



PROGRAMME DESCRIPTION

An escape room activity to teach transitions-of-care: Student perceptions and lessons learned

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Abstract

Introduction: Outside of experiential pharmacy education, there is a lack of curricular innovations focused on teaching transitions-of-care (TOC) to pharmacy students. **Description of Innovation:** A TOC escape room activity was implemented for pharmacy students after learning about diabetes management in the didactic curriculum. A perceptions survey and pre-and post-activity knowledge assessment were administered to assess student knowledge attainment and allow for continual improvement of the activity. **Evaluation:** The majority of students perceived that the escape room activity improved their readiness to treat patients with diabetes during care transitions. The escape room significantly improved knowledge, as demonstrated by an increase in mean scores between pre-and post-activity knowledge assessments. **Future Implementation:** Though the escape room activity was perceived by pharmacy students as an enjoyable opportunity to apply material from a didactic setting, many challenges related to content development, assessment administration, logistics, and material complexity were experienced.

Introduction

Although increasing in number, only a third of hospitals in the United States report having transitions-of-care (TOC) pharmacy services (Pedersen, Schneider, Scheckelhoff, 2017). Transitions-of-care programmes are essential to reduce hospital readmissions, accounting for approximately USD 25-45 billion in medical costs annually (Jencks, Williams, 2009; Burton, 2012). Contributors to hospital readmissions include poor communication or coordination of care, incomplete discharge planning, and limited access to outpatient care (Jencks, Williams, 2009; Dharmarajan *et al.*, 2013). Medication-related problems (MRPs), including polypharmacy, high-risk medications, and inappropriate prescribing, are also a prominent cause of hospital readmissions (Rodrigues, 2017). There is an imminent need to integrate TOC concepts into the pharmacy curricula, which align with Domain 2:

Essentials for Practice and Care of the Center for Advancement of Pharmacy Education 2013 Education Outcomes and several core Entrustable Professional Activities (Medina *et al.*, 2013; Haines *et al.*, 2017).

Student participation in TOC pharmacy services is well-established in the setting of experiential education. However, pharmacy student exposure to TOC processes within the didactic curriculum appears to be lacking. In a recent survey of 36 pharmacy practice department chairs, the median number of curriculum hours devoted to TOC education was four (Eltaki *et al.*, 2018). Medication history and communication skills were largely taught in laboratory sessions, and a small percentage of pharmacy programmes offered interprofessional activities. The authors identified the following barriers to didactic implementation of TOC concepts: uncertainty of placement in the pharmacy curriculum, resistance by faculty and administration, and inadequate faculty training (Eltaki *et al.*, 2018).

Given these barriers, there exists an opportunity to create TOC-focused educational materials that can be easily implemented in the didactic setting. Curricular innovations focused on TOC that are implemented early within pharmacy education, including elective courses, laboratory simulations, and educational games, are generally well-received by students and activity facilitators (Sen *et al.*, 2016; Serag-Bolos *et al.*, 2017). More recently, the escape room has increased in popularity among various health professions, including pharmacy, nursing, and medicine (Zhang *et al.*, 2018; Brown, Darby, Coronel, 2019; Cain, 2019). The escape room utilises a hands-on, team-based approach toward problem-solving by requiring team members to solve puzzles to escape a locked room. Since the activities are usually timed, students must demonstrate critical thinking, effective communication, and interpersonal skills to escape successfully.

Overall, the escape room activities proved to be informative and engaging from the student's perspective. This educational game can also be applied to a variety of conditions. Within pharmacy education, escape rooms have been designed to assess student knowledge in diabetes, infectious diseases, and pharmacy management (Eukel, Frenzel, Cernusca, 2017; Cotner *et al.*, 2018; Cain, 2019). To date, an escape room activity focusing on TOC knowledge and skills has not been studied in the health professions literature. In this paper, the authors describe the preparation process, successes, challenges, and future considerations related to a TOC diabetes escape room implemented in a large classroom setting.

