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## Development and Evaluation of a Diabetes Themed Escape Room for Students Completing an Ambulatory Care Advanced Pharmacy Practice Experience

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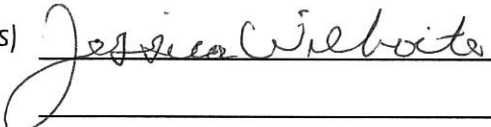
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Applicant Katherine Brown  
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Thesis title Development and Evaluation of a Diabetes Themed Escape  
Room for Students Completing an Ambulatory Care  
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Date

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Date

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**Development and Evaluation of a Diabetes Themed Escape Room for Students Completing  
an Ambulatory Care Advanced Pharmacy Practice Experience**

A Thesis

Presented to the Department of Pharmacy, College of Pharmacy and Health Sciences

and

The Honors Program of Butler University

In Partial Fulfillment

of the Requirements for Graduation Honors

Katherine Frances Brown, PharmD Candidate, Butler University

March 7, 2021

# Development and Evaluation of a Diabetes Themed Escape Room for Students Completing an Ambulatory Care Advanced Pharmacy Practice Experience

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## Abstract

**Introduction:** Escape rooms are a novel form of entertainment that have become increasingly popular in the United States. The idea of an escape room has great potential for educational purposes as well. In professional healthcare schooling, they have been used to supplement what students learn in the classroom. Interactive learning through the use of an escape room has been studied in the setting of pharmacy students completing their third year of traditional didactic learning. As of yet, there is no published literature that analyzes the use of escape rooms in the Advanced Pharmacy Practice Experience (APPE) setting.

**Objectives:** The primary objective of this study was to evaluate student knowledge retention following participation in a diabetes themed escape room used for APPE students completing an ambulatory care rotation. The secondary objective of this study was to evaluate student satisfaction of this learning activity.

**Methods:** The study consisted of a 10-question knowledge assessment to be taken before and after APPE students completed the escape room activity. Students were also given a 14-item survey to provide feedback on the escape room activity itself. Students received assessments and surveys electronically and completed them through Qualtrics software, Version 2019 of Qualtrics. All survey responses were obtained anonymously and no identifiable information was collected. Students on rotation from January 2020 through February 2021 were given the option to participate in the study.

**Results:** Fifty-six students participated in the escape room activity and 46 students (82%) completed some portion of the pre/post assessment and survey. Sixteen students completed all portions of the pre/post assessment and were able to be matched for analysis. A paired t-test was used to analyze assessment questions. The mean ( $\pm$  SD) score for pre-assessment was  $76.25\% \pm 11.47$  and  $83.75\% \pm 9.57$  for post-assessment with a p-value of 0.0285. Twenty-four students completed the satisfaction survey following completion of the escape room and reported generally positive feedback for the escape room as an educational activity. Nineteen students (83%) agreed that this activity should be continued in the future.

**Conclusion:** This escape room activity helped students understand a specific health-related topic and how it is utilized in practice through an enjoyable and team-building method. High rates of satisfaction among students indicate continued future use of this learning activity. Further studies consisting of a larger number of participants are needed to further assess how effective this teaching method is for knowledge retention.

## **Introduction**

Escape rooms are a novel form of entertainment in which teams of players “must use and manipulate their surroundings to escape an enclosed area or achieve a goal within a set amount of time.”<sup>1</sup> This type of activity has become increasingly popular in the United States and many companies have developed their own versions of the game in a majority of large cities, totaling over 2,300 escape rooms in the US in April 2018.<sup>2</sup> Through the utilization of puzzles, clues, and mind problems, teammates must work together toward a common goal of completing the activity within a timely manner.

