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BRIEF REPORT

Escape Boxes: A Serious Game for Teaching Nontechnical Skills Pertinent to Crisis Management

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INTRODUCTION

Escape games offer an innovative approach to teaching nontechnical skills essential for managing critical events.¹ In this study, we assessed how an escape box activity affected anesthesia residents' self-efficacy at establishing role clarity and using closed loop communication.

Game-based learning is an educational approach aligned with the needs and expectations of modern health professions learners by applying game concepts to enhance knowledge, engagement, and satisfaction.² Escape games are serious games increasingly popular in health professions education in which teams work together to complete multiple puzzles within a time limit.³ In traditional simulation, the cognitive demands of simultaneously practicing technical and nontechnical skills may overwhelm learners.⁴ By removing the spotlight on technical skills, escape games help learners focus on nontechnical skills such as teamwork and communication. Escape rooms have been described for medical students,⁵ nursing students,⁶ pharmacy students,⁷ and resident physicians⁸ but are resource-intensive. Escape boxes are a more accessible alternative in which teams solve puzzles to unlock a box. Virtual escape boxes are feasible and well-received by health professions learners.⁹ However, it is unclear how this translates to in-person (analog) escape boxes.

Our objective in this study was to assess how an analog escape box activity affected anesthesiology residents' self-efficacy with 2 nontechnical skills: establishing role clarity and using closed loop communication. We hypothesized that this activity would increase self-efficacy with both skills.

MATERIALS AND METHODS

We conducted a single group pretest-posttest study in June 2024 and June 2025 assessing an analog escape box activity for anesthesia intern residents. This study was reviewed and approved by the Mayo Clinic Education Research Committee (ID# 24-110) and exempted by the Mayo Clinic Institutional Review Board (ID#24-011540).

Setting and Participants

A total of 38 anesthesiology residents (all 19 residents each year) participated in a formative escape box activity during the final month of their intern year. Residents completed pretest/posttest surveys before and after the escape box activity. The escape box activity took place in a simulation lab located within the hospital and lasted 1 hour (10-minute prebrief, 30 minutes for the escape box, then a 20-minute debrief).

Interventions

We used ChatGPT 3.5 (free version) to create 5 anesthesia-themed riddles. We used Microsoft Copilot (free version) to write a final riddle requiring teams to locate and take a team photo with a specific education

program coordinator (Supplemental Online Material 1 and 2). We purchased Sheffield Ammo Storage Boxes, hasp locks, and a variety of alphanumeric combination locks from Amazon.com (Figure 1). Each box cost approximately \$15, and each lock cost between \$10 and \$15, coming to a total cost of \$325.56 for 4 escape boxes. We pilot tested the escape boxes with 3 first year clinical anesthesiology (CA-1) residents to ensure that the activity could be completed in the expected time frame. The total time for escape box development and testing was approximately 4 hours.

During the educational activity, we began with a prebrief explaining instructions including a 30-minute time limit and reviewing definitions, examples, and the importance of role delegation and closed-loop communication. We randomly divided residents into 4 teams (4–5 residents) at separate tables. With permission, we locked residents' cellular phones and the final riddle inside the box using a hasp lock and 5 combination locks. Each team received a page of 5 riddles corresponding to the 5 locks (Supplemental Online Material 1). After teams opened the box, the final riddle required them to leave the simulation lab and locate and take a selfie with an education program coordinator. Afterward, the authors debriefed residents on role delegation and closed-loop communication during the activity.

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Survey Instrument

We designed a paper survey consisting of two 5-item Likert questions (1 = *not at all confident*, 5 = *extremely confident*) asking how residents felt about (1) establishing role clarity and (2) using closed-loop communication and comments on what they liked and what could be improved. We pilot tested this survey with 3 CA-1 residents to confirm instruction clarity. Residents received a stapled packet with pretest/posttest surveys, and we administered the pretest survey before the prebrief and the posttest survey after the debrief. During the June 2025 iteration, we added a 5-point Likert question to assess resident satisfaction with the whole educational activity (1 = *not at all* to 5 = *extremely satisfied*) and a 6-item, 7-point National Aeronautics and Space Administration Task Load Index (NASA-TLX) as a validated tool for assessing perceived workload.¹⁰

Analysis of Outcomes

We analyzed changes in self-efficacy using Wilcoxon signed-rank tests using BlueSky Statistics version 10.3.4. We calculated descriptive statistics for raw NASA-TLX scores and perceived workload. We analyzed comments using thematic analysis: investigators BB and JH coded all comments in duplicate with semantic and latent codes and then clustered related codes into provisional themes. The investigators then met to discuss, compare, develop, and revise themes. Discrepancies between coders were resolved through discussions until the coders reached a consensus.

RESULTS

Thirty-eight residents participated in the escape box. All 8 teams successfully completed the escape box (mean time 14.3, standard deviation 3.8 minutes). During debriefing, role delegation was addressed by comparing team strategies: both years, the slowest team solved riddles sequentially, whereas the fastest team delegated riddles to different members. Closed-loop communication was addressed through specific observations, such as when 1 resident struggled to open a lock yet teammates were unaware of the issue, highlighting the need for clear

communication, acknowledgment, and confirmation. Thirty of 38 residents (79%) completed surveys. Resident self-efficacy for establishing role clarity and for using closed-loop communication both increased significantly ($p < .001$ for both) (Table 1). Median NASA-TLX scores (Table 1) indicated that the escape box activity had moderate mental demand (4.5 of 7), temporal demand (4.5), and effort (4) and low physical demand (3), performance (2), and frustration (1.5). Thematic analysis of 11 comments revealed 2 key themes: teamwork and engagement. Five (45%) of 11 comments highlighted teamwork and described the escape box as a valuable opportunity to solve problems collaboratively with classmates. Three (27%) of 11 mentioned that the activity was very engaging and noted that the interactivity fostered an enjoyable learning environment. Residents asked for future similar activities and more challenging riddles. No negative comments were received. Mean satisfaction on a 5-point scale was 3.8 (standard deviation 1.2).

