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Beep-Beep SIM: A six station escape game experience to simulate on-call scenarios for medical students

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Short Report

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Abstract

Medical students work ‘on-call’ shifts, responding to the ‘beep-beep’ of pagers. To prepare students for on-call emergencies, ‘Beep-Beep SIM’ (BBS), a low-cost simulation, was created. Teams navigate six clinically-themed escape game stations, each with four puzzles. Solving a station’s puzzles unlocks a QR code linked to summary card of medical content. After completing all stations, students debrief. Piloted in 2019 at the University of Calgary, BBS ran for five years, with two online iterations during the COVID-19 pandemic. BBS received positive reviews in-person (4.45/5, n = 161) and online (4.49/5, n = 124), using repetition to reinforce learning through puzzle-solving, summary cards, and debriefing.

Background

Clinical clerkship is the last part of medical school, where students begin overnight on-call shifts and receive ‘beep-beep’ alerts of medical emergencies through pagers. This can be stress-provoking, especially if it is a student’s first time responding to acute situations.

Lefroy et al. in 2017 identified features that support students through clinical firsts [1]. These include ‘opportunities for rehearsal’, ‘being given responsibility as a student in the clinical team’, and ‘building self-efficacy for tasks’. Simulation-based education fits these goals, by rehearsing common medical management approaches, collaborating with colleagues, and using problem-solving skills. Simulation provides an opportunity to practice in safe environments, while learning from errors [2].

An on-call simulation program ideally exposes students to various scenarios. With a traditional set-up in a simulation theater, this would require multiple rooms, educators, manikins, and equipment. Additionally, scheduling multiple post-scenario debriefs extends the program’s duration significantly.

Curriculum

Beep-Beep SIM (BBS) was developed to prepare clerkship students for on-call emergencies. Rather than hosting multiple full-fledged simulations, BBS introduces 6 mini-escape games housed in separate rooms, each with a different clinical topic (elevated potassium level, high blood glucose, chest pain, falls, agitation, and fever).

Each room has 4 medical puzzles, covering areas such as clinical recognition, differential diagnosis, investigations, and management. 4 teams of 5 medical students choose the order to enter 6 rooms. Using their knowledge and researching queries, students learn and reflect while solving puzzles. Every puzzle is an ‘escape game’, where students determine answers to unlock a lock. Solving a puzzle yields a number. Once 4 puzzles are complete, students unlock a 4-digit lock, which opens a box containing a QR code. The code is linked to a summary card of learning points. After completing all rooms, students gather for a final debrief, where facilitators quiz students, review summary cards, and invite questions.

In BBS, participants self-direct learning by applying knowledge, researching knowledge gaps, and peer-teaching. Station learning (i.e., moving between rooms) keeps the experience physical and provides learning in digestible chunks. Equipment required includes locked boxes with QR codes and puzzles in each room, which can be projected digitally or provided in paper form. During BBS, students continuously learn, discuss, reflect on, and consolidate knowledge while collaborating on multiple puzzles rather than needing to save discussion and reflection solely for post-session debriefs.

Although educational escape games have been used in medical school to teach other topics such as pathophysiology [3], to the authors' knowledge, BBS is the first blend of multiple mini-escape games with a student-driven station learning mechanism.

BBS was piloted in 2019 and ran at University of Calgary for 5 years (2019–2023).

In BBS, prebrief time is 5 minutes, game time to complete 6 rooms is 75 minutes, and debrief time is 30 minutes. 2 facilitators (physicians, or physician plus nurse) monitor the hallway containing 6 rooms, providing hints and support as needed.

Because of the COVID-19 pandemic, BBS was hosted online for 2 iterations (2020–2021). The format and puzzles were retained, except students 'entered rooms' by clicking on links on Google Forms. The online version is found here: https://forms.gle/7ZDXnAadjyew7UGi8.

Results

When BBS was piloted in 2019, 'usefulness of gamification for learning' was rated 1.89/2 or 95% (n = 19), where 0 = not useful, 1 = fair, and 2 = very useful. 'Usefulness of 4-time repetition for learning' (n = 19) was rated 1.92/2 or 96% (n = 19). Confidence of participants (n = 20) to achieve stations' learning objectives increased pre- vs-post BBS session ($p < 0.001$ for all objectives except one, at $p < 0.01$) (Table 1).

