INSTRUCTIONAL DESIGN AND ASSESSMENT

Impact of an Elective Diabetes Course on Student Pharmacists' Skills and Attitudes

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Objective. To assess the impact of an elective diabetes course on student pharmacists' skills and attitudes about diabetes management.

Design. A 1-credit elective course on diabetes was developed that included a 1-week simulation experience during which students completed daily insulin injections, glucose checks, carbohydrate counts, and kept a daily log.

Assessment. A preintervention and postintervention survey was administered to assess students' attitudes toward and confidence in performing and teaching patients various diabetes self-management skills. Students' confidence in performing and teaching diabetes self-management skills significantly improved. Students' reflective writing assignment, diabetes logbook, weekly quizzes, and group presentation were also evaluated.

Conclusion. A diabetes elective, which included a 1-week simulation of living as a diabetic patient, was an effective teaching method to increase students' confidence in performing and teaching diabetes self-management skills.

Keywords: diabetes, simulation, active learning, elective, survey

INTRODUCTION

The need for doctor of pharmacy (PharmD) students to acquire a thorough knowledge of diabetes is well recognized.[1-6] Some of the innovative educational approaches used to teach students about diabetes have included a Web-based interprofessional diabetes course,[2] student-facilitated patient care programs,[3,4] and a diabetes concentration.[5,6] In 2 PharmD programs, students simulated living the life of a diabetic patient by self-administering daily injections and testing their glucose levels.[4,5]

In 1997, students at the University of Minnesota initiated a diabetes experience through a student organization, Minnesota Pharmacy Student Alliance (MPSA). The experience was designed to give students the opportunity to simulate living as a person with diabetes for 5 days by completing daily glucose checks and daily "insulin" (using normal saline) injections. This project was started by a group of students who believed that experiencing the lifestyle of a person with diabetes would help them be-

come more empathetic when caring for these patients. In addition to the simulation, the experience included an introduction to carbohydrate counting, insulin dosing, and glucose monitoring, and writing a reflective paper describing the experience and its application to patient care. At that time, the experience was offered as a 1-credit directed study under the advisement of a faculty member. Each year, a student volunteer coordinated registration, donations, and purchases, and recruited faculty members to evaluate the reflective papers and provide feedback to the students.

The diabetes experience survived as a directed study organized by students for over 10 years due in part to the lack of faculty resources to run it as an official elective. In fall 2007, faculty members from both the Minneapolis and Duluth campuses expressed interest in serving as course directors for an elective diabetes experience course. The faculty members utilized the basic format from the student-organized directed study and further developed the structure to include other diabetes-related topics. The elective course was then approved by the faculty of the college and offered for the first time in spring 2008 under the direction of faculty course directors on the Minneapolis and Duluth campuses. This action

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formalized the experience, offered increased consistency in the learning experience from year to year and from campus to campus, and expanded the course content to include important diabetes-related topics.

Caring for patients with diabetes fits into Accreditation Council for Pharmacy Education (ACPE) Standard 12, which states that professional pharmacy graduates must be able to provide patient-centered care. The described course is also in alignment with ACPE Standard 10, which states that professional programs should have both required and elective courses for students to pursue special interests.[7] The Diabetes Experience course provides an opportunity for students who have an interest in diabetes to gain an increased understanding about the condition, and improve their ability to empathize with diabetic patients, thereby increasing the likelihood that they will provide patient-centered care.

The diabetes experience elective course was intended to deepen students' understanding of diabetes and the impact of the condition on an individual's daily life. The course supplemented topics about diabetes covered elsewhere in the curriculum, provided a simulation experience, and provided detailed information about related topics such as gestational diabetes and pancreatic transplants. This paper provides an overview of the design of the elective course, and details an assessment completed during the 2009 spring semester to evaluate the impact of the course on students' skills and attitudes related to diabetes.

