

Out-BREAK!: An IDWeek 2023 Escape Room to Break Out of the Educational Mold

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Background. An escape room is a cooperative game that has been adapted into medical education and major academic conferences.

Methods. We describe the design, development, and implementation of an educational ID-themed escape room activity entitled “Out-BREAK!” at an international conference, IDWeek 2023. An anonymous survey was conducted to collect demographic data, assess participant satisfaction with the escape room puzzles, and gauge participant interest in game-based learning.

Results. Thirty escape room sessions were held over 3 days and included 201 participants. Escape room survey respondents ($n = 132$) were younger and more likely to be trainees compared with in-person IDWeek attendants. Among 131 responses, all respondents enjoyed the experience and would recommend the escape room activity to friends. Survey respondents enjoyed the puzzle solving (93%), medical content (92%), and team building (79%) components. Only 35% of the respondents had ever previously participated in game-based learning; 95% thought the escape room was a valuable teaching method. Among the 72 survey respondents involved in medical education, almost all (90%) said they were interested in incorporating escape rooms into medical education.

Conclusions. The Out-BREAK! escape room at IDWeek 2023 was successfully implemented and well received. Despite only a third of participants having prior experience with game-based learning, almost all respondents perceived the escape room to be an effective teaching method.

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An IDWeek 2023 escape room to break out of the educational mold

Introduction

An **escape room** is a cooperative game experience in which participants are confined in a room and solve a series of interconnected puzzles within a limited timeframe to “escape” the room

Methods

- We describe the design, development, and implementation of an educational infectious diseases-themed escape room
- An anonymous survey was conducted to collect demographic data, assess satisfaction, and gauge participant interest in game-based learning

Results

30 escape room sessions over 3 days



201 participants



- 99% of the 132 survey respondents enjoyed the experience and **all** stated that they would recommend the activity to others
- Survey respondents enjoyed the **puzzle solving (93%), medical content (92%), and team building (79%)** aspects
- Only 35% of the respondents had ever previously participated in game-based learning; 95% thought the escape room was a valuable teaching method

Conclusions

- The Out-BREAK! escape room at IDWeek 2023 was successfully implemented and well received
- An educational escape room has the potential to be a valuable learning tool and team-building activity



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Keywords. conference; escape room; infectious diseases; medical education; serious game.

An escape room is a cooperative game experience in which participants are confined in a space—literally or figuratively—and asked to solve a series of interconnected puzzles within a limited time frame to achieve a goal, usually to “escape” the room [1]. Escape room activities reward curiosity, critical thinking, and problem-solving skills while being applied in a collaborative and immersive environment. Traditionally enjoyed as social and recreational puzzle activities, escape rooms have been increasingly applied in the health professions as an immersive and interactive educational format that can be constructed to align principles of active learning with educational objectives and enhance teamwork and communication skills [2–9]. Use of an educational escape room activity has been reported in a wide variety of health professions learners, including in undergraduate and graduate medical education, nursing, and pharmacy [2, 4, 5, 10–21]. These educational escape rooms have previously been used to teach or reinforce a wide variety of topics ranging from clinical skills (such as history-taking, physical exam, discussing difficult diagnoses) to patient safety to specific targeted content such as hepatitis.

Escape rooms have previously been incorporated into major academic scientific conferences to increase attendee engagement and encourage interprofessional camaraderie in both in-person and virtual formats [22, 23]. Within infectious diseases (ID) conferences, the European Congress of Clinical Microbiology &

Infectious Diseases (ECCMID; now renamed ESCMID Global) has featured both virtual online and in-person escape room activities since 2021 [23]. An online social media poll on X (formerly Twitter) also suggested enthusiasm for an escape room activity in the context of an ID conference (eg, IDWeek), with 62% of poll respondents “interested to participate” and an additional 17% “possibly interested” if the opportunity existed [24].

Here, we describe the process of creating and implementing an ID-themed escape room at the international ID conference IDWeek. The Out-BREAK! educational escape room debuted at the IDWeek 2023 conference, the annual joint meeting of the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA), HIV Medicine Association (HIVMA), Pediatric Infectious Diseases Society (PIDS), and the Society of Infectious Diseases Pharmacists (SIDP). We also present results from a survey aimed to evaluate participant demographics, satisfaction with the escape room experience, and current and future interest in gamification for medical education.

METHODS

Development of the Out-BREAK! Escape Room for IDWeek 2023

A pilot proposal for an interactive ID-themed escape room session was submitted for consideration at IDWeek 2023 in

Boston, Massachusetts, in November 2022 and accepted in April 2023. An organizing committee including 11 members (authors D.Z., S.W.D., V.T.C., J.B., K.L., J.S., R.L.W., E.R., A.B., N.G., P.P.) met weekly via video conference to iteratively develop the theme, storyline, promotional campaign, and logistics. Members consisted of ID physicians, an ID pharmacist, and an IDSA administrator; members possessed varied skill sets, including experience in medical education, building educational escape rooms, and graphic design. All members collaborated on the puzzle and room design, build, testing, and implementation. An additional volunteer collaborator was sought for audiovisual support for the introduction and conclusion videos for the escape room. For the inaugural IDWeek escape room, we chose to highlight notable women pioneers in the field of infectious diseases based on general consensus of the organizing committee members.