DISCUSSION

This analog escape box activity was well-received by anesthesia residents in their last month of their intern year and improved their self-efficacy with assigning roles and using closed-loop communication. Mental demand, temporal demand, and effort were moderate, whereas physical demand, performance workload, and frustration were low. These findings suggest that the interactive and team-based nature of the escape box activity can provide a valuable psychologically safe platform for isolating and developing nontechnical skills essential to patient safety.

Integration With Prior Work

Our findings align with previous reports that escape games improve teamwork and communication, encourage learner engagement, foster active participation, and maintain learner interest.^{3,6} The Cantwell et al. virtual escape box activity found that medical students on their emergency medicine clerkship rated the escape box higher than flipped classroom activities for explaining content clearly at a proper level and for providing effective instruction.⁹ The Hawkins et al. escape room found that a large majority of first-

year nursing students reported the activity as effective for practicing safe medication administration skills and an enjoyable opportunity to improve teamwork and communication skills.⁶

Limitations

Limitations include the subjective outcomes, posttest timing, sample size, and single institution/specialty. Our outcomes were limited to subjective surveys; whereas validated tools, such as the Ottawa Crisis Resource Management Global Rating Scale exist, these are more resource-intensive, requiring rater training and direct observation of participants by raters, and this may have reduced study participation and was beyond the scope of this proof-of-concept project. The posttest was administered after the prebrief and the debrief, making it difficult to separate the benefit of the escape box activity from learning during the prebrief/debrief. However, prebriefing and debriefing are integral components of simulation-based education and should always be included with an escape box activity. The absence of a control group limits conclusions about how the activity affected outcomes. We omitted a control group as the small sample size would have lacked appropriate power, and we wanted all interns to participate in this team-building activity. The questions on perceived workload and satisfaction were added in 2025, further limiting sample size as only 2 questions were answered by both cohorts. These 2 questions also did not have anchoring rubrics though we did label answer options. We studied anesthesiology interns, limiting generalizability to senior residents. Because anesthesiology interns may have fewer opportunities to engage in crisis management skills, junior residents may derive higher value from practicing these skills in a game setting compared with senior residents.

Future Directions

Escape boxes may be further incorporated into the anesthesia resident education for other skills, such as informed consent and equipment troubleshooting. For example, puzzles could include core elements of neuraxial informed consent or interpreting anesthesia machine alarms.

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CONCLUSIONS

This study serves as a proof of concept that escape boxes can improve residents' self-efficacy in establishing role clarity and using closed-loop communication. Educators may consider escape box activities to train critical skills without cognitively overloading residents with simultaneously learning technical skills.

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Abstract

Background: Escape games offer an innovative approach to teaching nontechnical skills essential for managing critical events. The primary aim of this study was to assess how an analog escape box activity affected anesthesiology residents' self-efficacy with 2 nontechnical skills: establishing role clarity and using closed loop communication.

Methods: In June 2024 and June 2025, a total of 38 anesthesia interns competed in teams of 4–5 to solve 5 riddles to open a locked box and take a team photo with an education program coordinator. Residents completed pretest/posttest surveys assessing their self-efficacy with establishing role clarity and using closed-loop communication and their satisfaction and perceived workload (mental/physical/temporal demand, performance workload, effort, and frustration). Changes in self-efficacy were analyzed using Wilcoxon signed-rank tests, descriptive statistics were calculated for perceived workload and satisfaction, and comments were analyzed with thematic analysis. The total cost of supplies was \$325.56 for 4 escape boxes.

Results: Thirty (79%) of 38 residents completed surveys. Resident self-efficacy for establishing role clarity and using closed-loop communication both increased significantly ($p < .001$). On a 7-point scale of perceived workload, median mental demand (4.5), temporal demand (4.5), and effort (4) were moderate, whereas physical demand (3), performance workload (2), and frustration (1.5) were low. Mean satisfaction was 3.8 out of 5. Thematic analysis of resident comments revealed teamwork and engagement as key themes.

Conclusions: This study serves as a proof of concept that escape boxes are well-received and can improve residents' self-efficacy in establishing role clarity and using closed-loop communication.