While most escape rooms in the United States are aimed at entertaining, the idea of an escape room has great potential for educational purposes as well. Problems that humans face in real life are best learned when people are put into situations that mimic real-life.<sup>3</sup> With an escape room, scenarios are created to develop a theme or story-line to help students better envision how they can utilize their knowledge beyond a typical lecture or written assessment. By being able to work together, students can also collaborate and brainstorm ideas, as they likely would be able to in “the real world.”<sup>3</sup> This hands-on learning model can provide many benefits to students, including better retention of material, improved engagement with the material, and practice of critical thinking skills.<sup>4</sup>

In professional healthcare settings, escape rooms and similar activities have been utilized to supplement and enhance what students learn in the classroom. Interactive learning through the use of serious games has been used to train students in the surgical field, both in terms of technical and non-technical skills.<sup>5</sup> Nurses in Philadelphia also developed an escape room to educate non-nursing healthcare colleagues on how to most effectively treat sepsis.<sup>6</sup> Escape rooms have also been utilized in a didactic setting for students in the healthcare field. In addition, it has

been shown that having effective communication skills, which are often utilized in escape rooms, is just as important as having clinical knowledge.<sup>7</sup> Escape rooms are a fun, collaborative way to engage with the material and with peers and instructors, and they can stimulate conversation topics following the activity.

Escape rooms are being used more frequently in educational and healthcare settings and there is some data on the improvement of knowledge for students using escape rooms in the didactic setting.<sup>8</sup> Little information has been collected to show that escape rooms increase student knowledge of diabetes in the APPE setting. While a comprehensive review of an escape room has been done in a didactic setting, it has not been completed in a clinical setting and been evaluated for efficacy.<sup>8</sup>

More specifically, the escape room as a learning tool can be applied in the healthcare setting for pharmacy students. A study looked at students completing their final year of didactic learning of pharmacy school.<sup>8</sup> However, as of yet, there is no published literature that analyzes the use of escape rooms in the APPE setting. The ambulatory care clinical pharmacy department at Community Health Network (CHN) wanted to develop an escape room to enhance the learning of their APPE students. An escape room was developed surrounding the topic of diabetes and how to best provide care to patients with diabetes. The design for the escape room was derived from Eukel and colleagues and utilized puzzles such as word searches, word jumbles, math riddles, and combination lock decoding, as well as a simulated patient counseling session.<sup>8</sup> Ambulatory care pharmacists are heavily involved in the management of diabetes at CHN, therefore the goals of this escape room were to create a more robust diabetes-focused training among APPE students and to standardize instruction from various faculty members and pharmacists.

In order to contribute to the information base on escape rooms utilized in an experiential format, APPE students completing ambulatory care rotations at Community Health Network were given a satisfaction survey to provide feedback on the escape room activity, as well as a pre-test and post-test to evaluate for any improvement on understanding of the material.

## **Methods**

### ***Research Design***

The escape room design was originally an in-person activity involving puzzles and locks. In March 2020, the in-person escape room was put on hold. In June 2020, the escape room was converted to a virtual format through Google Forms and completed through that platform for the remainder of the study period. The study consisted of a 10-question knowledge assessment (Appendix A) that was taken before and after APPE students completed the escape room activity. Students were also given a 14-item survey (Appendix B) to provide feedback on the escape room activity itself. Students were also informed that while completion of the escape room is mandatory, the survey and knowledge assessment was voluntary. Students could elect to cease participation in the survey and knowledge assessments at any point without penalty. There was no grade or score associated with completion of the survey and knowledge assessments for students wishing to participate. Students received both assessments electronically and completed them through Qualtrics software, Version 2019 of Qualtrics. All survey responses were obtained anonymously, and no identifiable information was collected.

### ***Inclusion Criteria***

All APPE students completing an ambulatory care rotation at CHN starting in fall 2019 who participate in the escape room activity were asked to complete the corresponding questionnaires.

### ***Exclusion Criteria***

None.

### ***Data Collection***

Question responses were collected at the conclusion of the February 2021 rotation and were organized for analysis. Demographic data including gender and age was also collected. All survey responses were obtained anonymously, and no identifiable information was collected.

### **Results**

#### ***Patient characteristics***

From January 2020 through February 2021, 56 students participated in the diabetes escape room as a part of their rotation. A total of 46 students completed some portion of the study materials, consisting of a pre/post knowledge assessment and satisfaction survey, shown in Figure 1. Sixteen students finished all portions of the knowledge assessment and were able to be matched for analysis. Twenty three students completed the satisfaction survey for analysis. Of the 16 students that participated in the knowledge assessment, 6 (37.5%) were male and the mean age (range) was 24.1 (23-30) as shown in Table 1.

