INSTRUCTIONAL DESIGN AND ASSESSMENT

Active-Learning Diabetes Simulation in an Advanced Pharmacy Practice Experience to Develop Patient Empathy

Heather P. Whitley, PharmD

Auburn University Harrison School of Pharmacy, Auburn, AL

The University of Alabama School of Medicine, Tuscaloosa, AL

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Objective. To develop and integrate an active-learning diabetes simulation into an advanced pharmacy practice experience to improve pharmacy students' empathy toward patients with diabetes mellitus.

Design. Students simulated the experience of having diabetes mellitus by conducting activities commonly prescribed to those with this disease state for 7 days, after which they submitted a standardized diabetes log and narrative reflection. Interpretive phenomenology design with thematic analysis was used to determine the impact of this experience on the students.

Assessment. As shown in student reflections, 95% developed empathy, 97% found the experience beneficial, and 67% improved their ability to relate to and counsel patients. Most (95%) found difficulty adhering to the regimen. On average, students consumed 179 grams of carbohydrates per day and exercised 5 days or 215 minutes per week. Additionally, 69% decided to modify their personal habits to become healthier.

Conclusions. Inclusion of the 7-day active-learning exercise greatly impacted student pharmacists' self-reported empathy toward and ability to relate to patients with diabetes mellitus. Completion of this experience may result in long-lasting personal behavior modifications.

Keywords: diabetes mellitus, advanced pharmacy practice experience, active learning, simulation, public health, empathy

INTRODUCTION

Healthcare-related education is shifting from traditional instructor-centered methods of dispensing information to learner-centered approaches of active learning.¹ To further enhance a learner-centered style of education, health-related disciplines have added simulation projects to some courses to further highlight aspects of certain disease states and patient populations. These include disability/rehabilitation,² low-vision,³ schizophrenia,⁴ HIV/AIDS,⁵ pediatrics,⁶ and geriatrics.⁷ Such active-learning educational strategies are encouraged within pharmacy curricula, as they are recognized by the Accreditation Council for Pharmacy Education Guidelines⁸ as a means of stimulating higher-order cognition, such as problem solving and critical thinking.⁹ The simulation exercise related to diabetes mellitus in this report was

developed and incorporated into a rural family medicine advanced pharmacy practice experience (APPE) at Auburn University Harrison School of Pharmacy.

Whether student knowledge is acquired through traditional lecture-based educational structures or more novel methods, such as team-based or problem-based learning, completion of a course does not ensure that students will have gained a competency level that includes empathy toward patients with specific diseases. Further, student empathy, altruism, and morality wane by the time a health degree is obtained.¹ Given that empathy is an essential component in the development of caring, therapeutic relationships with patients, empathy-building activities should be a required aspect of all healthcare curricula.¹⁰ Unlike other simulation exercises, many of which are aimed solely at improving student confidence, knowledge base, or problem-solving skills, this active-learning exercise was constructed to improve student pharmacists' empathy for patients with diabetes mellitus. The primary goal was to better prepare them to provide patient-centered diabetes management services, which may likely enhance the provision of clinical pharmacy services for other disease states as well.

Corresponding Author: Heather P. Whitley, PharmD, Associate Clinical Professor, The University of Alabama School of Medicine, Tuscaloosa, Institute for Rural Health Research, Box 870326, Tuscaloosa, AL 35487-0326. Tel: 205-348-1333. Fax: 205-348-9417. E-mail: whitlhp@auburn.edu

DESIGN

The active-learning diabetes simulation experience was integrated into a rural medicine ambulatory care APPE during which student pharmacists participated in patient encounters 4 half-days per week in 2 different rural Alabama counties (Hale and Walker). Clinical pharmacy duties centered on providing diabetes mellitus-focused pharmaceutical care for patients and informational in-service programs to healthcare practitioners. Both clinics functioned as practice experience sites for students of various health-related disciplines.

On the first day of each 5-week practice experience, the preceptor of the rural medicine ambulatory care APPE met with assigned student pharmacists for approximately 1.5 hours. During this orientation, various aspects of the practice experience schedule were addressed, including the completion of the active-learning diabetes-simulation experience. Pharmaceutical companies supplied needed resources for students: a glucometer, 25 testing strips, lancets, a lancing device, a carbohydrate counting book, a demonstration device, and a placebo insulin pen. A standardized documentation log was also provided for each student's use (Appendix 1).