The diabetes experience course was designed to meet 3 learning objectives. First, students would be able to empathize with diabetic patients about the impact of this condition on their daily lives. Simulating the lifestyle of a diabetic patient was intended to increase the student's ability to empathize with patients with diabetes. The development of empathy can be classified as an application domain, according to Bloom's taxonomy.[8] Because empathy is a difficult skill to assess, this objective was evaluated primarily through the students' reflective papers.

Second, students would be able to educate colleagues about a diabetes-related topic, while incorporating active-learning techniques. Development of group presentations during the course involved analysis, synthesis, and evaluation of information resources, tasks that required the highest domains of learning according to Bloom's taxonomy.[8]

Third, students would be able to educate patients about diabetes management, including glucose monitoring, healthy eating, carbohydrate counting, exercise, insulin administration/injections, and use of other pharmacotherapy options. Again, this objective focused on the higher levels of Bloom's taxonomy of learning: analysis and synthesis.[8] To educate patients, a student must be able to evaluate a patient's situation (living conditions, financial limitations, disease complications, etc) and synthesize a plan to resolve problems. The experience of living as a patient with diabetes was expected to increase the students' ability to teach self-management skills to patients. This objective was the focus of the preintervention and postintervention survey described in this report.

DESIGN

The Diabetes Experience course was a 1-credit elective, offered as a 2-hour class session for the first 8 weeks of the spring semester. This elective was open to PharmD students in their second and third years. Because the University of Minnesota has campuses in Minneapolis and Duluth, most of the required and elective courses in the curriculum are taught simultaneously to students on each campus via interactive television. However, this class was taught separately at each campus by on-site faculty members, which facilitated increased active student participation and class discussions. The individual faculty members who taught the course were practicing pharmacists with extensive experience in providing medication therapy management services to diabetic patients.

Pedagogy

The pedagogical techniques utilized in the course included simulation, reflective writing, group presentations, quizzes, and lectures. Simulation is a powerful educational tool.[9-12] In this course, students were required to simulate daily activities of a patient with diabetes. This technique was chosen so that the students would immerse themselves in a diabetes experience to improve their ability to educate and empathize with diabetic patients. Following the simulation, students were required to complete a writing assignment reflecting on what they learned as a result of the experience.

In addition, students worked in groups to teach their colleagues about specific diabetes topics. This pedagogical approach required the students to complete self-learning on the specific topic, and be knowledgeable enough about the topic to teach their colleagues. In addition, the students were required to include an active-learning exercise for the class as part of their presentation. This ensured the active engagement of the class members as well as the presenters. Student groups also wrote their own assessment questions, which encouraged them to determine the key points of their topic. These questions were then used in weekly quizzes.

Traditional faculty-led lectures were given early in the course to provide necessary introductory course content to the students. Each of these lectures included some active-learning component, such as participating in a quiz

game or performing dosing calculations. This pedagogical approach ensured that students were well prepared for the simulation part of the course.

Content

The first class session provided an introduction to the course, followed by an overview of diabetes educator credentialing and a Diabetes Jeopardy game. The next 3 class sessions consisted of introductory information on nutrition, insulin, and glucose monitoring. The nutrition lectures were led by certified diabetes educators (either PharmD or dieticians), and the remainder of introductory material was taught by faculty members. Students were given time during these presentations to complete individual calculations of recommended carbohydrate intake (based on weight and activity level), a starting total daily insulin dose, insulin-to-carbohydrate ratio, and insulin sensitivity factor. These first 4 sessions provided a foundation to prepare the students for their week of living as a diabetic patient (Table 1).

Students then spent 7 days simulating the life of a patient with Type 1 diabetes. Each student received a glucose meter, test strips, a lancet device, lancets, and alcohol swabs. In addition, they received 30 insulin syringes and a 10 mL multiple-dose vial of bacteriostatic normal saline for injecting their "insulin," along with a sharps container for disposing of used syringes. Students also were provided glucose tablets to use for a simulated hypoglycemic event. The glucose meters, test strips, and lancets were donated to students by the glucose meter manufacturer. Since students' glucose levels presumably would be normal, they also were given a bag of glucose values typical for a person with Type 1 diabetes (30 values ranging from 45 to 320).