#### ***Primary Outcome***

For all students that answered the knowledge assessment (including unmatched students), the mean score for pre-assessment was 74.85% (n=35) and the mean score for post-assessment was 85.6% (n=25). For matched students, the mean score for the pre-assessment was 76.25% and mean score for the post-assessment was 83.75% (Table 2). Eight individual student scores improved after having completed the escape room activity. Fifty percent (n=8) of students improved their score by one or two questions, and seven students kept the same score for both pre- and post-assessments. One student score dropped after having completed the escape room.



Results of a paired t-test showed improved scores following completion of the escape room (-14.1, -0.9;  $p=0.0285$ ) and were statistically significant.

Looking into each individual question, Table 3 shows the breakdown of scores for the pre- and post-assessment. Questions 1 and 8 were answered correctly 100% of the time, both prior to and following participation in the escape room. These questions involve first line treatment of diabetes and route of administration for medications, respectively (Appendix A). Such high scores to begin with may indicate that these topics do not need to be addressed in future escape rooms, as those topics may already be understood well by students coming into rotations. Questions 3 and 5 showed the greatest amount of improvement between pre- and post-assessment scores. Question 7 performed the worst, both before and after completion of the escape room. Response rates for the pre-assessment and post-assessment were 77.78% ( $n=35$ ) and 44.64% ( $n=25$ ) respectively.

### ***Secondary Outcome***

Out of the 56 students that completed the escape room during the study period, 23 completed the satisfaction survey (Appendix B).. Eighteen students had completed an educational escape room in the past and all students agreed that they learned something new during the activity. Only 4 students agreed with the statement that they felt somewhat stressed during the escape room, while all students felt that they utilized successful teamwork and got a good review of devices used in diabetes treatment. Only 1 student preferred traditional learning over more unique experiences such as the escape room and two students indicated that the puzzles and locks element of the escape room distracted from their learning experience. All students enjoyed the simulation aspect of the activity and felt that it stimulated further conversation and bonding with peers. All students also recommended that this specific activity

be continued with future APPE students; however, only 19 students stated they would like to see more escape room activities in the pharmacy curriculum (Figure 2).

Qualitative data from students regarding positive feedback, or strengths of the escape room, include adjectives such as “fun,” “different,” “active,” “engaging,” “informative,” and “educational.” One student praised “collaboration with peers” and “use of creative problem solving skills” that were utilized during the escape room. Another student appreciated that it “accommodated varied learning styles.” A third student enjoyed the “opportunity to share knowledge with each other and think out loud through discussion.” Conversely, students included a few opportunities for improvement for future utilization of the escape room, including making “instructions for Google Form more clear [for virtual edition],” adding “more questions about insulin dosing” and “more escape rooms for other topics,” and including a review or “answer key at the end.” The response rate for the satisfaction survey was 41.07% (n=23).

## **Discussion**

Overall, students improved knowledge retention scores after completion of the escape room, indicating that the activity has some utility as a learning activity. Generally, students had positive feedback for the experience and would like to see it continued in the future. This activity also provided students with opportunities to collaborate with peers, work as a team, and discuss varying viewpoints through a fun and interactive experience. While having a proper knowledge base is important, these skills practiced through the escape room will also be extremely beneficial as healthcare professionals.

Knowledge questions regarding first line treatment of diabetes and route of administration for medications had strong performance on the knowledge assessment both before and after completing the escape room. Such high pre-assessment scores on these questions may

indicate that these topics do not need to be addressed in future escape rooms, as those topics may already be understood well by students coming into rotations. Questions 3 and 5 showed the greatest improvement in scores, indicating that they likely were addressed appropriately during the escape room and helped students learn and retain knowledge. These questions related to guideline updates and renal dose adjustments for medications, respectively. Question 7 regarding black box warnings performed the worst overall for both pre- and post-assessment. These low scores indicate that students may not have a good knowledge base of black box warnings and that the escape room may have room for improvement as far as addressing this topic. Future considerations include adding additional puzzles or modifying the current puzzles to adapt to student knowledge gaps.