Description of innovation

The escape room is an innovative activity designed to test the knowledge and problem-solving abilities of individuals. The goal is to “escape” from each room by solving a series of puzzles within a specified time frame. In order to enhance the application of TOC interventions in diabetes management, the authors created an activity requiring students to use knowledge learned in didactic courses to solve diabetes-related puzzles to “escape” the room. At The University of North Texas Health Science Center at Fort Worth, College of Pharmacy, the innovative TOC escape room was housed in the Integrated Pharmacotherapy (IPT) Recitation course, which facilitates the application of didactic material taught within the systems-based IPT sequence. The TOC escape room was developed by the faculty members who taught outpatient and inpatient diabetes management (eight hours and three hours, respectively) in the IPT Endocrinology and Male/Female Health course for second-year pharmacy students. Four total hours of the recitation course, split between two weeks, were utilised for the activity. The TOC escape room was completed in Spring 2019 and 2020, with some changes between the years that are described later in the Challenges and Future Implementation section. Table I summarises the steps and considerations for planning the TOC escape room activity.

Table I: Steps to planning a transitions-of-care escape room

Planning stage	Questions to answer
Brainstorming	<ul style="list-style-type: none"> - What is the curricular need for an innovative approach to learning? - What topics can be reinforced through active learning or group work? - Where in the curriculum can the escape room activity be implemented? - How far in advance do I need to plan?
Consultation with Faculty and Administration	<ul style="list-style-type: none"> - Who are the stakeholders that will influence the outcome of the project? (e.g., information technology, course faculty, support staff) - What logistics should course directors consider prior to integrating an escape room activity into their course?
Securing resources	<ul style="list-style-type: none"> - What facilities are available where students can transition from one room to another? - What funds are required to rent facilities, purchase materials, or hire facilitators or actors?
Assessment	<ul style="list-style-type: none"> - What are the learning objectives for the escape room activity? - What pre-reading or preparatory work is required for student participation in the escape room activity? - What assessment strategies best fit the purpose of the activity (e.g. perception survey, knowledge quiz)?
Planning puzzles and Logistics	<ul style="list-style-type: none"> - How much time should be dedicated to facilitator or actor training? - What rules must be implemented to ensure a consistent student experience (e.g., use of hints, materials allowed inside the escape room)? - How much time is allotted for students to complete the escape room activity? - What is a reasonable number of puzzles that students can complete within a given time frame? - How does the complexity of the puzzles align with the complexity of the topic? - What are strategies to engage student participation during the escape room activity?

*TOC = transitions-of-care

When planning for this escape room activity, selection of location and purchase of supplies determined how closely the escape room could be created to mirror an actual inpatient and outpatient care setting. To account for the limited time frame, it was imperative for two escape room activities to operate concurrently. Each room included inpatient and outpatient facilitators, which consisted of faculty, pharmacy residents and Advanced Pharmacy Practice Experience student volunteers. Additional students and College of Pharmacy staff oversaw the following activity logistics: timing, student orientation, the flow of students into different rooms, and administration of course assessments. In total, there were four escape room activity facilitators, one staff member coordinating the administration of assessments, and three student volunteers coordinating activity orientation and flow.

The innovation laboratory suite at The University of North Texas Health Science Center at Fort Worth, College of Pharmacy simulated a hospital room (with hospital beds and IV poles) and separate patient-counselling areas; this facility accommodated a realistic patient transition from the hospital to an ambulatory care clinic setting. Though the innovation suite was used without cost, some materials, including lock boxes and locks, were purchased using faculty and IPT Recitation course funds.

Students were responsible for completing assigned readings prior to participating in the escape room. Orientation included an introduction to the escape room concept, rules for calculations and rounding numbers, and required materials: writing utensils, scratch paper, calculators, assigned readings, lecture notes, and laptops. As part of the orientation, students also received rules for requesting hints that would be provided by facilitators. Hints were standardised so that facilitators were consistent in their delivery. Students were allowed to request five hints over the duration of the escape room activity.