During the experience week, students checked their blood glucose and injected normal saline as their "insulin" 4 times daily: a basal insulin dose at bedtime and 3 doses of rapid-acting insulin with meals. Students were required to check their glucose levels prior to the administration of their "insulin" injection. To simulate a need for dosing adjustments, students also randomly drew a piece of paper from the bag of glucose values during each glucose check and reacted to the glucose value on the paper as if it were their own, responding if necessary by treating hypoglycemia or adjusting their mealtime insulin to cover a hyperglycemic value. Students were asked to remove the glucose value from the bag after it was drawn, to ensure that they experienced both hypo- and hyperglycemic events requiring intervention during the simulation. Students kept a daily log that included the following: actual glucose, "drawn" glucose, carbohydrates consumed, insulin dose for carbohydrates, insulin dose for current "drawn" glucose value, and total insulin dose given. The above information was required for 3 meals daily, and students also documented their basal insulin dose and glucose ("drawn" and actual) once daily. Each log also required the students to record their calculated insulin-to-carbohydrate ratio and their insulin sensitivity factor to assist faculty members in proper grading of their logsheet.[13, 14]

Table 1. Course Outline for a Diabetes Elective

Date	Topic	Presenter/Assignments
Week 1	Course introduction ● Overview of credentialing ● Diabetes Jeopardy	Faculty
Week 2	Nutritional management	Guest Speaker (CDE)
Week 3	Insulin dosing	Faculty
Week 4	Insulin injection & glucose meters; prepare for experience week	Faculty (Week as a person with diabetes starts after this week)
Week 5	Sociobehavioral aspects of diabetes and Goal setting to promote health Cultural impact on diabetes	Student Groups
Week 6	Insulin pump therapy and alternative devices for insulin delivery Pediatric management of diabetes	Student Groups
Week 7	Potluck Meal: Discuss experience Diabetes in pregnancy: preconception planning and gestational diabetes	All Student Group (Reflective Paper and Log Due)
Week 8	Complementary and alternative medicine for diabetes Pancreatic transplants	Student Groups

Following the simulation week, 1 hour of class time was devoted to a diabetic-friendly potluck meal and a reflective discussion on the experience. During the discussion, the students reflected on how the simulation affected their daily routines and its impact on their friends and families. In particular, students discussed practical issues such as the time it took to calculate insulin doses, the challenges of going out to eat as a diabetic patient, and their surprise at the nutritional content of many of their food choices. In addition, students submitted a 3- to 5-page reflective paper detailing what they learned during the experience, including its application to patient care. Within the reflective paper, students were required to respond to the questions listed below, which have been revised repeatedly since the inception of the diabetes experience in 1997. The course faculty members accepted these reflective questions with only minor modifications, as they required the students to reflect on their full experience and apply it to future patient care activities.

- What did you hope to accomplish from this course?
- Provide a detailed description of your experience as a patient with diabetes.
- What was the most challenging part of having diabetes? What impact did it have on your lifestyle?
- What feelings and emotions did you have about having diabetes?
- What else did you take away from the experience?
- How will you incorporate what you have learned when caring for patients?

The remainder of the course content was delivered by student groups. Students were provided with resources on the course Web site regarding writing learning objectives, creating and delivering effective presentations, and effectively using PowerPoint. Faculty members identified 7 topics that were included in the American Diabetes Association Self-Management of Diabetes curriculum[15] but not covered well in the required curriculum for the student groups to research (Table 1).