Students were allowed to select any 7-day period during the 5-week practice experience to conduct this diabetes mellitus immersion investigation. By the end of the first week of the APPE, each student was required to have committed to a day on which this experience would commence. On their respective predetermined days, students were expected to begin incorporating the following tasks into their daily routine: check feet daily for circulation, sensation, and integrity; initiate an exercise routine consistent with the American Diabetes Association recommendations;¹¹ quantify the number of carbohydrates eaten at each meal or snack; and self-monitor blood glucose twice daily before eating meals, 2 hours postprandially 4 times during the week, and at least once at 3:00 AM. To create an elevated blood glucose value (students' personal self-monitored blood glucose readings were typically "normal"), they were to add 100 mg/dL to each self-monitored blood glucose value recorded. Based on an insulin sensitivity factor of 1:10 (meaning that 1 unit of rapid-acting insulin would lower blood glucose by 10 mg/dL) and an insulin-to-carbohydrate ratio of 1:5 (meaning that 1 unit of rapid-acting insulin would adjust blood glucose for elevations otherwise caused by 5 g of carbohydrates consumed), students were to calculate the correct rapid-insulin dose needed to compensate for the carbohydrate content consumed and necessary to adequately lower blood glucose to 120 mg/dL. Using the placebo insulin pen, students administered the calculated number of units into the

demonstration device before eating 2 meals daily and postprandially, as necessary. These specific activity requirements were chosen because they were either recommendations commonly prescribed to patient with diabetes mellitus¹¹ (foot care, exercise, glucose monitoring, medical nutrition therapy) or practices advised for patients who use rapid-acting insulin (insulin injection, insulin doses calculation).

Prior to this APPE, students had received multiple educational course modules devoted to topics related to diabetes mellitus during their second and third years of pharmacy education. The Contemporary Aspects of Pharmacy Practice courses provide hands-on laboratory-type education on diabetes mellitus topics, including carbohydrate counting and insulin dosing for type 1 diabetes mellitus, drug-therapy selection for type 2 diabetes mellitus, and insulin injection and glucometer techniques. During Integrated Pharmacotherapy, a team-based problem-solving course provided during the third year of education, students open and solve 2 separate cases focused on type 1 and type 2 diabetes mellitus. Given the extensive diabetes mellitus education provided earlier in the curriculum and the school's vision for student-led education, no additional background education was provided when the diabetes simulation experience was presented during the APPE orientation. If students did not remember how to conduct, calculate, or apply any of these activities or concepts, they were expected to engage in additional self-directed learning efforts as needed.

To gain further insight into patients' perspectives, students were instructed to interview 3 unrelated individuals who had diabetes mellitus regarding their ability to maintain healthcare recommendations for the disease state. Rather than being assigned individuals to interview, students were responsible for identifying individuals to interview and for scheduling and conducting the interview themselves. They could elect to interview family members, friends, community members, clinic patients, or any other individuals who had diabetes. Rather than conducting standard medical interviews, students were instructed to use the interview to learn how affected individuals live with, view, and cope with the disease. Each student was expected to document all activities (carbohydrate counting, exercise, feet evaluations, self-monitored blood glucose, and insulin doses) in a standardized log maintained throughout the week (Appendix 1) and to prepare and submit a typewritten 2-page single-spaced personal reflective narrative on the experience within 4 days of completing the exercise. Students were not required to specifically comment on the 3 interviews conducted, and presence or absence of these comments

did not factor into the evaluation of empathy or grade calculation. The required reflective compositions were graded based on the presence of spelling and grammar errors (loss of 2% per individual error) and failure to meet the submission deadline (5% loss per day late). The purpose of the paper was to help students explore their personal thoughts and feelings regarding this unique experience and to enable a deeper understanding of how they, as outsiders to diabetes mellitus, grew as healthcare providers as a result of the simulation.

Upon completion of the 7-day diabetes simulation experience and the reflective compositions, students were expected to have met 4 learning outcome objectives: (1) applying (ie, performing specific diabetes mellitus-related self-management tasks, including carbohydrate counting, self-monitored blood glucose via glucometer use, insulin dose calculation, insulin injection technique, and implementation of daily exercise; (2) understanding (ie, identifying challenging components of the standard diabetic regimen; (3) evaluating (ie, considering hindrances associated with long-term continuation of self-management efforts; and (4) creating (ie, developing empathy for those living with diabetes mellitus).