Keywords: Escape game, escape box, nontechnical skills, graduate medical education; game-based learning; serious game

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Figure

Figure 1. *Escape box equipment. Sheffield ammo storage boxes, hasp locks, and a variety of alphanumeric combination locks used for the escape box activity.*



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Table

Table 1. Improvement in Resident Self-Efficacy and Summary of Perceived Workload

How Confident Are You About Your Ability to Perform This Task When Working in a Team Environment? (Gray Bar = Pre; Red Bar = Post)						p-value
Not at all Confident	Slightly Confident	Moderately Confident	Quite Confident	Extremely Confident		
Establish role clarity	11	14	18	1	5	<.001
Using closed-loop communication	8	14	15	1	7	

NASA Task Load Index (TLX)

Category	Median TLX
Mental Demand	4.5
Physical Demand	3.0
Temporal Demand	4.5
Performance	2.0
Effort	4.0
Frustration	1.5

We compared pretest and posttest self-efficacy using paired Wilcoxon signed rank tests. We assessed residents' perceived workload during the escape box activity using the National Aeronautics and Space Administration Task Load Index. We report medians and median absolute deviations due to the skewed distribution of the data. Mental demand: How mentally demanding was the task? Physical demand: How physically demanding was the task? Temporal demand: How hurried or rushed was the pace of the task? Performance: How successful were you in accomplishing what you were asked to do? Effort: How hard did you have to work to accomplish your level of performance? Frustration: How insecure, discouraged, irritated, stressed, and annoyed were you? The performance scale ranged from 1 = *perfect* to 7 = *failure*. All other scales ranged from 1 = *very low* to 7 = *very high*.

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Supplemental Online Material

Supplemental Online Material 1. ChatGPT and Copilot Conversations

Can you help me write some riddles for first year anesthesia residents. These riddles will be used to help open an escape box. The first riddle should lead to an answer that is a 4-digit numeric code, followed by a 3-digit numeric code, followed by another 3-digit numeric code, then a 5-character alphanumeric code, and lastly a 4-character word.

ChatGPT said,

Of course! Here are some riddles tailored for first-year anesthesia residents:

1. Four-digit numeric code: Riddle: "In the realm of vital signs, where numbers dance and pulse, this figure holds the key to cardiac repose. What am I?" Answer: Heart rate (eg, 7012 for 70 beats per minute, 12 per breath)
2. Three-digit numeric code: Riddle: "Within the gas we administer lies a trio of digits, marking the depth of a patient's tranquil slumber. What do they signify?" Answer: End-tidal CO₂ (eg, 035 for 35 mmHg)
3. Three-digit numeric code: Riddle: "In the labyrinth of tubes and passages, a numeric code guards the gateway to oxygenation's zenith. What is it?" Answer: Pulse oximetry (eg, 099 for 99% saturation)
4. Five-character alphanumeric code: Riddle: "Amidst the sea of medical records, a cryptic blend of letters and numbers conceals the dosage of our chosen elixir. What's the combination?" Answer: Propofol (eg, POP01 for 100 mg/20 mL)
5. Four-character word: Riddle: "In the silence of the OR, whispered tales of anesthesia lore converge on this four-lettered sentinel, guarding our passage to unconsciousness. What is it?" Answer: Mask

You said,

Can the first riddle be some sort of ABG interpretation?

ChatGPT said,

Absolutely! Here's the revised first riddle tailored to ABG interpretation:

1. Four-digit numeric code (ABG interpretation): Riddle: "In the realm where blood whispers its secrets, a quartet of digits deciphers the balance of life's breath. What marks the pH of our arterial journey?" Answer: Arterial pH (eg, 7.40, represented as 7400)

Would you like me to adjust any of the other riddles accordingly?

You said,

Can the riddle be more complex?

ChatGPT said,

Certainly! Here's a more complex version of the first riddle:

1. Four-digit numeric code (ABG interpretation): Riddle: "In the delicate dance of gases, where oxygen kisses the bloodstream and carbon dioxide whispers its tale, a numerical symphony orchestrates the equilibrium of life. Find the maestro's mark, the harmony of acidity and alkalinity, where 7.4 reigns supreme." Answer: Arterial pH (eg, 7.40, represented as 7400)

Would you like any further adjustments or elaborations on the other riddles?

You said,

Can we make the first code by NPO guidelines?

ChatGPT said,

Certainly! Let's craft the first riddle based on NPO (Nil Per Os) guidelines:

1. Four-digit numeric code (NPO guidelines): Riddle: "In the realm

of preoperative preparation, where hunger meets caution, a four-digit cipher guards the gate to a patient's fasting state. What combination locks away their last morsel before the surgical journey begins?" Answer: NPO duration (eg, 1200 for fasting for 12 hours)

Would you like to continue with this theme for the other riddles or opt for different medical concepts?

You said,

Let's change the second riddle to be about the maintenance fluid 4-2-1 rule.

ChatGPT said,

Certainly! Let's adapt the second riddle to focus on the maintenance fluid 4-2-1 rule:

2. Three-digit numeric code (maintenance fluid rule): Riddle: "In the balance of hydration, where IV drips play their tune, a trio of numbers echoes the mantra of equilibrium. What's the code that dictates the flow, where every kilogram counts in milliliters three?" Answer: Maintenance fluid rate (eg, 100 for 100 ml/hr for the first 10 kg)

How does that sound?

You said,

Let's make riddle 4 have the answer PLRFP, which stand for propofol, lidocaine, rocuronium, fentanyl, and phenylephrine.

ChatGPT said,

Certainly! Here's the revised fourth riddle with the answer PLRFP:

4. Five-character alphanumeric code (medication acronym): Riddle: "In the pharmacopeial alphabet, where letters weave their magic, a quintet of characters unlocks the recipe for smooth induction and balanced

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Supplemental Online Material *continued*

anesthesia. What's the code that spells the symphony of sedation, the blend that guides us through the realms of consciousness?" Answer: PLRFP

How does that fit for your escape box puzzle?