Students chose their own groups and ranked their list of preferred presentation topics. Topics were assigned to the groups using rank order of preference. Each group was responsible for developing a 40-minute presentation that incorporated active-learning strategies to educate their colleagues. The group presentations were evaluated by the class and the course faculty members using a faculty-developed rubric. Forty percent of the group presentation grade was based on the peer evaluations, and 60% on the faculty evaluations. In addition, each group developed 3 multiple-choice quiz questions which were reviewed and graded by faculty members, and edited

if necessary before including them in the following week's quiz. Although students were not required to use them, resources on writing multiple-choice test questions, utilizing active-learning strategies, and delivering presentations were provided on the course Web site.

Each week, students completed a 5-item multiple-choice question quiz from the previous week's materials. Students were allowed to refer to their class notes, but they had only 10 minutes to complete the quiz.

EVALUATION AND ASSESSMENT
Assessment of Learning

Eighty-four students enrolled in the Diabetes Experience elective in spring 2009. Fifty of these students were on the Minneapolis campus, and 34 were on the Duluth campus. Twenty of these students were third-year students, and the rest were second-year students. As described above, learning was assessed via weekly quizzes, daily logbook from the simulation week, reflective papers, and student group presentations. The overall average score on the weekly quizzes was 2.3 out of a possible 2.5 points, indicating that students learned the material provided during the course.

The logbooks were evaluated using a faculty-developed rubric and worth a possible 20 points. Points were awarded for accuracy in adjusting insulin doses for carbohydrate intake, adjusting insulin dose for glucose values, insulin regimen, insulin-to-carbohydrate ratio, and insulin sensitivity calculations. In addition, students received points for completeness. A thorough understanding of appropriate insulin dose adjustments was necessary for a student to do well on the logbook evaluation. The average score for the class was 19.1 out of 20 possible points.

The reflective papers were scored on a 30-point scale using a faculty-developed rubric based on overall reaction to the experience, a description of their experience, application to patient care, and grammar. Overall, students provided thoughtful, complete reflective papers on their experience of living as a person with diabetes for 1 week. Students indicated that this experience would help them empathize with their future patients, and many discussed that they would use this experience immediately to help patients in their current internship or pharmacy technician positions. The overall quality of the reflections was evidenced by the high average score of 28.6 out of 30 possible points.

The student group presentations were also evaluated using a faculty-developed rubric. The rubric was based on presentation style, presentation topic content, ability to answer questions, audience participation, and presentation efficiency. The average score for the student group presentations was 28.1 out of a possible 30 points. All

students in a presentation group received the same grade. Although the group sizes were different between campuses, the overall grades were 28 on both campuses.

At the conclusion of the course, an online evaluation was distributed to students to gather their feedback on the course content and teaching.

Assessment of Course

To assess the impact of this course on student skills and attitudes, a survey instrument was administered on the first and last days of class (Table 2). The study was reviewed by the University of Minnesota Institutional Review Board senior office staff and determined to be exempt from full board review. While participation was anonymous, students were asked to put a numeric code on both their preintervention and postintervention survey instruments to allow the 2 survey instruments to be matched. The survey instrument contained 15-items with responses based on a 5-point Likert scale. Survey questions were developed and revised by the authors to reflect the skills students were expected to gain from the diabetes simulation week. In addition, students were asked to self-assess their ability to teach others these skills. Although the course specifically did not address patient education skills, this self-assessment was intended to illustrate any change in student confidence regarding teaching diabetes management skills to patients. Descriptive statistics were used to evaluate responses on the preintervention and postintervention survey responses. Responses were paired for each question and analyzed using the Wilcoxon signed-rank test, using an alpha level of 0.05 for significance. All statistical tests were completed on SPSS, version 15.0 (SPSS, Inc., Chicago, IL).

Seventy-three of the 84 students enrolled in the elective completed both the preintervention and postintervention surveys. Six students failed to complete the back page of the survey instrument, so the total number of student responses for the last 5 questions was lower.