A unique strength of this study was the ability to transition to a virtual format in light of a global pandemic limiting in-person interactions. As the world of healthcare and specifically ambulatory care had to adapt to decreased face-to-face interactions, so did the educational world. While traditional escape rooms are done solely in person, this activity was able to be completed while discussing strategies and ideas with teammates through a video format. The final puzzle of the escape room included a “patient counseling” simulation and this was still able to be completed through video as well.

Of the 56 students that completed the escape room, only 11 students did the activity in person, while the remaining 45 students completed it virtually. One limitation of this study is that it was not designed to evaluate in-person data compared to virtual data. Because 80% of students completed the escape room virtually, it may be fair to speculate that the data supports success in a virtual format.

In addition, the virtual aspect of the escape room may have limited the utility of some interactive and tactile parts that students would have gotten had they completed an in-person experience, including lock utilization and using paper and pen to work on the puzzles. Most importantly, the final puzzle of the escape room was originally intended to be a hands-on simulation for students to teach a patient how to give a self-injection. This experience was limited to teaching through video after switching to virtual.

This study came with other limitations. First and foremost, the study sample was small and only took place at one facility. Ideally, more students would have participated in the assessments and survey to provide more robust feedback and data. For comparison, a similar study in design cited a response rate of 95% for a perception survey<sup>8</sup>; however, it is unknown if that study associated grades or extra credit for students based on whether or not they responded. With a response rate of 41% for the satisfaction survey, there is concern for reporting bias if students who were satisfied with the activity were more likely to complete the survey.

A future consideration for this activity would be to compare this educational intervention to a control or placebo group. This activity could be an addition to or a replacement of traditional learning styles such as a classroom lecture or student topic discussion. Without comparing to a control, it is difficult to determine whether or not the escape room itself enhanced the knowledge retention of students compared with what they would have retained in the absence of the escape room. Further studies of a larger population and with a comparator group may be needed to continually assess the utility of this activity as an educational tool in the APPE setting.

Regarding logistics of the assessments, there was no time restriction for students completing the post-assessment, meaning that they may have finished the assessment immediately following the escape room or they may have waited until later in the rotation to

complete. Future studies may include a third follow up assessment a few days or weeks after completion of the escape room, or may allow for more time between completion of the escape room and completion of the post-assessment. Addressing this may give a better understanding of knowledge retention over the long term. Future studies may also analyze preceptor or proctor perspectives on how the activity can be improved from a moderator standpoint.

## **Conclusion**

As students near the end of their pharmacy education, more and more creative and unique learning opportunities may be necessary to help create more knowledgeable and versatile pharmacists and to mimic real-world situations that will be seen as a practicing pharmacist. This study analyzed an escape room as an educational activity for pharmacy students and showed that utilization of the activity improved students' scores on an assessment testing diabetes knowledge. Additionally, student satisfaction survey results showed overall positive feedback. Most commonly, students enjoyed working as a team. This escape room was found to be a beneficial part of the curriculum for students completing an APPE in the ambulatory care setting at Community Health Network and will continue to be offered for future rotations.

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Figure 1: Participants Included