You said,

The riddle needs to include a hint for each letter in the answer.

ChatGPT said,

Got it! Here's the revised riddle for the medication acronym PLRFP with hints for each letter:

4. Five-character alphanumeric code (medication acronym): riddle: "In the realm of anesthesia's pharmacopoeia, where each letter wields its power, a journey awaits through hints of their essence. Peruse the clues:
 - P: A milky infusion, the harbinger of slumber's embrace.
 - L: An anesthetic ally, numbing the nerves to silence their protest.
 - R: A neuromuscular blockade, seizing control with precision.
 - F: A potent opioid, whispering oblivion with each breath.
 - P: A vasoconstrictor surge, raising pressure to protect.

Unravel these secrets, and the path to sedation shall reveal itself." Answer: PLRFP

Does this meet your expectations?

You said,

Can the last riddle be about TIVA?

ChatGPT said,

Absolutely! Here's the revised fifth riddle focusing on TIVA (total intravenous anesthesia):

5. Four-character word (TIVA): Riddle: "In the realm of anesthesia, where intravenous rivers flow, a four-lettered

sentinel guards the gate to seamless sedation. What word stands tall, representing the path to consciousness cloaked in drugs' embrace?" Answer: TIVA

How does that sound?

You said,

Can the riddle be longer?

ChatGPT said,

Certainly! Here's an extended version of the fifth riddle focusing on TIVA:

5. Four-character word (TIVA): Riddle: "In the realm of anesthesia, where the dance of consciousness meets the melody of medication, there lies a path less traveled yet known to the adept. Harken to the whispers of pharmacological synergy, where intravenous streams converge to orchestrate a symphony of sedation. This four-lettered sentinel, a beacon amidst the fog of volatile agents, signifies not just an approach, but a philosophy—an artful mastery of dosage, titration, and precision. What word stands tall, representing this journey of total intravenous anesthesia, where every drop carries the weight of sleep's tender embrace and every infusion shapes the canvas of tranquility?" Answer: TIVA

How does this longer version resonate with you?

You said,

Can riddle number 3 be longer as well?

ChatGPT said,

Absolutely! Here's an extended version of the third riddle focusing on pulse oximetry:

3. Three-digit numeric code (pulse oximetry): Riddle: "Amidst the labyrinth of tubes and sensors, where the rhythm of life is measured in beats and breaths, there lies a sentinel—a device that peers into the depths of

oxygen's dance with hemoglobin. Picture the scene: a fingertip bathed in red light, a pulse oximeter whispers its secrets in numerical form. But beyond the digits lies a tale of oxygenation, a saga of saturation and perfusion. Three digits, a triffecta of insight, reveal the balance between oxygen's embrace and the body's demand. It's not merely a number; it's a window into the unseen realms of circulation, a guide through the maze of respiration. What numerical code unveils this narrative, where each digit is a chapter in the saga of arterial oxygenation, pulsatile and profound?" Answer: Pulse oximetry (eg, 099 for 99% saturation)

How does this longer version suit your needs?

You said,

Can we expand upon this riddle: Riddle: "In the balance of hydration, where IV drips play their tune, a trio of numbers echoes the mantra of equilibrium. What's the code that dictates the flow, where every kilogram counts in milliliters three?" Answer: "4-2-1" rule

ChatGPT said,

Absolutely! Here's an expanded version of the riddle for the "4-2-1" rule:

2. Three-digit numeric code (maintenance fluid rule—"4-2-1" rule): Riddle: "Within the realm of hydration, where IV drips trickle like a stream, there exists a sacred formula, whispered among the healers—a code of equilibrium, where the balance between dehydration and fluid overload is delicately maintained. Picture the scene: a patient lies in repose, their weight in kilograms a measure of their body's needs. And so, the mantra emerges—a trio of numbers that dictates the flow, where every kilogram counts in milliliters three. But this is more than a mere sequence;

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it's a symphony of physiology, a melody of metabolism, where sodium and glucose dance in harmony with water's embrace. What's the code that governs this aqueous ballet, where the rhythm of life pulses in milliliters per hour?" Answer: "4-2-1" rule

Does this expanded version capture the essence of the "4-2-1" rule effectively?

You said,

Can you expand upon this riddle: Riddle: "In the realm of preoperative preparation, where hunger meets caution, a four-digit cipher guards the gate to a patient's fasting state. What combination locks away their last morsel of water, breast milk, light meal, and full meal before the surgical journey begins?" Answer: NPO duration for each category = 2468, which represents 2 hours, 4 hours, 6 hours, and 8 hours.

ChatGPT said,

Absolutely! Here's an expanded version of the riddle for the NPO (Nil Per Os) guidelines:

1. Four-digit numeric code (NPO guidelines): Riddle: "Step into the realm of preoperative anticipation, where the dance of hunger and caution intertwines. Here, a four-digit cipher stands sentinel, guarding the gateway to a patient's fasting state—a period where sustenance surrenders to necessity, where the last morsel of water, the final sip of breast milk, the lingering taste of a light meal, and the echoes of a full feast fade into memory. Picture the scene: a countdown begins, each digit a measure of patience, of preparation, of precision. Two hours mark the journey from thirst to stillness, four hours usher in the silence of satiety, six hours beckon the body to surrender its reserves, and eight hours stand as the threshold between indulgence and emptiness. This is not merely a code; it's a testament to discipline, a ritual

of readiness, a symphony of sacrifice. What combination locks away the whispers of nourishment, bidding the body to embrace the surgical journey that lies ahead?" Answer: NPO duration (eg, 2468 for 2, 4, 6, and 8 hours)

Does this expanded version capture the essence of the NPO guidelines effectively?