The theme of the escape room centered on the fictional ghost of historical figure Angelina Fanny Hesse, who was instrumental in pioneering agar as a thickening agent for media to culture microorganisms [25]. Participants were tasked with solving puzzles to assist the ghost in sharing her journal to demonstrate her underrecognized contributions to microbiology. Content from the narrative and puzzles also highlighted contributions of other women instrumental to the field of infectious diseases.

Activity Objective

The primary objective of the pilot Out-BREAK! activity was to provide proof of concept that an escape room activity could be successfully implemented during the IDWeek conference. The organizing committee anticipated a wide range of interprofessional participants, and additional goals of the Out-BREAK! activity included to engage participants in team-based collaborative learning and to inspire participants and educators to consider utilizing similar teaching experiences at their home institutions.

Puzzle Design and Build

The escape room was designed with educational principles and guided by the following learning goals:

- Participants will learn infectious diseases and microbiology topics through game-based learning and immersion in an escape room format.
- Participants will be inspired to apply active learning techniques and creative teaching tools (including games, puzzles, storytelling, and/or roleplay) toward future teaching experiences at their home institutions.
- Participants will recognize unique problem-solving strengths within multidisciplinary team members with diverse skills, knowledge, and expertise.

The principles guiding the development of the escape room puzzles included balancing the difficulty of individual puzzles,

formulating educational content, linking puzzles to the activity objectives and theme, and encouraging collaboration. The general process of creating a medical education escape room, as well as challenges to consider, is detailed in Table 1. Six individual puzzles were created, and the solutions for these were linked to provide the answer to a final overarching puzzle, or “meta-puzzle.” An overview of the puzzles can be seen in Figure 1, and a detailed description of puzzles with images can be found in the Supplementary Data. Supplies for the puzzle prototypes and final build cost an estimated \$2000 total for both rooms.

Equipment and Resources

Two physical escape rooms were assembled in the IDWeek 2023 conference exhibit hall. Identical 20'×20' rooms were created with a shared entrance and exit area (control room) for learner orientation and debriefing. A room setup diagram is available in the Supplementary Data. Puzzle components and props were shipped to the convention center and either built or reassembled on-site.

Implementation

Before the conference, announcements and promotions for the activity were provided in IDWeek/IDSA email distribution lists, on the dedicated IDWeek webpage (<https://idweek.org/escaperoom>), and on social media (Twitter/X @IDWeekOutBREAK).

The room decoration, construction, and puzzle setup were completed 1 day before the conference opening to all participants. Four groups of 3–7 people completed trial runs of the escape room 1 day before the conference opening to all participants. Play observation and detailed debriefing with feedback were conducted with puzzle developers. Room setup was iteratively revised based on pilot testing to optimize participant experience, provide adequate clues to facilitate progression, and minimize the usage of trial-and-error (“brute force”) or guessing-based approaches to solving the final meta-puzzle (Table 1). Collectively, the escape room committee estimates that at least 400 hours of time were contributed to the project from the conception to the final build.

Two identical escape rooms were run concurrently throughout the 3-day conference (October 12, 2023, to October 14, 2023). Each team consisted of 6–7 members. To provide multiple opportunities for interested attendees to register and to maximize the likelihood that registered participants would arrive on time for their assigned session, daily in-person registration was implemented.

Participants began the activity by entering the central “control room,” where they were provided instructions and safety tips. This introduction was initially provided via live presentation by the escape room organizing committee members but later changed to a recorded video. Teams would then enter the escape room. Teams were provided an introductory video followed by a 45-minute visual countdown timer, reflecting

Table 1. Process and Tips for Creating an Escape Room for Medical Education [10, 22, 26]