The escape room puzzles and pre-and post-activity assessments were mapped to learning objectives developed by the faculty. To assess the impact of the escape room on student knowledge, students completed a 10-question pre-activity knowledge assessment related to the assigned readings and IPT Endocrinology and Male/Female Health course materials. Assessment areas included TOC interventions and inpatient and outpatient diabetes management. Students repeated the knowledge assessment immediately following the completion of the escape room activity. A perceptions survey

consisting of 14 questions using a five-point Likert scale was also administered after students completed the activity. The results of the perceptions survey administered in Spring 2020 are shared in the Evaluation section. Students received course credit for completion of the perceptions survey and pre-and post-activity knowledge assessments. This study protocol, as well as the assessments, were approved by the University of North Texas Health Science Center Institutional Review Board.

Students were expected to solve puzzles tracking an individual patient's journey from their hospital stay to hospital discharge and presentation to the ambulatory care clinic. Room A had a series of three puzzles related to inpatient glucose management, and once solved, students transitioned to room B with three additional puzzles specific to transitions of care services (e.g. medication reconciliation) and management of diabetes in the ambulatory care setting. Students were given 20 minutes to escape from each room for a total of 40 minutes. Figure 1 depicts the flow of the entire escape room activity.

In the first inpatient puzzle, the facilitator acted as a medical resident presenting a patient on Intensive Care Unit (ICU) rounds. The patient's current diagnosis was diabetic ketoacidosis, and the students were asked to make recommendations for the patient's fluids, electrolytes, and insulin drip. A list of current laboratory values, an IV pole with an insulin drip labelled with the current rate of administration, multiple fluid bags, and electrolyte vials were hidden throughout the room for students to assess. Students had to provide a correct verbal response to the facilitator in order to obtain a lock code that would open lock box one to proceed to the next puzzle. As a part of puzzle two, students verbally identified the patient's criteria for resolution of diabetic ketoacidosis utilising laboratory values that were opened in lock box one. Since that criteria had been met, the patient was transitioned from the ICU to a step-down unit by the medical team. The third puzzle began with a miscalculation in the conversion from intravenous to subcutaneous insulin, resulting in the patient return to the ICU for further management of diabetic ketoacidosis. Students were required to recognise the patient's return to diabetic ketoacidosis with a new set of laboratory values. They also identified the insulin miscalculation as the problem during the transition of care from the ICU to the step-down unit. To escape from Room A, students had to correctly convert the intravenous insulin dose from the insulin drip to a subcutaneous insulin dose.