You said,

What are 3 important digits in anesthesia?

ChatGPT said,

Three important digits in anesthesia are 7.4, representing the target arterial pH level during anesthesia.

You said,

Another example?

ChatGPT said,

Another example of three important digits in anesthesia is 100, representing the standard atmospheric pressure in millimeters of mercury (mmHg) used as the reference point for calculating partial pressures of gases in the blood during anesthesia.

You said,

Another example?

ChatGPT said,

Certainly! Another example of three important digits in anesthesia is 0.9, representing the concentration of normal saline (0.9% sodium chloride solution) commonly used as an intravenous fluid during anesthesia procedures.

You said,

Write a riddle with the answer being 1.34, referencing the oxygen carrying capacity equation.

ChatGPT said,

Certainly! Here's a riddle referencing the

oxygen carrying capacity equation with the answer being 1.34:

Riddle: "In the bloodstream's labyrinth, where oxygen reigns supreme, there lies a numerical enigma—a key to understanding the vessel's bounty. Harken to the whispers of hemoglobin's embrace, where every gram counts in the currency of oxygenation. What's the magic number that unlocks the potential of erythrocytes, where 1.34 units guide the dance of oxygen from lungs to tissues, a vital exchange that sustains the flame of life?" Answer: 1.34.

You said,

Can you expand on that riddle?

ChatGPT said,

Of course! Here's an expanded version of the riddle:

Riddle: "Within the winding pathways of the circulatory system, where rivers of crimson flow, there exists a hidden truth—a numerical essence that defines the essence of life's breath. Picture the scene: within the scarlet rivers, erythrocytes weave their intricate dance, each bearing a cargo crucial for sustenance. Amidst this symphony of circulation, there lies a magical number—a figure imbued with the power to unlock the secrets of oxygenation. It's not just a number; it's a revelation—a revelation of the wondrous capacity of hemoglobin, the molecular maestro of oxygen transport. At its core, it signifies the miraculous exchange between lungs and tissues, where 1.34 units of oxygen cling to every gram of hemoglobin, orchestrating the delicate ballet of respiration. What's this mystical number, the beacon of oxygen's journey through the bloodstream, guiding the rhythm of life itself?" Answer: 1.34

You said,

What are important formulas in anesthesia?

ChatGPT said,

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Supplemental Online Material *continued*

In anesthesia, several formulas are crucial for various calculations and assessments. Some important formulas include

1. Oxygen Delivery (DO₂) Formula:

$$DO_2 = \text{Cardiac Output (CO)} \times \text{Arterial Oxygen Content (CaO}_2\text{)}$$
 - This formula calculates the amount of oxygen delivered to tissues per minute.
2. Oxygen Consumption (VO₂) Formula:

$$VO_2 = CO \times (CvO_2 - CaO_2)$$
 - This formula calculates the amount of oxygen consumed by tissues per minute.
3. Alveolar Gas Equation: $PAO_2 = (FiO_2 \times (P_{atm} - PH_2O)) - (PaCO_2 / R)$
 - This formula calculates the partial pressure of oxygen in the alveoli.
4. Anion Gap: $\text{Anion Gap} = [Na^+] - ([Cl^-] + [HCO_3^-])$
 - This formula helps diagnose metabolic acidosis.
5. Body Surface Area (BSA): $BSA = \sqrt{((\text{Height in cm} \times \text{Weight in kg}) / 3600)}$
 - This formula estimates the body surface area, useful for dosing medications.
6. Ideal Body Weight (IBW): IBW (Male) = 50 kg + (2.3 kg × Height in inches over 5 feet) IBW (Female) = 45.5 kg + (2.3 kg × Height in inches over 5 feet)
 - This formula helps determine appropriate drug dosages.
7. Fluid Maintenance Rate: Maintenance Fluid Rate = 4 ml/kg/hr for the first 10 kg + 2 ml/kg/hr for the next 10 kg + 1 ml/kg/hr for each additional kg above 20 kg
 - This formula calculates the rate at which fluids should be administered to maintain hydration.

Understanding and applying these formulas are essential skills for anesthesiologists in optimizing patient care and safety during procedures.

You said,

“Within the realm of hydration, where IV drips trickle like a stream, there exists a sacred formula, whispered among the healers—a code of equilibrium, where the balance between dehydration and fluid overload is delicately maintained. Picture the scene: a patient lies in repose, their weight 70 kg. And so, the mantra emerges—a trio of numbers that dictates the flow, where every kilogram counts in milliliters three. But this is more than a mere sequence; it’s a symphony of physiology, a melody of metabolism, where sodium and glucose dance in harmony with water’s embrace. What’s the rhythm of life pulses in milliliters per hour that will maintain life for our 70 kg individual?”