Steps	Notes	Challenges/Considerations
Form an organizing committee	<ul style="list-style-type: none"> Assemble a diverse team Be deliberate about identifying multidisciplinary members by seeking out individuals who have differing expertise (could be related to the educational content, simulation, medical education, organizational skills, creativity, and more) Create a clear communication plan for the team and set up standing meetings to share progress 	<ul style="list-style-type: none"> Time is a limiting factor. It can help to have smaller subgroups that can share responsibilities if planning a more complex activity Consider also identifying local collaborators if the activity will be at an in-person conference
Determine learning objectives	<ul style="list-style-type: none"> Define clear educational goals and objectives to help effectively deliver your content and guide puzzle creation <ul style="list-style-type: none"> If focused on medical knowledge, establish what information will be addressed If goal is to enhance teamwork or communication in a group, objectives should be related to team-based skills and improvement 	<ul style="list-style-type: none"> Consider the audience and scope of the future escape room as you create objectives (may have a wide range of training levels and/or variable expertise among participants) Use the SMART (specific, measurable, attainable, relevant, and timely) framework for crafting objectives [27] Be cognizant of the time available for the escape room session. Limit the number of objectives to what is feasible
Consider logistics	<ul style="list-style-type: none"> What resources are available to you? <ul style="list-style-type: none"> Consider time management of design team members What is the available monetary budget? Details about the activity <ul style="list-style-type: none"> Size of teams? Number of groups? Will multiple sessions run in sequence or in parallel? Timing of the activity? What is the physical environment/space like? What objects can you include? 	<ul style="list-style-type: none"> The ideal escape room group size is somewhat variable and based on size of room and number/complexity of puzzles—but likely a group of 4–8 people would be reasonable Ensure that time is built into the activity for debriefing with participants
Craft your storyline	<ul style="list-style-type: none"> Create a consistent theme and narrative/story arc that will run throughout the activity Use this to point toward the ultimate “escape” or final task 	<ul style="list-style-type: none"> Be creative! Consider how this will impact what puzzles and decor may be used Ensure no copyright infringement
Design puzzles	<ul style="list-style-type: none"> Review published escape rooms, blogs, social media for examples of puzzles and props Brainstorm tasks and props Principles to consider for puzzle design: <ul style="list-style-type: none"> Balance the ease/difficulty of each puzzle. Ensure that the experience remains fun by crafting to an appropriate level or provide the information necessary to solve the puzzle in the room What content knowledge does this deliver? Does this fit with the goals/objectives of the room? How does the puzzle link to or augment the theme of the room? How will individual puzzles unite to solve the final master or “meta”-puzzle? How many participants can collaborate to solve this puzzle? What materials or props would be needed? 	<ul style="list-style-type: none"> Utilize online resources to assist in puzzle design Discovery of items or puzzle components in and of itself can be fun too, similar to a scavenger hunt Puzzles should ideally be cooperative experiences that involve at least 2 people Keep it simple: <ul style="list-style-type: none"> Try not to introduce brand new material at an escape room If something is not familiar, provide the materials within the room to answer that Try to simplify complexity: puzzles or games should not be harder than the material they are trying to teach Workshop puzzles to get a sense of ease/difficulty and consider time needed to solve Minimize ability to solve puzzles through “brute force” (trial-and-error) guessing
Create a moderator guide	<ul style="list-style-type: none"> Construct a blueprint of the puzzles and how they interdigitate Have a diagram of the physical space/props in the room Create a moderator guide that includes: <ul style="list-style-type: none"> Instructions and a quick summary of the room Puzzle flow and solutions Consider having notes on what may need troubleshooting as well as tentative hints to provide to groups that are becoming frustrated or stuck on an individual puzzle A standard operating procedure for resetting your room for next group 	<ul style="list-style-type: none"> Puzzles may be solved linearly or in parallel Consider providing an estimated timeline for the room moderators Consider the reproducibility of the escape room in the future, including if involving new moderators
Do a test/trial run	<ul style="list-style-type: none"> If possible, perform pilot or trial runs of the room and/or puzzles 	<ul style="list-style-type: none"> Monitor how long pilot groups take to solve puzzles and seek feedback to adjust for future iterations
Run your escape room	<ul style="list-style-type: none"> Take notes on what went well and what could be improved in real time Identify members who will assist in room reset Record participants, group names, and times for later reference Facilitators should be supportive but allow teams to struggle slightly before providing clues 	<ul style="list-style-type: none"> Consider group or team names, which can create a sense of community. These can also be incorporated into a leaderboard if desired Clue-giving can be used but should be tailored to each group. Try to focus on redirecting attention with open-ended questions rather than giving direct answers to puzzles
Debrief & seek feedback	<ul style="list-style-type: none"> Debrief with participants, room facilitators, and design team Seek out feedback on: <ul style="list-style-type: none"> Satisfaction with overall activity Ease/difficulty of and flow between puzzles Appropriate amount of time Areas for improvement Consider whether to provide asynchronous materials after the fact 	<ul style="list-style-type: none"> Consider the role of the escape room in future teaching curricula Consider generating scholarly output