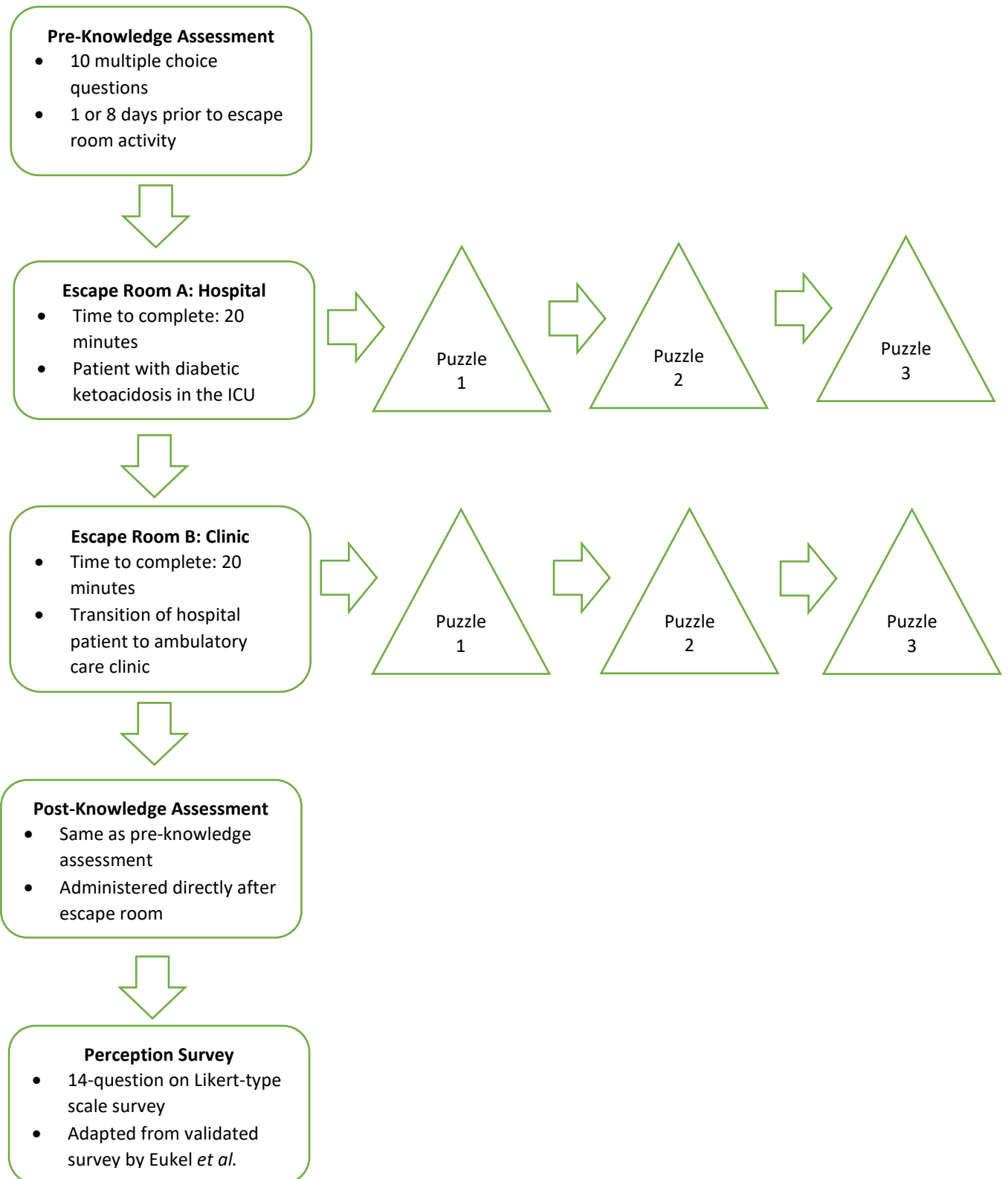


Figure 1: Flow of escape room

Evaluation

Descriptive statistics were used to characterise student perceptions of the activity. The student perceptions survey was adapted from Eukel and colleagues (Eukel, Frenzel, Cernusca, 2017). A paired t-test was performed to analyse the composite scores of all questions on the pre-and post-activity knowledge assessment. The a priori level of significance was set at .05. Statistical analysis was conducted using Microsoft Excel for Mac, Version 16.42 for the descriptive statistics and IBM SPSS Statistics for Macintosh, Version 25.0 (IBM Corp.,

Armonk, NY) to perform the paired t-test. Of the 106 students who participated in the activity, 60 (56.6%) students completed the perceptions survey in the spring of 2020 following the escape room activity (Table II). The majority of items on the perception survey demonstrated that students improved in the perception of knowledge and confidence to provide patient care related to transitions of care and diabetes management. Students also noted that they learned from their peers. Detailed results related to the perceptions survey are shared in Table II.