ChatGPT said,

Certainly! Here’s the expanded version of the riddle with your provided context:

Riddle: “Within the realm of hydration, where IV drips trickle like a stream, there exists a sacred formula, whispered among the healers—a code of equilibrium, where the balance between dehydration and fluid overload is delicately maintained. Picture the scene: a patient lies in repose, their weight 70 kg. And so, the mantra emerges—a trio of numbers that dictates the flow, where every kilogram counts in milliliters three. But this is more than a mere sequence; it’s a symphony of physiology, a melody of metabolism, where sodium and glucose dance in harmony with water’s embrace. What is the rhythm of life that pulses in milliliters per hour, maintaining the delicate balance for our 70 kg individual?” Answer: 110 ml/hr (calculated using the 4-2-1 rule: 4 ml/kg/hr for the first 10 kg, 2 ml/kg/hr for the next 10 kg, and 1 ml/kg/hr for each kg above 20 kg: $(4 \times 10) + (2 \times 10) + (1 \times 50) = 40 + 20 + 50 = 110$ ml/hr)

You said,

Can you make the riddle sound better? “Within the realm of hydration, where IV drips trickle like a stream, there exists a sacred formula, whispered among the healers—a code of equilibrium, where the balance between dehydration and fluid overload is delicately maintained. Picture the scene: a patient lies in repose, their weight 70 kg. And so, the mantra emerges—a trio of numbers that dictates the flow, where every kilogram counts in milliliters three. But this is more than a mere sequence; it’s a symphony of physiology, a melody of metabolism, where sodium and glucose dance in harmony with water’s embrace. What’s the rhythm of life pulses in milliliters per hour that will maintain life for our 70 kg individual?”

ChatGPT said,

Certainly! Here’s a polished version of the riddle:

Riddle: “In the realm of hydration, where IV drips flow like a gentle stream, there lies a sacred formula, whispered among healers—a code of balance, where the delicate line between dehydration and fluid overload is expertly maintained. Picture this: a patient rests peacefully, their weight 70 kg. From this, a mantra emerges—a trio of numbers that dictates the flow, with every kilogram accounted for in milliliters. But this is more than a mere calculation; it’s a symphony of physiology, a melody of metabolism, where sodium and glucose dance harmoniously with water’s embrace. What is the rhythm that pulses in milliliters per hour, sustaining life and balance for our 70 kg individual?” Answer: 110 ml/hr (calculated using the 4-2-1 rule: 4 ml/kg/hr for the first 10 kg, 2 ml/kg/hr for the next 10 kg, and 1 ml/kg/hr for each kg above 20 kg: $(4 \times 10) + (2 \times 10) + (1 \times 50) = 40 + 20 + 50 = 110$ ml/hr)

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Supplemental Online Material *continued*

You said,

The last sentence needs some improvement.

ChatGPT said,

Of course! Here's an improved version of the last sentence:

Riddle: "In the realm of hydration, where IV drips flow like a gentle stream, there lies a sacred formula, whispered among healers—a code of balance, where the delicate line between dehydration and fluid overload is expertly maintained. Picture this: a patient rests peacefully, their weight 70 kg. From this, a mantra emerges—a trio of numbers that dictates the flow, with every kilogram accounted for in milliliters. But this is more than a mere calculation; it's a symphony of physiology, a melody of metabolism, where sodium and glucose dance harmoniously with water's embrace. What is the flow rate in milliliters per hour that sustains the life and balance of our 70 kg patient?" Answer: 110 ml/hr (calculated using the 4-2-1 rule: 4 ml/kg/hr for the first 10 kg, 2 ml/kg/hr for the next 10 kg, and 1 ml/kg/hr for each kg above 20 kg: $(4 \times 10) + (2 \times 10) + (1 \times 50) = 40 + 20 + 50 = 110$ ml/hr)

You said,

Can we make a riddle with the answer being 3 digits for an acid–base calculation?

ChatGPT said,

Sure! Here's a riddle with a focus on an acid–base calculation:

Riddle: "In the complex dance of blood chemistry, where balance is key and equilibrium reigns, a triad of digits holds the secret to understanding the body's pH stability. Within the arterial blood, where gases mingle and bicarbonate stands guard, lies the answer to our quest. Consider the values that reflect a delicate balance: a carbon dioxide tension at 40 mmHg, a bicarbonate concentration at 24 mEq/L, and the final piece of the puzzle, the arterial pH. This combination reveals a state of harmony, neither acidic nor alkaline.

What is the numerical value representing this harmonious state, expressed as three digits?" Answer: 740 (for a normal arterial pH of 7.40)

How does this riddle work for your purpose?

You said,

Can the riddle involve Winter's formula?

ChatGPT said,

Of course! Here's a riddle involving Winter's formula:

Riddle: "In the labyrinth of blood chemistry, where the balance between acids and bases determines health, a trio of digits unlocks the mystery of metabolic acidosis. Within this balance, carbon dioxide and bicarbonate dance to maintain equilibrium. Winter's formula, the key to predicting compensation, reveals the expected pCO₂. When bicarbonate is measured at 12 mEq/L, this calculation guides our expectations. Seek the three-digit answer that Winter's wisdom imparts, indicating the anticipated pCO₂ in millimeters of mercury. What is the number that completes this crucial calculation?" Answer: 028 (using Winter's formula: Expected pCO₂ = $(1.5 \times [\text{HCO}_3^-]) + 8 \pm 2$; for HCO₃⁻ of 12 mEq/L, Expected pCO₂ = $(1.5 \times 12) + 8 = 26 \pm 2$, approximately 28 mmHg)

Does this riddle meet your needs?

You said,

Instead, make the riddle include calculating the anion gap. The question stem should include a diagnosis that causes a high anion gap.