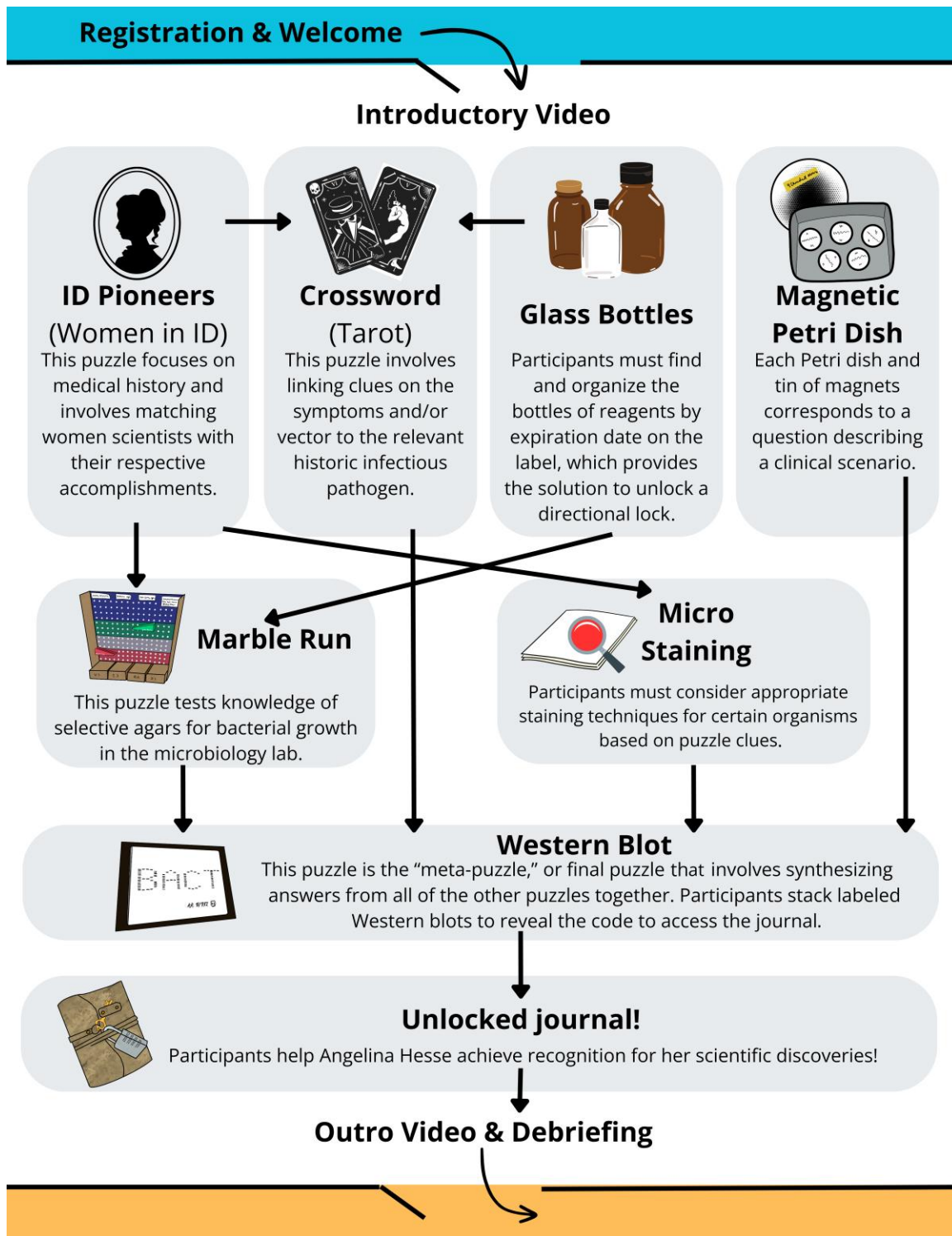


Figure 1. IDWeek 2023 Out-BREAK! escape room puzzle flow and summary.

the time limit to escape. One to 2 committee members remained in the room to moderate the gameplay. Moderators monitored the tempo of the team’s progress, supplied hints as needed, and coordinated with “control room” members who ran the audiovisual experience. Committee members

created puzzle standard operating procedures, reserve prop supplies, and standard work checklists to facilitate continuous operation throughout each day and standardize a quick room and audiovisual reset between groups. At the end of the session, an outro video was played, and the room facilitators provided

personalized feedback in a debriefing with the team on their puzzle-solving and solutions, which also served as an opportunity to highlight the educational objectives of the individual puzzles.

Evaluation

An online anonymous survey was developed with the goals to (1) obtain participant demographics, (2) assess participant satisfaction with the escape room and individual puzzles, and (3) gauge participant experience and interest in applying game-based learning, including the escape room format, for medical education purposes. The final survey is available in the [Supplementary Data](#). Study data were collected and managed using REDCap electronic data capture tools hosted at the University of California, San Francisco [28, 29]. All participants of the escape room were eligible to complete the survey, and no incentive was offered for participation. Participants were provided a survey link via QR code during the debriefing and exit from the escape room. Responses were collected from October 12 to 15, 2023. A descriptive analysis of the survey data was performed. Participant demographics were compared with the demographics of in-person IDWeek attendees; *P* values were calculated using the chi-square test or Fisher exact test when counts were <5.