Table 1

Participants' (n = 20) confidence significantly increased pre- vs post-BBS 2019 pilot session for every station's learning objectives (1 = no confidence, 3 = neutral, 5 = strong confidence)

Learning Objective	Confidence Mean PRE (/5)	Confidence Mean POST (/5)	Change (%)	T-Test
HYPERKALEMIA	2.24	4.02	44%	< 0.001
Identify manifestations of hyperkalemia	1.85	3.70	50%	< 0.001
Identify early ECG changes in hyperkalemia	2.20	4.05	46%	< 0.001
Discuss an approach to the differential diagnosis to electrolyte abnormalities	2.50	4.35	43%	< 0.001
Identify indications for treating acute hyperkalemia	2.30	3.90	41%	< 0.001
List potential treatments for acute hyperkalemia	2.35	4.10	43%	< 0.001
CHEST PAIN	3.46	4.46	22%	< 0.001
List 6 life-threatening causes of chest pain	3.60	4.80	25%	< 0.001
Identify features on history and physical examination for high risk chest pain	3.50	4.35	20%	< 0.001
List appropriate initial investigations in a patient with chest pain	3.75	4.55	18%	< 0.001
Identify concerning ECG features in a patient with chest pain	3.35	4.15	19%	< 0.001
Propose initial management plans for select chest pain presentations	3.10	4.45	30%	< 0.001
HYPERGLYCEMIA	2.86	3.98	28%	< 0.001
Outline a differential diagnosis for hyperglycemia in patients with and without diabetes	2.65	3.95	33%	< 0.001
List manifestations of hyperglycemia	3.00	3.95	24%	< 0.001
Practice the use of the Basal Bolus Insulin Therapy (BBIT) protocol	2.65	3.70	28%	< 0.01

Learning Objective	Confidence Mean PRE (/5)	Confidence Mean POST (/5)	Change (%)	T-Test
Describe an approach for the management of DKA	3.15	4.30	27%	< 0.001
AGITATION	2.39	4.34	45%	< 0.001
Define agitation	2.20	4.35	49%	< 0.001
Identify risk factors for agitation	2.55	4.35	41%	< 0.001
Describe an approach for the differential diagnosis of agitation	2.35	4.20	44%	< 0.001
List preventative and proactive measures when interviewing agitated patients	2.30	4.40	48%	< 0.001
List verbal methods of de-escalation	2.25	4.35	48%	< 0.001
List physical and chemical methods of de-escalation	2.70	4.40	39%	< 0.001
FALL	2.81	4.14	32%	< 0.001
Outline a differential diagnosis for why a patient may fall	3.20	4.45	28%	< 0.001
Identify features on history and examination important in elucidating the cause of a fall	3.05	4.25	28%	< 0.001
List the Canadian CT Head Injury Rule criteria, including its inclusion criteria	2.15	4.05	47%	< 0.001
Identify hip fractures on x-rays	2.85	3.80	25%	< 0.001
FEVER	2.81	3.96	29%	< 0.001
Outline a differential diagnosis for fever	3.10	4.20	26%	< 0.001
Describe appropriate investigations for a septic work-up	3.35	4.30	22%	< 0.001
Identify potential causes of post-operative fever	3.00	4.00	25%	< 0.001
List the criteria of SIRS and qSOFA, and identify which is more sensitive or	1.80	3.35	46%	< 0.001

Learning Objective	Confidence Mean PRE (/5)	Confidence Mean POST (/5)	Change (%)	T-Test
specific for predicting mortality in sepsis				

From 2019–2023, BBS was positively reviewed, whether hosted in-person (average 4.40/5, n = 158) or online (average 4.48/5, n = 123). (1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent).

Discussion

The BBS format was successful for several reasons.

First, BBS's design is grounded in the self-determination theory, which posits that learner motivation requires the needs of competence, autonomy, and relatedness met [4]. Students achieve competence through application of knowledge during puzzle-solving and peer-teaching. Order choice when completing stations provides autonomy. Student collaboration promotes relatedness.