ChatGPT said,

Certainly! Here's a riddle involving calculating the anion gap with a diagnosis that causes a high anion gap:

Riddle: "In the intricate realm of blood chemistry, where ions shift and balances hold, lies a key to uncovering hidden metabolic secrets. Imagine a patient with

a diagnosis of diabetic ketoacidosis, where acids accumulate and balance is disturbed. By assessing sodium, chloride, and bicarbonate, one can reveal the gap that tells the tale. Sodium reads 140 mEq/L, chloride at 100 mEq/L, and bicarbonate at 12 mEq/L. Calculate the difference that uncovers the high anion gap, a hallmark of this condition. What is the three-digit number that reveals the gap in this metabolic mystery?" Answer: 028 (Anion Gap = $[\text{Na}^+] - ([\text{Cl}^-] + [\text{HCO}_3^-])$; Anion Gap = $140 - (100 + 12) = 28$)

Does this riddle fit your requirements?

You said,

Can you make the riddle more complicated?

ChatGPT said,

Certainly! Here's a more detailed and complex riddle involving the calculation of the anion gap:

Riddle: "In the enigmatic world of blood chemistry, where ions play a crucial role and balance is vital, a hidden gap reveals a deeper truth. Imagine a patient presenting with rapid breathing, confusion, and abdominal pain—symptoms that point to diabetic ketoacidosis. In this state, acids accumulate, disrupting the delicate equilibrium. With the following laboratory values: sodium at 140 mEq/L, chloride at 98 mEq/L, and bicarbonate at 10 mEq/L, the task is to unveil the hidden gap that signifies this metabolic derangement. Calculate the anion gap, which will shed light on the extent of this imbalance. What is the three-digit number that emerges, revealing the high anion gap and confirming the diagnosis?" Answer: 032 (Anion Gap = $[\text{Na}^+] - ([\text{Cl}^-] + [\text{HCO}_3^-])$; Anion Gap = $140 - (98 + 10) = 32$)

Does this more detailed riddle work for your needs?

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Supplemental Online Material *continued*

You said,

Add some additional values as distractors.

ChatGPT said,

Certainly! Here's the enhanced riddle with additional values as distractors:

Riddle: "In the intricate world of blood chemistry, where ions dance in delicate balance, a hidden gap reveals a deeper truth. Imagine a patient presenting with rapid breathing, confusion, and abdominal pain—symptoms pointing to diabetic ketoacidosis. In this state, acids accumulate, disrupting the equilibrium. Consider the following laboratory values: sodium at 140 mEq/L, potassium at 4.5 mEq/L, chloride at 98 mEq/L, bicarbonate at 10 mEq/L, and glucose at 250 mg/dL. Amidst these numbers, the key to solving this mystery lies in the anion gap. Calculate the anion gap, which will expose the extent of the metabolic derangement. What is the three-digit number that emerges, revealing the high anion gap and confirming the diagnosis?" Answer: 032 (Anion Gap = $[Na^+] - ([Cl^-] + [HCO_3^-])$; Anion Gap = $140 - (98 + 10) = 32$)

Does this riddle with additional distractors meet your needs?

You said,

Please make a riddle regarding NPO guidelines. The answer should be 2468. The riddle will involve needing to place foods in the correct order of which patients will be able to have surgery first if they ate those foods.

ChatGPT said,

Certainly! Here's a riddle involving NPO guidelines with the answer being 2468:

Riddle: "In the realm of preoperative preparation, where the timing of one's last meal dictates readiness for surgery, lies a code of fasting that ensures safety. Imagine four patients, each having consumed different substances: water, breast milk, a light meal, and a full meal. Their times to

surgery vary, and placing their consumption in the correct order reveals a vital sequence. The numbers, when placed in order, reflect hours since ingestion needed before surgery can commence. Identify the order of fasting durations—water, breast milk, light meal, full meal—that ensures the safest surgical journey. What is the four-digit code that unlocks this order?" Answer: 2468 (2 hours for water, 4 hours for breast milk, 6 hours for a light meal, 8 hours for a full meal)

Does this riddle fit your needs?

You said,

Be more general with regards to the foods.

ChatGPT said,

Certainly! Here's a more general version of the riddle involving NPO guidelines with the answer being 2468:

Riddle: "In the realm of preoperative preparation, where timing is crucial to ensure patient safety, a code of fasting governs who is ready for surgery. Picture four patients, each having consumed different types of intake: clear liquids, breast milk, a light snack, and a full meal. The time each must wait before surgery varies, and placing their consumption in the correct order reveals a vital sequence. These durations reflect the hours needed to ensure their stomachs are empty and safe for anesthesia. Determine the order of these fasting durations: clear liquids, breast milk, light snack, full meal. What is the four-digit code that unlocks the correct order for surgical readiness?" Answer: 2468 (2 hours for clear liquids, 4 hours for breast milk, 6 hours for a light snack, 8 hours for a full meal)

Does this version meet your needs?

You said,

Can you make an opening riddle to the escape boxes? The answer should be a hint that the anesthesia residents need to solve 5 riddles to open the box.

ChatGPT said,

Certainly! Here's an opening riddle to set the stage for the anesthesia residents:

Riddle: "Welcome to a challenge where knowledge is key, and unlocking the secrets will set your mind free. Before you lies a box, securely locked tight, and to open it up will require your might. The journey ahead is one of wit and precision, with five riddles standing as your mission. Each riddle you solve will bring you one step near, to unveiling the box and the treasures it holds dear. What must you decipher to begin this grand quest, and open the path to prove you're the best?" Answer: Solve Five Riddles

You said,

The riddle should include something about how the riddles will be related to anesthesia knowledge.