EVALUATION AND ASSESSMENT

The study design of subjective measurements found in students' reflective narratives followed interpretive phenomenology,^{12,13} and thematic analysis was used as the qualitative interpretive method.¹³ Both techniques are well-accepted methods of qualitative research and have been used in studies regarding numerous disease states, including diabetes mellitus.¹⁵⁻²⁰ Interpretative phenomenology is an assessment technique used to gather qualitative data,¹² while thematic analysis is a technique used to analyze data obtained through qualitative research.²¹⁻²³ In thematic analysis, the researcher identifies patterns and themes in a subject's life and/or behavior,¹⁴ which, in this study, consisted of a retrospective detailed investigation of participants' reflective writing about their active-learning diabetes simulation experience. Through an intense analysis of each narrative, transcripts were coded, allowing for the discovery of many recurring patterns of meaning throughout the text. The following superordinate themes emerged: developed empathy, found the experience beneficial/useful, developed new motivation to change personal lifestyle, expressed difficulty with regimen adherence, and identified helpful methods/tools for improving adherence. Each superordinate theme was further subdivided into themes, as appropriate per analyzed codes. A standardized data collection form was developed to quantify systematically the superordinate themes presented in students' personal reflections as

objective data. Four student pharmacists participated in cooperative inquiry to validate the utility of the data collection form and to ensure accurate interpretation of expressed concepts. Two separate blinded student pharmacists independently read the reflections and systematically recorded the data using the standardized form. Subsequently, the APPE preceptor verified accuracy of the data collection using the same technique and compared outcomes to those of the student pharmacists. This method of triangulation further ensured consistency of interpreted data. Data obtained from the standardized collection form were analyzed within Excel (Microsoft, Redmond, WA). This project received Institutional Review Board approval through exempt procedures at Auburn University.

From February 2007 through fall 2011, 39 student pharmacists completed the diabetes simulation experience; 69.2% (n=27) were female, and 25.6% (n=10) noted in their reflective narratives having a family history of diabetes mellitus. Nearly all students (n=37, 94.9%) reported developing empathy as a result of participating in this experience, and 97.4% (n=38) found the experience beneficial (Table 1). Improved ability to counsel/relate to patients was the most commonly reported theme related to experience benefits (n=26, 66.7%). Additionally, approximately 70% (n=27) of students decided to alter their personal lifestyle habits as a result of changed perspectives gained through participation (Table 2), and nearly all students (n=37, 94.9%) reported having difficulty adhering to the regimen (Table 3). Two-thirds (n=26, 66.7%) of students found the following tools and methods helpful: carbohydrate-counting book or electronic application (n=12, 30.8%), meal repetition (n=10, 25.6%), and setting reminders/alarms (n=9, 23.8%).

Data reported in students' standardized logs, created in Excel, were reviewed for objective measurements (Appendix 1). During the simulation experience, students exercised an average of 5 days (range, 3 to 7) for an average duration of 215 minutes per week (range, 90 to 360 minutes) and conducted foot inspections an average of 6 days (range, 3 to 7 days). On average, students

Table 1. Student Pharmacists' Self-Reported Development of Empathy and Benefits Achieved From Completing a Diabetes Simulation

Endpoints	No. (%)
Found experience useful	38 (97.4)
Developed empathy	37 (94.9)
Improved patient counseling	26 (66.7)
Assessed personal glycemic control	9 (23.1)
Refreshed self-monitored blood glucose technique	9 (23.1)

Table 2. Student Pharmacists' Self-Reported Anticipated Changes in Personal Behavior to Improve Health as a Result of Completing a Diabetes Simulation

Anticipated Behavioral Change	No. (%)
1+ Lifestyle Change	27 (69.2)
2+ Lifestyle Changes	11 (28.2)
3+ Lifestyle Changes	4 (10.3)
Gained self-health awareness	18 (46.2)
Dietary modifications	13 (33.3)
Exercise routine	9 (23.1)

reported consuming 179 grams of carbohydrates per day (range, 173 to 186 grams). Average fasting and postprandial blood glucose values ranged from 76 to 115 mg/dL and 88 to 111 mg/dL, respectively. The average blood glucose at 3:00 AM was 89 mg/dL (range, 70 to 109). Based on their self-monitored blood glucose values, reported carbohydrate intake, and assigned insulin sensitivity factor and insulin-to-carbohydrate values, students were able to correctly calculate their needed insulin doses with an overall accuracy rate of 77.3%, based on an average of 20 dosing attempts per week (range, 13 to 28). Postexperience reflections revealed that students found the simulation regimen challenging, appreciated being able to refresh their knowledge of device use and carbohydrate counting, and experienced increased empathy for those with diabetes mellitus.

DISCUSSION

Given the annually increasing prevalence and economic cost associated with diabetes mellitus, most if not all doctor of pharmacy (PharmD) programs across the nation are likely providing student education regarding proper management of the disease state. However, no intervention has yet been documented to specifically develop and positively impact empathy in students.