Qualitative data from 2 free-text questions (“What would you like to see improved upon or added in the next iteration of ‘Out-BREAK!: An ID Escape Room?’” and “Any additional comments on the ‘Out-BREAK!: An ID Escape Room’ experience?”) were analyzed using a framework analysis. Two authors (V.T.C., P.P.) reviewed all comments to develop an initial codebook for each question independently; they then reviewed the codebooks and agreed upon the final codes to be used in analysis. Two authors (V.T.C., P.P.) categorized the free-text data into a framework matrix with the final codes. In cases where there was not a consensus in the coding, a third author (D.Z.) was used to reconcile the differences and reach consensus. Code interpretations and exemplar quotes were selected for descriptive analysis.

RESULTS

The Out-BREAK! activity held 30 escape room sessions over 3 days (October 12–14, 2023). These 30 groups included a total of 201 participants. The fastest escape time was 26:09 minutes, and 93% of groups completed the activity within the allotted time of 45 minutes. The total number of interested participants was not recorded due to the limited waitlist capacity, but room sign-ups were filled within 10–15 minutes each day upon registration opening.

Survey Results

Of the 201 activity participants, 132 (66%) completed the survey. Of the survey respondents, 74/127 (58%) were 30–39 years old, and 73/127 (57%) were women. Most of the survey

respondents were ID attendings (53/131, 40%), followed by ID fellows (37/131, 28%), pharmacists (17/131, 13%), pharmacy trainees (6/131, 5%), medical students and residents (6/131, 5%), and other (12/131, 9%). Of the survey respondents, 45/129 (35%) were attending the IDWeek conference for the first time, and 48/130 (37%) had never participated in an escape room previously. Escape room survey respondents were younger, more likely to be in training, and more likely to have IDSA/HIVMA or PIDS membership when compared with all in-person IDWeek attendees (Table 2).

Among the 132 survey respondents, 131 (99%) selected that they would recommend the Out-BREAK! escape room to friends; 1 survey respondent did not respond. Different aspects of the escape room that respondents enjoyed included puzzle solving (123/132, 93%), medical content (108/132, 82%), team building (104/132, 79%), multidisciplinary content and teams (85/132, 64%), and the competition (75/132, 57%). Most (115/132, 87%) thought 45 minutes was enough time for this particular escape room, although 13/130 respondents (10%) wanted more time. Most respondents rated the difficulty of the individual puzzles as “just right” for 5 of the 7 puzzles (Figure 2).

Only 45/130 respondents (35%) had participated in game-based learning at their home institution, and 121/127 (95%)

Table 2. Demographics of Escape Room Survey Respondents and In-Person IDWeek Attendees

	Escape Room Survey Respondents (n = 132), No. (%)	In-Person IDWeek Attendees (n = 8897), No. (%)	<i>P</i> Value*
First IDWeek?	45 (34)	2383 (27)	.07
Age (years)	n = 127	n = 6753	<.01
20–29	14 (11)	781 (12)	
30–39	74 (58)	2324 (34)	
40–49	22 (17)	1782 (26)	
50–59	13 (10)	1077 (16)	
60–69	4 (3)	625 (9)	
≥70	0 (0)	164 (2)	
Gender	n = 127	n = 6931	.14
Male	53 (42)	3134 (45)	
Female	73 (57)	3787 (55)	
Nonbinary	1 (0.8)	10 (0.1)	
Roles	n = 131	n = 7893	<.01
Not in training	82 (63)	6157 (78)	
Fellow	37 (28)	740 (9)	
Resident and student	12 (9)	996 (13)	
Membership	n = 131	n = 8897	
IDSA/HIVMA	96 (73)	4509 (51)	<.01
SHEA	15 (11)	604 (7)	.054
PIDS	34 (26)	572 (6)	<.01
None of the above	12 (9)	3239 (36)	<.01

Bolded *n* values are the total number of respondents or attendees that responded for a particular characteristic. Abbreviations: HIVMA, HIV Medicine Association; IDSA, Infectious Diseases Society of America; PIDS, Pediatric Infectious Diseases Society; SHEA, Society for Healthcare Epidemiology of America.