ChatGPT said,

Of course! Here's the revised opening riddle incorporating the theme of anesthesia knowledge:

Riddle: "Welcome, brave residents, to a test of your skill, where knowledge and wit will be key to the thrill. Before you lies a box, securely locked tight, and to open it up will require your might. The journey ahead is one of wisdom and precision, with five riddles standing as your mission. Each puzzle you face is tied to your trade, with anesthesia knowledge at the heart of this escapade. Solve each riddle, using what you've learned, and the secrets of the box will soon be discerned. What must you decipher to begin this grand quest, and open the path to prove you're the best?" Answer: Solve Five Anesthesia Riddles

You said,

The answer of solving riddles should not be included in the stem.

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ChatGPT said,

Understood! Here's the revised opening riddle without directly mentioning solving riddles:

Riddle: "Welcome, brave residents, to a test of your skill, where knowledge and wit will be key to the thrill. Before you lies a box, securely locked tight, and to open it up will require your might. The journey ahead is one of wisdom and precision, where anesthesia knowledge will be your mission. Each puzzle you face is tied to

your trade, with insights you've gained and skills you've displayed. Unlock the secrets, and the box will reveal, the treasures inside and the pride you will feel. What must you discover to begin this grand quest, and open the path to prove you're the best?"
Answer: Five Keys of Knowledge

Is this version more aligned with what you're looking for?

Prompt

Write a limerick for a team of anesthesia residents where they have to go and find a

coordinator and take a selfie with her as a team and then email in the selfie.

Copilot output

Sure, here's a limerick for your team of anesthesia residents:

There once was a coordinator so key,
Today, now where could she be? Find her
and snap a selfie with your whole team,
email it in as you beam with esteem!

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Supplemental Online Material *continued*

Supplemental Online Material 2. Escape Box Riddles

Welcome, brave residents, to a test of your skill, where knowledge and wit will be key to the thrill. Before you lies a box, securely locked tight, and to open it up will require your might. The journey ahead is one of wisdom and precision, where anesthesia knowledge will be your mission. Each puzzle you face is tied to your trade with insights you've gained and skills you've displayed. Unlock the secrets, and the box will reveal, the treasures inside and the pride you will feel.

Step into the realm of preoperative anticipation, where the dance of hunger and caution intertwines. Here, a four-digit cipher stands sentinel, guarding the gateway to a patient's fasting state—a period where sustenance surrenders to necessity. Picture four patients, each having consumed different types of intake: Eggs / Water / Breast Milk / Cow Milk. The time each must wait varies, revealing a vital sequence that will unlock the correct for anesthesia readiness.

In the intricate world of blood chemistry, where ions dance in delicate balance, a hidden gap reveals a deeper truth. Imagine a patient presenting with rapid breathing, confusion, and abdominal pain—symptoms pointing to diabetic ketoacidosis. In this state, acids accumulate, disrupting the equilibrium. Consider the following laboratory values: hemoglobin 10 mg/dL, platelets 235 k/mL, sodium at 140 mEq/L, chloride at 98 mEq/L, bicarbonate at 10 mEq/L, creatinine 0.8 mg/dL. Amidst these numbers, the key to solving this mystery lies in the anion gap. Calculate the anion gap, which will expose the extent of the metabolic derangement.

Within the realm of hydration, where IV drips trickle like a stream, there exists a sacred formula, whispered among the healers—a code of equilibrium, where the balance between dehydration and fluid overload is delicately maintained. Picture the scene: a patient lies in repose, their weight 70 kg. And so, the mantra emerges—a trio of numbers that dictates the flow, where every kilogram counts in milliliters three. But this is more than a mere sequence; it's a symphony of physiology, a melody of metabolism, where sodium and glucose dance in harmony with water's embrace. What's the rhythm of life pulses in milliliters per hour that will maintain life for our 70 kg patient?

In the pharmacopeial alphabet, where letters weave their magic, a quintet of characters unlocks the recipe for smooth induction and balanced anesthesia. What's the code that spells the symphony of sedation, the blend that guides us through the realms of consciousness? Unravel these secrets, and the path to sedation shall reveal itself.

- A milky infusion, the harbinger of slumber's embrace.
- An anesthetic ally, numbing the nerves to silence their protest.
- A nondepolarizing neuromuscular blockade, seizing control with slow but reliable onset.
- A potent opioid, whispering oblivion with each breath.
- (#) A pure alpha vasoconstrictor surge, raising pressure to protect: how many mL is 100 mcg?

In the realm of anesthesia, where the dance of consciousness meets the melody of medication, there lies a path less traveled yet known to the adept. Harken to the whispers of pharmacological synergy, where intravenous streams converge to orchestrate a symphony of sedation. This four-lettered sentinel, a beacon amidst the fog of volatile agents, signifies not just an approach, but a philosophy—an artful mastery of dosage, titration, and precision where every drop carries the weight of sleep's tender embrace, and every infusion shapes the canvas of tranquility. How much nausea compared to gas?

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Photo of Education
Program Coordinator

**There once was a coordinator so key,
Today, now where could she be?
Find her and snap a selfie with your whole
team,
Email it in as you beam with esteem!**

[Email address of instructor]

Be sure to include your team's name!