Students' basic attitudes toward diabetes did not change significantly between the preintervention and postintervention surveys (Table 2, items 1 through 3). There was a significant change ($p = 0.005$) in students' responses to the statement: "I believe that patients with Type 2 diabetes deserve to have the disease." The mean scores decreased, indicating that the level of disagreement with that statement increased. The remaining statements focused on self-report of students' confidence in performing diabetes management skills and teaching diabetes management skills to others. Each of these statements was associated with a significant increase in confidence in performing these skills and teaching others ($p < 0.001$).

The results from the survey were divided into the self-performance of skills and the ability to teach the skills to others. Regarding self-administration skills, prior to the experience, students' responses indicated that, as a whole, the group was most comfortable with checking blood glucose (Table 2, item 7), and least comfortable with adjusting insulin doses based on carbohydrate intake (item 11). Similarly for the teaching patients skills, prior to the experience, students' responses indicated that, as a whole, the group was most comfortable teaching patients how to check blood glucose (Table 2, item 8) and least comfortable teaching patients to adjust insulin doses based on carbohydrate intake (item 12). Although not significant, responses routinely demonstrated that students were less confident in their skill in teaching patients than they were performing the skill themselves. After the experience, all mean responses exceeded 4.0 (4 = agree on Likert scale used) for both self-administration skills and teaching skills, indicating that the average student's confidence in performing these skills increased through this experience. The tendency for students to be slightly less confident teaching the skills compared to doing the skills themselves remained constant.

DISCUSSION

Prior to enrolling in this course, all students had completed at least 3 semesters of the PharmD curriculum. In the spring of the first year, all students completed laboratory activities on the use of glucose meters, insulin, and insulin administration. Therefore, all students had previous exposure to insulin injection techniques and the use of glucose meters. Students completed the diabetes section in the pharmacotherapy sequence in the spring of their second professional year, which was immediately following the conclusion of this Diabetes Experience elective in 2009. Therefore, the third-year students had the pharmacotherapy background in basic insulin adjustment, while the second-year students did not.

Given the curriculum to this point, it is not surprising that the mean preintervention survey scores for the statements regarding insulin administration and checking glucose using a glucometer were higher than other preintervention scores. However, the responses to all of the statements related to skills significantly improved at the end of the course. These results indicate that students can improve their confidence in skills significantly through an intense simulation experience such as that offered in this elective. This increased confidence was also evident in the student reflections, where students consistently commented on their increased level of confidence to manage diabetes and teach these skills to patients. Some excerpts from student reflective papers include: "I think what I

Table 2. Student Self-Assessment Survey Statement and Responses Before and After Completing an Elective Course in Diabetes

Statement	N	Median Preintervention (min, max)[a]	Median Postintervention (min, max)[a]	P[b]
1. I believe that having Type 1 diabetes would be difficult.	73	5 (1, 5)	5 (1, 5)	0.853
2. I believe that having Type 2 diabetes would be difficult.	73	4 (2, 5)	4 (1, 5)	0.491
3. I believe that it would NOT be difficult to adjust my current lifestyle if I had diabetes.	73	2 (1, 5)	2, (1, 5)	0.733
4. I believe that patients with Type 2 diabetes deserve to have the disease.	73	2 (1, 5)	1 (1, 3)	0.005
5. I feel confident in my ability to administer insulin.	73	3 (1, 5)	5 (4, 5)	< 0.001
6. I feel confident in my ability to teach someone else how to administer insulin.	73	3 (1, 5)	5 (3, 5)	< 0.001
7. I feel confident in my ability to check blood glucoses with a home glucometer.	73	4 (1, 5)	5 (4, 5)	< 0.001
8. I feel confident in my ability to teach someone else how to check blood glucoses with a home glucometer.	73	4 (1, 5)	5 (4, 5)	< 0.001
9. I feel confident in my ability to count carbohydrates in my meals.	73	2 (1, 5)	4 (2, 5)	< 0.001
10. I feel confident in my ability to teach someone else how to count carbohydrates in their meals.	72	2 (1, 5)	4 (2, 5)	< 0.001
11. I feel confident in my ability to adjust insulin doses based on the carbohydrate content of my meals.	67	2 (1, 5)	4 (3, 5)	< 0.001
12. I feel confident in my ability to teach someone else how to adjust insulin doses based on the carbohydrate content of their meals.	67	2 (1, 5)	4 (3, 5)	< 0.001
13. I feel confident in my ability to adjust insulin doses based on glucose values.	67	2 (1, 5)	4 (4, 5)	< 0.001
14. I feel confident in my ability to teach someone else how to adjust insulin doses based on glucose values.	67	2 (1, 5)	4 (3, 5)	< 0.001
15. I understand the details needed to keep a complete blood glucose log.	67	2 (1, 5)	5 (4, 5)	< 0.001