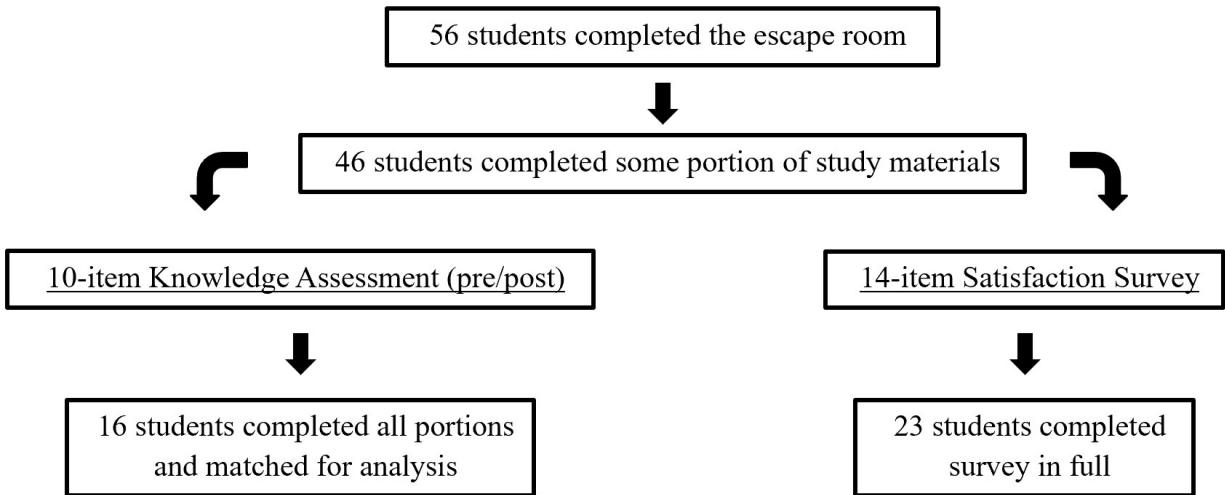


Table 1: Participant Demographics

Demographics	
Sex, n (%)	
<i>Male</i>	6 (37.5)
<i>Female</i>	10 (62.5)
Age, n (%)	
23	7 (43.8)
24	6 (37.5)
25	2 (12.5)
30+	1 (6.3)



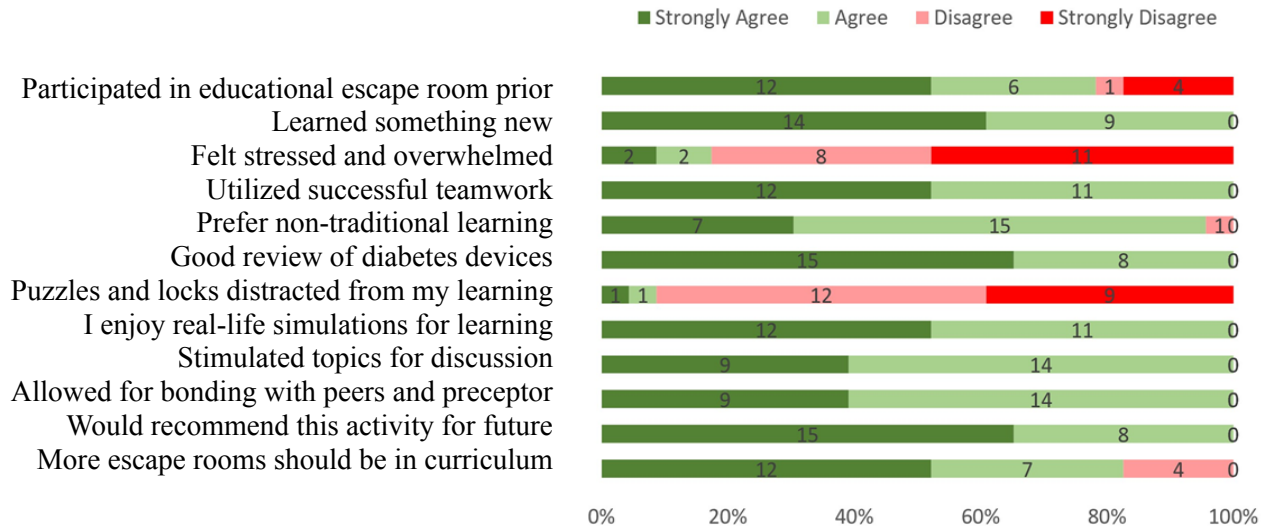
Table 2: Knowledge Assessment Paired Scores

Student	Before Score	After Score	Difference
1	100	80	-20
2	80	90	10
3	80	80	0
4	80	100	20
5	80	80	0
6	80	80	0
7	80	80	0
8	70	90	20
9	90	90	0
10	60	90	30
11	70	70	0
12	80	90	10
13	50	60	10
14	70	90	20
15	80	80	0
16	70	90	20
Mean	76.25	83.75	7.5