Table II: Student perceptions survey for spring 2020

Item	Median (IQR)	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
The escape room encouraged me to think about material in a new way	4(1)	5.0	0.0	5.0	41.7	48.3
I would recommend this activity to other students	5(1)	3.3	0.0	6.7	38.3	51.7
I learned from my peers during the diabetes escape room	4.5(1)	1.7	3.3	11.7	33.3	50.0
The escape room was an effective way to review the topic of diabetes	5(1)	1.7	1.7	10.0	31.7	55.0
The escape room was an effective way to learn new information related to diabetes	4(1)	1.7	8.3	10.0	35.0	45.0
The escape room improved my confidence in making transitions-of-care interventions	4(1)	1.7	6.7	11.7	38.3	41.7
The escape room improved my knowledge of transitions-of-care interventions	4(1)	1.7	8.3	6.7	40.0	43.3
I learn better in a game format than in didactic lecture	4(2)	1.7	11.7	13.3	38.3	35.0
The escape room was an effective way to assist my learning of diabetes products	4(1)	1.7	3.3	5.0	48.3	41.7
I feel I was able to engage with my teammates to learn new material	4(1)	1.7	1.7	15.0	36.7	45.0
It was easy for me to focus on learning because I was not feeling stressed or overwhelmed	3.5(1.25)	8.3	13.3	28.3	25.0	25.0
The non-educational portions (e.g., cyphers, puzzles) did not distract me from learning about diabetes	4(1)	1.7	0.0	16.7	43.3	38.3
I prefer assembling information from a variety of sources when learning new material	4(1)	1.7	0.0	20.0	41.7	36.7
In general, I enjoy playing games (e.g., video games, board games, social media games)	5(1)	1.7	1.7	6.7	36.7	53.3

Eighty-six (96%) students in 2019 and 106 (98%) students in 2020 completed both pre-and post-activity knowledge assessments (Table III). There were statistically significant differences in the mean composite scores between pre-and post-activity knowledge assessments in 2019 ($t_{85} = -2.121, p=0.037$) and in 2020 ($t_{105} = -3.908, p=0.000$). The mean composite score for the 2019 post-activity assessment

was 0.256 points higher than the mean composite score for the pre-activity assessment (95% CI [-0.496, -0.016]). In 2020, the mean composite score of the post-activity assessment was 0.736 points higher than the pre-activity assessment mean composite score (95% CI [-1.109,-0.362]).

The knowledge assessment addressed both diabetes management and TOC concepts. Improvements in student knowledge and confidence to perform

diabetes and TOC interventions were observed following participation in the diabetes-focused TOC escape room activity.

Table III: Pre- and post-knowledge assessments

Spring 2019			
N (%)	Pre-Activity score, Mean (SD)	Post-Activity Score, Mean (SD)	p-value
86 (96%)	3.477 (1.404)	3.733 (1.241)	0.037
Spring 2020			
N (%)	Pre-Activity Score, Mean (SD)	Post-Activity Score, Mean (SD)	p-value
106 (98%)	4.07 (1.462)	4.80 (1.588)	0.000

Challenges and future implementation

The initial implementation of the escape room activity came with several challenges. These challenges can be classified into four areas: development of content, administration of assessments, implementation of logistics, and complexity of materials. This section includes a description of the different challenges that were encountered and possible considerations for improvement in the future implementation of the escape room activity.

Development of content

When developing content, faculty had a short timeframe to include updates in the educational materials to reflect recent changes in clinical practice guidelines. The American Diabetes Association Standards of Medical Care in Diabetes was updated several weeks before the implementation of the diabetes-themed escape room activity (American Diabetes Association, 2019). During the second year of the escape room implementation, instructors changed the IPT and recitation course sequences to address this issue and allow for adequate time to adjust teaching materials. Instructors should be thoughtful of the anticipated timeline of the updates in practice guidelines as they pertain to patient case creation.

Also, the difficulty of puzzles and their sequence integrated in the escape room activity need to be carefully evaluated. During the initial implementation of the hospital escape room, a more complex puzzle had been placed earlier in the escape room activity, which may have limited student progression through the puzzles. A simpler puzzle was utilised first in the following year allowing for an increase in difficulty throughout the activity. This may encourage students to successfully complete the activity, thereby learning and applying the concepts as originally intended.