[a] For each of the statements, students indicated their response on a Likert scale of 1 - 5, on which 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
[b] Based on Wilcoxon signed-rank test.

have gained will help me relate to patients and to find ways to help them help themselves. I want to be able to empower my patients and I think that this experience has given me the knowledge and understanding to do so."
"After having experienced diabetes for a week, I have come to appreciate the complexity of the condition and the many compliance issues that can arise and lead to complications. There is much more to diabetes management than knowing how to use your glucometer and how to inject insulin properly."

Although this course did not include development of students' patient education skills, by their own report, this immersion did build their skills and confidence in their ability to teach patients. The students' performance on the reflective writing exercise, logbook, quizzes, and group

presentations indicated that they did achieve the desired course outcomes. Overall, this course utilized a broad mix of pedagogical approaches, leading to a diverse learning environment that benefitted all types of learners.

According to student course evaluations, the biggest strength of this course was the simulation week. Students consistently ranked this experience as the best part of the course, and it was effective in meeting course goals. Student feedback from the first 2 offerings of the course indicated disappointment in the portion of the course that was taught by student groups. Most students would have preferred to have all of the course content taught by faculty members. Current course directors are expecting to make this change in the 2010 offering, with a concerted effort to ensure that active learning and class participation

remain integral pieces in this elective course. No specific changes to the course are planned as a result of the survey results because faculty members were pleased that the student self-assessment indicated improved confidence in the ability to perform diabetes self-management techniques and to teach these techniques to others. Consideration will be given to creating additional opportunities within the course for students to apply their new skills in a patient-care scenario through role-playing.

Similarities and differences exist between this elective course and other diabetes education programs. The University of Washington diabetes program requires students to spend 1 week role-playing a case pharmacist and 1 week role-playing a diabetes patient. During their week as a patient, students administer normal saline as insulin, candy as oral medications, and complete multiple daily glucose checks. This program yielded increases in student confidence in preparing diabetes management skills.[4] Drake University also offers specific diabetes education through a diabetes concentration, and one of the courses includes a "Living the Life" component, 24 hours of living with Type 1 diabetes and 48 hours of living with Type 2 diabetes.[5] These examples from the literature are similar to this elective in that they require students to experience daily injections and glucose checks. Our elective is unique in that it requires students to make insulin dose adjustments based on carbohydrate intake and simulated glucose values, as a person with Type 1 diabetes would do, for a full week.

A limitation of the survey is that students' skills were self-reported levels of confidence, rather than objectively assessed skills. There is evidence that confidence is not always associated with competence.[16] Also, our survey instrument was developed and reviewed by the investigators, and did not undergo further validity testing.

SUMMARY

This diabetes experience elective course provided students with the opportunity to immerse themselves into the life of a patient with insulin-dependent diabetes. Results of a preintervention and postintervention survey indicated that students' confidence increased in their ability to complete and to teach others basic diabetes management skills, such as glucose monitoring, insulin administration, carbohydrate counting, and appropriate insulin dose adjustments.

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