Table 3: Knowledge Assessment Scores Breakdown

Question	Students answering correctly (pre-assessment), n (%)	Students answering correctly (post-assessment), n (%)
1	16 (100)	16 (100)
2	13 (81.3)	14 (87.5)
3	9 (56.3)	12 (75)
4	14 (87.5)	13 (81.3)
5	7 (43.8)	10 (62.5)
6	13 (81.3)	13 (81.3)
7	6 (37.5)	8 (50)
8	16 (100)	16 (100)
9	13 (81.3)	15 (93.8)
10	14 (87.5)	16 (100)

Figure 2: Satisfaction Survey Results



## Appendix A: Student Knowledge Assessment

1. Which of the following is an appropriate first line oral agent for the treatment of Type 2 diabetes?
  - a. Januvia® (sitagliptin)
  - b. Glucophage® (metformin)
  - c. Victoza® (liraglutide)
  - d. Lantus® (insulin glargine)
2. What is the standard A1C goal for all patients with diabetes (T1DM and T2DM), according to the ADA?
  - a. <6.0%
  - b. <6.5%
  - c. <7.0%
  - d. ≤7.0%
3. Which answer choice correctly reflects how often standard guidelines are set and by what corresponding organization?
  - a. Updated yearly by the American Diabetes Association
  - b. Updated every other year by the American Association of Clinical Endocrinology
  - c. Updated every 3 years by the American Diabetes Association
  - d. Updated every 5 years by the American Association of Clinical Endocrinology
4. Which of the following reduces Major Adverse Cardiovascular Events (MACE)?
  - a. Jardiance® (empagliflozin)
  - b. Onglyza (saxagliptin)
  - c. Ozempic® (semaglutide)
  - d. Tradjenta® (linagliptin)
5. Which of the following drugs does NOT have dosing adjustments in patients with renal impairment?
  - a. Farxiga® (dapagliflozin)
  - b. Byetta® (exenatide)
  - c. Januvia® (sitagliptin)
  - d. Actos® (pioglitazone)
6. Which of the following drugs has the greatest potential to cause hypoglycemia?
  - a. Invokana® (canagliflozin)
  - b. Amaryl® (glimepiride)
  - c. Humalog® (insulin lispro)
  - d. Januvia® (sitagliptin)
7. Which of the following drugs does NOT have a black box warning?
  - a. Trulicity® (dulaglutide)
  - b. Invokana® (canagliflozin)
  - c. Actos® (pioglitazone)
  - d. Onglyza® (saxagliptin)
8. Which of the following is NOT given subcutaneously?
  - a. Victoza® (liraglutide)
  - b. Steglatro® (ertugliflozin)
  - c. Lantus® (glargine)
  - d. Novolog® (aspart)

9. Which of the following is NOT an appropriate choice for T2DM patients receiving once daily injections of long acting insulin?
- Tresiba® (degludec)
  - Lantus® (glargine)
  - Levemir® (detemir)
  - Humulin N® (NPH)
10. How would you counsel a patient starting insulin injections using an insulin pen?
- When using a 4mm pen needle, injections MUST be given at a 45-degree angle.
  - It is not always necessary to use an alcohol swab to clean your skin before giving an injection.
  - Be sure to rotate your injection sites to avoid buildup of scar tissue.
  - You must prime your insulin pen with at least 4 units of insulin prior to every injection.

## Appendix B: Student Perception Survey

*Disclaimer: Completing this survey is voluntary and you may stop at any time without penalty. You are not required to participate in the surveys to participate in the escape room.*

Answer choices: strongly agree, agree, disagree, strongly disagree

1. I have participated in an escape room for educational purposes before this activity.
2. I learned something new from this activity.
3. This escape room activity made me feel stressed and overwhelmed.
4. I utilized successful teamwork while working through the escape room.
5. I prefer learning in a setting other than traditional classroom lectures.
6. This escape room helped me review the various products that patients with diabetes may be using.
7. The non-educational portions of the escape room (puzzles, locks, etc.) distracted from my learning experience.
8. I enjoy doing activities that simulate real-life situations in order to enhance my learning experience.
9. The escape room stimulated topics for discussion with my preceptor following the activity.
10. This escape room allowed me to bond with my peers and preceptor.
11. I would recommend continuing this activity for future APPE students.
12. More escape room activities should be incorporated into the pharmacy curriculum.

What are the strengths of this activity?

What can be improved for future utilization of this activity?