Administration of assessments

To accurately assess the escape room activity, it was critical to ensure that students had reviewed relevant pre-reading assignments prior to the activity. Given student exam schedules and the timing of the escape room, it was challenging to ensure that students had adequately prepared for the activity. Students were split into two different groups that performed the activity on separate weeks. Improved alignment of the escape room activity and didactic lectures to allow adequate preparation time may positively impact the learning outcomes.

In order to refine the quality of assessments, questions included in the knowledge assessment and perception survey should be created with careful consideration. The knowledge assessment may benefit from a peer-review process. Specifically, questions related to knowledge of transitions-of-care performed poorly. The knowledge-based questions were primarily derived from the pre-reading assignments and did not assess the application of transitions-of-care interventions within the escape room activity. Additionally, the negative questions in the perception survey were re-worded so the student response was less instinctive when compared to that of a positive question.

Finally, the appropriate type of assessment—either formative or summative—should be thoughtfully determined. During the initial implementation of the activity, students received full credit for completing the assessments. However, summative assessments may encourage students to adequately prepare for the activity by reviewing the relevant materials and pre-reading assignments.

Implementation of logistics

Prior to the escape room activity, a tutorial or simulation video of an escape room may help students understand the rules and flow of the escape room. Moreover, the rules may be modified to improve student learning outcomes. During the activity, students were allowed up to five hints to use to ask questions or to clarify information pertinent to the case. Students seemed to ration the five allowable hints, knowing that several puzzles must be completed to “escape” in a timely manner. As a result, faculty should discuss the appropriate use of hints or adjust the maximum number of hints to encourage questioning and to enhance the facilitation of student learning.

Additional items that need to be considered when developing the educational escape room activity include the location and timing of the activity. The location selected for the activity should facilitate the flow and transitions needed for the activity. The location should allow for clues to be placed in inconspicuous places and ensure appropriate privacy if more than one group is allowed to participate at a time. The timing of the activity should be monitored by a device, preferably a digital clock, visible to all participants. A practice run among facilitators and actors prior to the activity would also be beneficial to minimise potential errors.

The inclusion of a debrief session after completion of each room provides an additional opportunity for students to review key points. During the debrief, a team-based learning approach may be applied to facilitate collaborative learning and enhance learning outcomes. This may enhance student performance on the post-knowledge assessment; however, further research needs to be done in this area.

Complexity of materials

When developing an educational escape room activity, careful consideration should be given to the complexity and quality of the materials used. Devices like puzzles and lock boxes should challenge the students without posing a significant barrier to the timely completion of the activity. During the described escape room, wooden boxes secured with digital locks, were utilized to allow for secure containment of the information used in the escape room and easy incorporation of the lock code into the preceding activities. However, the locks had a unique latching system which required intervention from the facilitator as some of the students were unable to open the locks despite having the correct code. For future iterations, the puzzle locks will be changed to keyed locks or digital locks with a simpler mechanism.

Conclusion

Pharmacy student exposure to TOC concepts in didactic education is lacking due to a paucity of TOC faculty members, faculty time and resources, and guidance on where to implement these topics within the curriculum. Most often, TOC concepts are incorporated into required pharmacotherapy or laboratory courses, elective or co-curricular activities, and educational games. This study described an escape room as an innovative method to teach TOC concepts in the didactic curriculum. Based on the results of this study, the diabetes-themed TOC escape room activity was enjoyable, improved student confidence to perform TOC interventions and enhanced student knowledge of both diabetes management and TOC concepts. Pharmacy faculty, who plan to implement a TOC escape room activity, should consider the timing of the activity in relation to pertinent didactic coursework. Future studies may determine whether the activity can be customised to other conditions, patient populations, and classroom settings.

Conflict of interest

The authors declare no conflict of interest.

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