge, confidence, and experience with the various devices used to deliver respiratory medications.

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Introduction

Pharmacists frequently receive their first exposure to inhaler devices and proper technique in pharmacy school. This education may be taught in any number of ways including didactic lectures on pertinent disease states or the devices themselves, demonstration by a teacher in a large lecture setting, student hands-on learning in a laboratory setting, or via internet-based modules. These devices are

most commonly used in the treatment of asthma and chronic obstructive pulmonary disease (COPD), and often the patient is required to use of multiple devices.¹ In addition to medications commonly prescribed in a pressurized metered dose inhaler (pMDI), a patient may receive medication in one of several dry powder inhalers (DPIs) or in a nebulizer.

Student pharmacist education on these devices may occur at any point in the pharmacy school curriculum. According to the Accreditation Council on Pharmacy Education (ACPE) updated 2011 Standards and Guidelines, students are required to complete Advanced Pharmacy Practice Experiences (APPEs) or experiential training.² At the Virginia Commonwealth University School of

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Pharmacy and other schools in the United States, APPEs are completed during the fourth year of the pharmacy school curriculum. Students may be asked to educate patients with asthma and COPD on the use of their inhalers during the course of these APPEs both in the hospital and community settings. They may also be asked to provide inhaler education to other health care professionals during their experiential training. This suggests that students should receive preliminary training in their pharmacy curriculum earlier than APPEs.

The proper use of these medications and devices is not intuitive and may require different inhalation techniques with multiple steps performed for correct use. While manufacturers do provide patient educational leaflets detailing the appropriate technique for a specific device, it has been estimated that fewer than one-half of adult patients use a pMDI effectively.³ In some patients who are unable to coordinate the actuation and inhalation of medication in pMDI, a valved holding chamber or “spacer” may be used to facilitate optimal delivery of medication, but this may not address all areas of incorrect use.⁴ Patients are also prone to use DPIs incorrectly. In 2008, Lavorini et al.⁵ conducted a systematic literature review of DPI use in patients with asthma or COPD and found that 4–94% of patients used their inhaler incorrectly. Incorrect use of inhalers may lead to a reduced proportion of drug reaching the lung, ultimately resulting in suboptimal control of a patient’s symptoms.⁶ In patients with asthma, optimizing patient inhaler use has been associated with a significant decrease in asthma exacerbation frequency and emergency department (ED) visits.⁷ In patients with COPD, incorrect use of inhalers has been associated with an increased risk of hospitalization, ED visits, courses of antimicrobials and oral steroids, and poor disease control, while patients receiving training on inhaler use have been reported to have a higher rate of adherence, a decrease in dyspnea, number of exacerbations, ED visits, and hospitalizations.^{8–10} An improved quality of life has been associated with inhaler instruction.^{9,10}

Guidelines recognize that pharmacists can provide effective education to patients about these devices.^{4,11} Education by pharmacists has also been shown to improve inhaler technique in patients with asthma and COPD.¹² For optimal education to occur, the pharmacist should know and be able to demonstrate the correct inhaler technique for each device. This is important, as patients who are educated on inhaler technique by pharmacists make errors similar to those who train them.¹ Unfortunately, it has been documented that health care professionals, including pharmacists and student pharmacists, may not be able to appropriately use these devices or educate patients on proper device technique.^{13–17} In addition, not all pharmacists educate patients on the proper inhaler technique, which has been suggested is due in part to a lack of knowledge and skills, which affects their confidence and willingness to educate patients.¹⁴ Fortunately, improvement in pharmacists’ inhaler

technique has been shown in community and hospital pharmacists who complete formalized educational training.^{14,18–20}

Provision of inhaler technique training in pharmacy schools has been described in several articles, although specifics on the effectiveness of these methods was not described in all.^{21–24} Two studies described specific educational methods that improved the knowledge, skills, and confidence of pharmacy students with inhalers.^{23,24} Toumas et al.²³ compared small-group versus internet-based training to improve 236 second-year pharmacy students’ knowledge of a single type of DPI (Turbuhaler[®]) in a pre- and post-intervention designed study. The small-group intervention consisted of watching a step-by-step demonstration of inhaler use by an asthma physician after which the students were paired, and they evaluated each other on correct inhaler technique using a checklist. The internet-based group each individually watched a pharmacist demonstrate the correct use of the Turbuhaler[®] via a computer. A checklist of steps was provided that students used to practice with a placebo inhaler. Finally, the students in this group also observed a patient using an inhaler and were asked to identify any steps performed incorrectly according to a checklist. Both the types of interventions resulted in an increase in the number of students who were able to demonstrate correct technique with this single device. The authors concluded that the small-group training was as effective as self-directed internet-based training in improving the students’ inhaler technique.²³ The authors also evaluated the students’ confidence in using the inhaler and increased student confidence was a predictor of correct inhaler technique.²³ In a smaller number of students, Erickson et al. compared 42 third-year students’ acquired knowledge and ability to correctly use a single type of pMDI in a three-arm design. A total of 13 students received education on correct pMDI use via a classroom lecture by the instructor who normally provided this information to students in the Pathophysiology and Therapeutics course. A total of 14 students independently completed internet-based instruction developed by the College of Pharmacy.²⁴ These two groups were compared to a control group of 15 students who did not receive any specific education on the topic before the post-evaluation assessment was conducted.²⁴ All students had not yet had formal educational training on the pMDI technique in their curriculum before the study was conducted. Comparing pre- and post-intervention assessments, the baseline MDI technique knowledge test scores did not differ between the three groups.²⁴ In the post-intervention assessment, both the intervention groups scored significantly better than the control group, but there was no difference between the two intervention groups.²⁴ Both of these studies indicate that educating students on inhaler technique is effective, albeit with a single device at a time. Due to the growth in the number of devices in the market (spacers; nebulizers; Diskus[®], Twisthaler[®], Flexhaler[®], Pressair[™], and Respimat[®] inhalers; and many more), a

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