**P* value was calculated using the chi-square test and the Fisher exact test in cases where the cell size was <5.

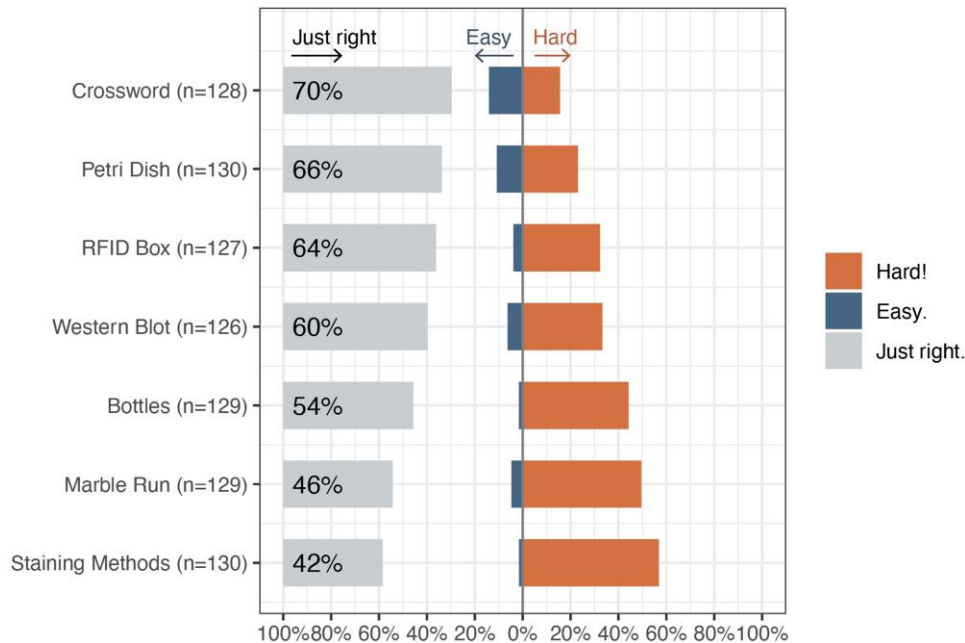


Figure 2. Puzzle difficulty rating from the survey respondents. The bars indicate the percentage of survey respondents (n = 132) who rated each puzzle difficulty as “easy”, “just right”, and “hard”.

thought the escape room was a valuable teaching method. Among the survey respondents, 72/123 (59%) of the participants who responded to the survey were involved in medical education; 65 (90%) of the 72 participants were interested in building either a physical (49/65, 68%), paper-based (36/65, 50%), or virtual (32/65, 44%) escape room; 31/65 (43%) were interested in multiple modalities. Among the 72 respondents who were involved in medical education, the following were cited as barriers to building an escape room: no time (59/72, 82%), cost (32/72, 44%), no expertise (30/72, 42%), no collaborators (24/72, 33%), no learner interest (7/72, 10%), and no room (2/72, 3%); only 6/72 (8%) responded with no barriers.

A qualitative analysis of the free-text responses identified 4 key themes that participants wanted to be improved upon in future iterations of the escape room: (1) increased availability to participate, (2) more guidance (on solving puzzles), (3) puzzle suggestions, and (4) room logistics (Table 3). Overall comments on the escape room could be grouped into 4 additional themes as well: (1) general praise, (2) enjoyment of the teamwork component, (3) enjoyment of learning the educational material, and (4) desire to have the escape room again the following year at IDWeek (Table 3). One comment suggested that time for introductions and team organization at the start of the experience would have been helpful.

DISCUSSION

The inaugural Out-BREAK! escape room was successfully implemented at the IDWeek 2023 conference, providing a new

and unique educational activity integrating 6 interconnected puzzles that highlighted the accomplishments of women in the field of infectious diseases. This multidisciplinary experience engaged >200 participants, consisting of members of several ID societies and health professions. The creation of the Out-BREAK! escape room was time- and labor-intensive, requiring robust ongoing IDWeek administrative support. This activity was well received, and survey respondents shared their satisfaction with both the quality and difficulty of puzzles and collaborative team-building aspects.

The inaugural IDWeek Out-BREAK! escape room was enthusiastically received, with survey respondents noting that they would recommend the activity to others. There was a high level of satisfaction with the rated difficulty of puzzles and time allotted for the activity. A minority of survey respondents expressed a desire for more guidance on puzzles. Clue-giving on puzzles was tailored to each room and varied depending on player dynamics and puzzle progress, and likely was affected by players’ prior experience with escape rooms and puzzle games. Survey respondents also noted the high production value, the fun nature of the activity, and how it provides a unique offering in the IDWeek experience. Interestingly, there was a significant portion of trainees who participated in the escape room compared with the overall conference attendance (37% vs 22%, respectively), which may signal that this activity was particularly appealing to trainees. As the field of infectious diseases has experienced ongoing challenges in workforce development, one of the priorities for infectious diseases physician recruitment is the engagement of learners and trainees, including those at the undergraduate and medical student levels [30–32].

Table 3. Themes and Exemplar Quotes Identified From the Free-Text Survey Responses