Table 3. Student Pharmacists' Self-Reported Difficulty Adhering to a Self-Care Regimen as Part of a Diabetes Simulation

Difficulty	No. (%)
Difficulty in regimen adherence	37 (94.9)
Found difficulty in 2+ adherence areas	31 (79.5)
Found difficulty in 3+ adherence areas	16 (41.0)
Self-monitoring schedule	22 (56.4)
Anxiety with needles	18 (46.2)
Carbohydrate counting	18 (46.2)
Time consuming	14 (35.9)
Self-monitoring technique	11 (28.2)
Exercise regimen	9 (23.1)
Foot inspections	2 (5.10)

Those enrolled in pharmacy programs are generally young adults in relatively good health. A review of the objective self-monitored blood glucose measurements indicates that none of the students participating in this project had diabetes mellitus; this finding was confirmed through personal interactions with each student. Few if any of them had taken medications on a lifelong basis or had to conduct daily activities like blood glucose testing, carbohydrate counting, and foot inspections. Prior to the simulation experience, most of the student pharmacists probably did not have an appreciation for the struggles of monitoring a disease state, day after day, and therefore could not personally identify well with patients in that position. The addition of the diabetes-simulation experience facilitated development of empathy in student pharmacists, as suggested by their reflective narratives. Many students commented that they would be much more considerate and realistic when providing self-care recommendations to patients and would be more understanding and compassionate when patients did not adhere to all aspects of the prescribed therapeutic plan.

Most of the expected learning outcome objectives were met by each student through completion of the diabetes simulation experience. Every student was required to perform the diabetes mellitus self-management tasks throughout the weeklong activity. Although students' ability to perform these tasks was not evaluated for clinical accuracy, one-fourth (23.1%, n=9) commented in their reflective narratives on their improved ability and comfort level with performing technique-related tasks, such as using a glucometer, administering insulin, and counting carbohydrates. Nearly all students (94.9%, n=37) found the experience challenging and were able to identify hindrances associated with maintaining self-management efforts for a mere 7 days and reflected on their likely inability to do so for longer periods of time. Almost all (95%) reported developing empathy for patients with diabetes mellitus. Future studies may include a baseline and postintervention assessment of empathy using a standardized and validated survey instrument.²⁷ They also may include administration of pre- and post-interventional diabetes knowledge assessments to provide further insight into actual improvements in self-monitored blood glucose and insulin administration techniques, dietary and disease state monitoring assessments, and learning progression throughout the experience.

Despite student pharmacists' positive experience, several alterations could be made in the future to better simulate a more realistic experience of an individual with diabetes mellitus. The date of initiating the exercise could be assigned or even imposed immediately on an

unannounced practice experience day, rather than allowing each student to select the date and prepare for project initiation. This modification would more closely mimic how patients often abruptly learn of their new diagnosis. Students could also be required to align their diet to the United States Department of Agriculture recommended "My Plate"²⁶ or to take inventory to identify the greatest glucose-influencing items in their diet and reduce or eliminate consumption of those items. In the current simulation experience, without diet adjustment, students self-evaluated and reflected on their current personal eating habits. Personal assessment of carbohydrate content in their commonly ingested foods may have a greater impact over time compared with an enforced and unwelcome dietary modification. The insulin-to-carbohydrate ratio and insulin sensitivity factor provided, which are those found in more-resistant individuals, could be adjusted for less-resistant patients. The postprandial goal of 120 mg/dL, which is unnecessarily low, could be adjusted to 180 mg/dL or 140 mg/dL. However, the exceptionally strict postprandial goal and low insulin-to-carbohydrate ratio and insulin sensitivity factor were specifically selected to force the insulin dose calculation toward higher units, allowing for a more sensitive assessment of students' accuracy in calculating the insulin dose. An additional placebo insulin pen could be added to mimic the use of basal insulin therapy. Rather than using a demonstration device, students could self-administer the normal saline placebo insulin injections to better simulate a real-world experience. Alternatively, students could simply conduct a 1-time self-injection with a normal saline placebo insulin pen to better grasp the level of pain and anxiety associated with the event, with the remainder of injections being administered into the demonstration device. Placebo tablets could be added to mimic oral medications commonly used by those with type 2 diabetes mellitus, such as metformin, HMG-CoA reductase inhibitors, angiotensin-converting enzyme inhibitors, and aspirin. Although limited funding prevented implementation of these additional aspects of the disease, the students collectively found the diabetes simulation experience challenging and beneficial.