Second, BBS uses repetition. Students encounter clinical material 4 times (i.e., solving puzzles, reviewing summary cards, retrieval during verbal quizzing, and final review of summary cards).

Third, because BBS puzzles likely evoke fun and joyful emotions, learning may be strengthened; emotionally arousing experiences activate the amygdala of the brain, which influences consolidation of long-term memories [5].

Educators should note some limitations of the BBS format. While it facilitates knowledge and teamwork skills, it does not simulate other clinical or procedural skills. Time must be budgeted to design and test puzzles. Puzzles should be piloted until solvable without prompts within a time limit (e.g. 10–12 minutes). Other tips include color-coding equipment for efficient resets, creating a facilitator answer sheet, and storing backup locks and boxes in case equipment fails.

Conclusions

BBS is a fun, low-technological, station-based learning activity using escape game puzzles to cover 'on-call' topics. It can be adapted to teach any specialty or subject area, and new stations can be introduced to create new experiences.

Although there is a tangible aspect of unlocking boxes, the BBS online version was also well-received; consequently, in-person BBS can be facilitated without locks and boxes by housing an electronic device (with BBS online version loaded) in each room. This streamlines the set-up of BBS, while maintaining the physicality of BBS of moving participants between stations.

Finally, besides using the BBS format to facilitate learning for medical students, this format can be used for teaching other trainees, multidisciplinary groups, and certified professionals.

Declarations

Funding Statement

Funding for equipment was provided by a University of Calgary Taylor Institute for Teaching and Learning Development & Innovation Grant.

Conflict of Interest Statement

The authors have no relevant financial or non-financial interests to disclose.

Ethics Statement

The University of Calgary Conjoint Health Research Ethics Board approved the use of the post-simulation evaluation survey for collecting data from the pilot participants, who provided informed consent. Data was collected anonymously. Once the curriculum was implemented within the medical school program, student ratings were collected as part of every course's routine. The anonymous numerical student ratings are routine program evaluation data. The University of Calgary Conjoint Health Research Ethics Board approved the use of this program evaluation data. The study was conducted in accordance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2, Canada) and institutional research ethics requirements.

Clinical Trial Number

Not applicable.

Consent to Participate

For the pilot study, verbal and written informed consent were obtained from participants, which involved participating in a simulation and completing pre-/post-confidence surveys. After the pilot study, new participants completed a post-course survey to rate their BBS sessions. This survey was part of University of Calgary medical school's routine program evaluation process; completion was taken as implied consent to provide feedback.

Consent to Publish

For the pilot study, participants provided verbal informed consent for data dissemination; written informed consent was provided for the use of their data for research purposes. After the plot study, post-course evaluation data were collected anonymously as part of routine program evaluation process by the medical school. The University of Calgary Conjoint Health Research Ethics Board approved the use of this program evaluation data.

Author Contribution

A.S. drafted the main manuscript text. All authors reviewed the manuscript.

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Data Availability

The raw data package supporting Table 1 are available in the University of Calgary's Digital Repository: https://doi.org/10.5683/SP3/NKRA39. This data package contains data for the BBS 2019 pilot as well as the student ratings of the BBS sessions that ran from 2019 to 2023.

References

1. Lefroy J, Yardley S, Kinston R, Gay S, McBain S, McKinley R. Qualitative research using realist evaluation to explain preparedness for doctors' memorable 'firsts'. Med Educ. 2017;51(10):1037–48. 10.1111/medu.13370.
2. Ziv A, Ben-David S, Ziv M. Simulation Based Medical Education: an opportunity to learn from errors. Med Teach. 2005;27(3):193–9.
3. Monaghan SR, Nicholson S. Bringing Escape Room Concepts to Pathophysiology Case Studies. J Hum Anat Physiol Soc. 2017;21(2):49–62.
4. Ten Cate TJ, Kusurkar RA, Williams GC. How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE guide 59. Med Teach. 2011;33(12):961–73. 10.3109/0142159X.2011.595435.
5. McGaugh JL. The amygdala modulates the consolidation of memories of emotionally arousing experiences. Annu Rev Neurosci. 2004;27:1–28. 10.1146/annurev.neuro.27.070203.144157.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PhotosofBBS.pdf