Themes	Quotes
Question: What would you like to see improved upon or added in the next iteration of “Out-BREAK!: An ID Escape Room”? (n = 49)	
Increased access, n = 13 (26%) <ul style="list-style-type: none"> • More time slots • Larger groups 	<ul style="list-style-type: none"> • “More sessions, more time slots.” • “It was FANTASTIC!!! More opportunities for people to participate.”
More guidance, n = 8 (16%) <ul style="list-style-type: none"> • More instructions at the start of the activity • More hints during the activity on how to solve the puzzles 	<ul style="list-style-type: none"> • “I’d like to have a little more direction with the puzzles to get going right up front with the escape room, it took me a little while to even figure out what the puzzles were.” • “An option for a ‘hint’ like in the OG escape Room.”
Puzzle suggestions, n = 8 (16%) <ul style="list-style-type: none"> • Multiple rooms within the escape room • Inclusion of different scientific fields (eg, pharmacy) • Suggestions on different or additional puzzles 	<ul style="list-style-type: none"> • “It would be cool to have two rooms to go through!” • “More incorporating of pharmacy.” • “More multidisciplinary knowledge utilization (very heavy microbiology this time).” • “What about adding a puzzle that has a patient component, kind of like Operation,” with a mannequin that has organs, and the puzzle involves a description of a disease or pathogen that affects a certain organ/certain organs and you have to scour the organ systems to solve the puzzle?”
Improved room logistics, n = 4 (8%) <ul style="list-style-type: none"> • Easier sign-up process • Time allotted to introductions before the starting the activity 	<ul style="list-style-type: none"> • “Sign up process was a little hectic—might try having online sign up and allowing people to list multiple available times.” • “Time at beginning for everyone to introduce themselves to each other.”
Question: Any additional comments on the “Out-BREAK!: An ID Escape Room” experience? (n = 56)	
General praise, n = 53 (95%)	<ul style="list-style-type: none"> • “Had a great time being part of the ‘Not-so-acid-fast’ team in solving puzzles to escape. The designers did a fantastic job, and I look forward to seeing them do even bigger and better things in the future for all to enjoy. My only wish is that more slots were available so more could enjoy it!” • “The production value was incredible, especially the physical puzzles! The experience exceeded my expectations. The cohesive and overarching narrative was well done. Time given was appropriate too.” • “This was definitely a unique experience and adds to the overall experience of IDWeek.”
Enjoyment of the teamwork aspect, n = 11 (20%)	<ul style="list-style-type: none"> • “I was an add-on to a different group and had so much fun jumping right in to solve puzzles with them!” • “It would be amazing if something like this is presented to our med students and residents to attract them to the amazing field of ID. I would love to do this for our residents. Definitely a fun way to work collaboratively.”
Desire to have the escape room activity again the following year at IDWeek, n = 10 (18%)	<ul style="list-style-type: none"> • “The escape room was amazing, will definitely want to have it again at future IDWeek conferences.”
Enjoyment of learning the educational material, n = 7 (13%)	<ul style="list-style-type: none"> • “I had so much fun learning and reinforcing ID content with my colleagues. I feel super proud to be a future ID doc!” • “This was so fun and educational. Also love that you used it to tell the story of an unsung heroine of medicine and microbiology:).”

Novel activities that may be particularly attractive to younger trainees, such as the Out-BREAK! escape room, may serve as valuable tools to enhance the engagement of earlier learners interested in ID.

A majority of respondents selected that an escape room was a valuable teaching method, and they valued the puzzle solving, educational content, and team-building aspects. There is increasing recognition of the value of active learning and adult learning theories in health professions education, and incorporation of innovative strategies such as game-based learning like escape rooms provides versatile options to help reinforce knowledge [30]. An escape room leverages numerous adult learning theories and active learning theories, which are described in Table 4, highlighting both learner and game designer perspectives. This activity brings together numerous game elements, including cooperative play (eg, collaboration between team members) and friendly competition between different teams (eg, team leaderboard).

Although only about one-third of survey respondents had participated in game-based learning at their home institution, and 90% reported that they would be interested in building an escape room locally. Given that Out-BREAK! was created and implemented for a large national conference, there are limitations in

its generalizability and reproducibility. Notably, the creation and implementation of Out-BREAK! 2023 was time- and resource-intensive, reflecting the large scale of the IDWeek conference. Survey respondents did cite concerns of time and cost as barriers to building an escape room locally, but escape rooms can be effectively implemented at a smaller scale. For educational projects with greater limitations in time and/or funding, an escape room can be designed with more modest resources. For example, Out-BREAK!’s Marble Run puzzle used a custom-built wooden structure; the same concepts of organism-agar matching could be tested using printed cards (Supplementary Data). Once the creative and material capital has been invested to design and build a room, it can be repeated or modified for new participants year after year. Furthermore, educational escape rooms can be created and implemented virtually [14, 17, 20, 21, 45, 46]. Several committee members have utilized escape rooms in other teaching activities, including an infectious disease-themed escape room for medical students (D.Z.), an infectious disease-themed, escape room-inspired educational activity for pediatric residents (J.S., J.B.), creation of a virtual escape room for PIDS (J.B., J.S., S.D., E.R.) [47], and incorporation of an escape room into pharmacy residency interviews (K.L.).