Based on the requirements for project completion, this diabetes simulation experience most closely resembled 1 for those using rapid-acting insulin with carbohydrate counting to help control diabetes mellitus. With the highest national prevalence of diabetes mellitus in Alabama (13.2% compared to the national prevalence of 8.7%)²⁴ and an even greater prevalence of the disease in rural counties of Alabama (eg, 14.5% in Hale County and 11.7% in Walker County),²⁵ many patients followed in these locations were using insulin-based regimens, including both basal and bolus insulin products. Therefore,

the implementation of a simulation exercise that helped APPE students gain familiarity with frequently prescribed products, including those for extremely uncontrolled diabetes mellitus, was appropriate.

Although this diabetes simulation experience most closely reflects activities performed by those using insulin, the self-reported empathy gained may translate to patients using only oral medications. The most commonly reported points of difficulty related to blood glucose monitoring (testing schedule and anxiety about lancet use) and carbohydrate counting rather than insulin calculation or administration. Given that glucose monitoring and carbohydrate counting are commonly prescribed to patients with diabetes mellitus, the self-reported empathy gained through this simulation exercise should likely extend to these patients as well.

The addition of the diabetes simulation experience to the APPE resulted in a unique and unexpected benefit. As a result of completing the experience, nearly 70% of students decided to alter their personal behaviors to improve their health or became more acutely aware of their current health status. The most common personal changes were related to improved dietary habits (33%) and physical activity (23%). In the second most obese state in the most obese nation globally, such a benefit on a public health scale is noteworthy. If every health professional student could participate in a similar active-learning exercise in which two-thirds are positively impacted regarding their personal health, large-scale benefits could be achieved over the long term. These students would not only reduce their personal health risks but also model good lifestyle choices for the family, community, and patients, which in turn would facilitate better lifestyle activities for those within their circles of influence.

Based on the benefits student pharmacists received from completed this experience, it has been adapted for a third-year course for medical students to complete as a Special Topics Week at The University of Alabama. With grant funding secured to cover supplies, the first group of medical students completed the course in April 2011. Data comparing pharmacy and medical students' reflective narratives as well as objective measurements will be analyzed in future years.

Other colleges and schools of pharmacy have developed unique educational efforts to provide enhanced learning experiences to students about diabetes mellitus. These have included a semester-long systems course for first-year students,²⁸ skills-based laboratory for second-year students,²⁹ problem-based learning in a clinical therapy course,³⁰ semester-long elective including a 1-week simulation for second- and third-year students,³¹ simulation during a clinical assessment course for third-year

students,³² lecture and case-based role-play for third-year students,³³ service-learning at a children's diabetes mellitus camp for fourth-year students,³⁴ and a 1-day simulation for pharmacy managers (postgraduate education).³⁵ While several of these educational efforts have listed "development of empathy for diabetes mellitus patients" as a learning objective, few have successfully quantified achievement. The inclusion of the diabetes simulation experience in an APPE, however, not only helped reinforce material previously learned during earlier years of pharmacy school but also improved self-reported empathy toward patients. Allowing students to reflect on their personal experiences without predefined guidance encouraged genuine introspective self-assessment. Use of thematic analysis simply provided a method of quantifying the frequency of common themes, including development of self-reported empathy, in a noncoerced approach. Overall, this simulation exercise of immersion and method of free-form exploratory reflection in conjunction with thematic design proved to be an exceptionally beneficial educational opportunity for students. Although this simulation experience centered on 1 disease state, helping students identify barriers and hurdles to medication and behavior adherence through the eyes of a patient may help them consider similar obstacles with other disease states in their future practices. Developing a week-long active-learning simulation experience based on the most common disease states encountered in all APPE courses to specifically improve health care professional student pharmacists' empathy would likely be a novel and welcomed addition by students and colleges.

SUMMARY

Implementation of this 7-day experience provided many benefits for fourth-year PharmD students, including increased self-reported empathy for patients, improved ability to relate to patients, increased comfort level with patient interactions, and heightened awareness toward and bolstered behavioral modifications related to personal health habits. The experience may be altered in the future to enhance adherence measures and to compare medical students' responses to those of student pharmacists.

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Appendix 1. Day 1 of the 7-Day Log Used by Students Participating in a Simulated Diabetes Experience

Day 1	Preprandial BG (Select 2 meals for readings)	Total CHO in Meal	Total Insulin Requirements	2hr Postprandial Readings	Total CHO/Total Insulin for day	3 a.m. BG Reading (at least 1 for the week)
☐ Check if Foot Exam performed ☐ Check for exercise day: Activity _____ Duration _____						
Breakfast:						
Lunch:						
Dinner:						
Snacks:						