Table 4. Application of Learning Theories to Escape Room Development

Learning Theory [6, 33, 34]	Sample Learner's Thoughts	Game Designer–Educator's Perspective
Self-efficacy: Learners' beliefs and perceptions about their own capabilities impact their learning and goal attainment [6, 35].	"I believe we can solve all of the puzzles and escape! We already figured out the bottle puzzle and we are making progress on the next puzzle already!"	Ensure that victory seems feasible for players to attain. Incorporate checkpoints and mini-victories throughout (eg, make it obvious when a few smaller puzzles are solved correctly, such as through the opening of a locked box).
Experiential learning: Learning occurs through iterative experiences (reflection, planning, and identifying challenges), especially through real-life contexts [6, 36].	"For the <i>M. leprae</i> case in the petri dish puzzle, I first placed the disc magnet on the isoniazid, which was probably wrong—I changed it to rifampin and think that was correct! I think the antifungal I picked for the <i>C. auris</i> question is wrong though, so let me revisit that one..."	Create experiences that encourage learners to reflect, innovate, and reevaluate. Ensure that experiences are relevant to real-life clinical scenarios through strategies like simulation and case-based questions.
Self-determination: Learners thrive in a learning environment where they have autonomy, perceived competence, and connection [37].	"I'll suggest to the team that we work on different puzzles first, and knowledge share later! I'll tackle the agar puzzle first—I think I'm onto something!"	Create a psychologically safe space where participants can choose what puzzles they work on, perceive tangible progress, collaborate with others, and are provided the necessary resources and guidance to solve puzzles successfully.
Self-directed learning: Learners can direct and assess their own learning [38].	"I can tell that I don't have the pioneers puzzle solution yet, since the box still won't open! Let me reread the portraits of the women scientists to check my work."	Create a sufficient quantity and variety of puzzles to allow players to engage with puzzles both individually and as a group. Provide feedback via the puzzles themselves and through tailored clue-giving.
Transformative learning: Learning occurs through experiences that lead to critical reflection, which in turn leads to transformation of one's perspectives and worldviews. In medical education, learning may occur through difficult situations (including situations specifically created for pedagogy), critical reflection, discourse, and action [39, 40].	"The escape room was a very unique and challenging experience—I was worried we wouldn't escape in time! The gram stain and petri dish puzzles stumped my team. We'll be reflecting on these puzzles for a while!"	Create puzzles that are sufficiently challenging, which will lead to an element of controlled stress. In an escape room, the time element will also add additional pressure. Create a game experience that is engaging and memorable.
Collaborative learning: Learning is enhanced through working together in a group [41].	"We must work together and communicate effectively in order to escape! It's going well—we just solved the crossword puzzle with everyone's help!"	Facilitate discussion and collaboration through puzzles that require multiple participants by design, or allow multiple participants to engage simultaneously (eg, the puzzle has clear visual components that are easy for multiple players to view simultaneously).
Constructivism: Learning occurs through active and individualized experiences, and learners build knowledge by incorporating new information into their preexisting knowledge base [42, 43].	"The way the marble run puzzle was presented was tactile and visually interesting—I am going to think about agars differently from now on."	Ensure that the puzzles are immersive and interactive, and incorporate different types of knowledge and sensory experiences.
Social learning: Learning is achieved through observing and modeling after the behavior of others [44].	"Wow, my ID pharmacist colleague has such a great approach to antibiotics, I'll have to take note of it!"	Create a variety of puzzles that highlight different areas of expertise (eg, HIV, epidemiology, transplant, stewardship), encourage multidisciplinary collaboration, and encourage participants of different training levels to work together.

Abbreviation: ID, infectious diseases.

Survey respondents emphasized their hope for future escape room activities at IDWeek. The Out-BREAK! organizing committee plans to continue developing and implementing new narratives and puzzles at future IDWeek conferences. Key themes identified from the survey for improvement in future iterations included puzzle content suggestions and feedback as well as access/logistics. Some survey respondents provided specific puzzle suggestions and recommendations for inclusion of more diverse aspects of ID in the free-text comments (Table 3). The educational content covered by Out-BREAK! 2023 primarily focused on microbiology and medical history. Future Out-BREAK! puzzles will seek to incorporate a wider breadth of different ID content areas, such as pharmacology, tropical medicine, HIV, and/or infection control and prevention. While this pilot of the Out-BREAK! escape room focused on feasibility and learner reactions and did not

formally evaluate educational outcomes, future iterations intend to incorporate content-related educational objectives for individual puzzles and consideration of specific knowledge evaluations (such as pre-/post-test surveys). Respondents also identified a desire for increased opportunities to participate in the escape room, which was also evident by the rapid fill of time slots during the conference. Future versions of the Out-BREAK! escape room will seek to incorporate an increased number of timeslots, a greater number of concurrently operating rooms, a larger physical space, and continued efforts to align puzzles with pedagogical goals and learning objectives.

CONCLUSIONS

The use of escape rooms for teaching is grounded in educational theory and provides an excellent opportunity to engage

multilevel learners and foster multidisciplinary collaboration in the field of ID. The successful implementation of the Out-BREAK! escape room at IDWeek 2023 shows that this is a feasible and welcome addition to the meeting and provides a fun, educational, engaging experience to members of the ID community.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Data availability. Data available upon request.

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