LECTURES

A Brief Didactic Intervention to Improve Multiple-Choice Item-Writing Quality

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ABSTRACT:

Audience: Emergency medicine residents and faculty.

Introduction: High stakes examinations encountered throughout medical education are often composed of single best answer multiple-choice questions (MCQs). Many guidelines for writing MCQs exist, but often item writers receive little to no formal training. Flawed exam items have been shown to have lower discrimination values, potentially introducing construct-irrelevant variance to examinations, reducing their validity.[1–3] Long-term faculty development in the area of item writing has been shown to improve examination item quality, with a pilot study showing that a more brief intervention had the same impact on quality of written items.[4–6] Furthermore, when learners have been engaged in item writing, they have found the exercise to be a beneficial learning experience, with one study demonstrating an improved performance on a summative assessment as a result of participating in item writing.[7–10]

Objectives: The primary objective of this training module is to provide emergency medicine residents the basic knowledge necessary to write high quality structured single-best answer examination items through a brief, independent study format.

Method: The training module is a PowerPoint-based lecture with recorded voiceover, which is provided in mp4 format.

Topics: Exam item writing, multiple choice questions.

USER GUIDE

List of Resources:

Learner Audience:
Junior residents, senior residents, faculty

Time Required for Implementation:
This independent learning module takes approximately 23 minutes to complete.

Recommended Number of Learners per Instructor: This module was designed to be utilized independently by learners without need for additional instructors. Alternatively, this module could be viewed in a small group setting (no more than 8 learners) with an instructor present to respond to inquiries.

Topics:
Exam item writing, multiple choice questions.

Objectives:
By the completion of the item-writing training module, learners will be able to create high quality, single best answer, multiple-choice examination items.

Linked objectives and methods:
Learners will write multiple-choice questions both before and after reviewing the module. Learners are expected to write higher quality MCQs after completing the module.

Recommended pre-reading for instructor:

- If implementing the curriculum with an instructor, we recommend that the instructor view the module prior to the training session. Additional information and training in item writing can be obtained through the National Board of Medical Examiners.[11–13]

Learner responsible content (LRC):
This module was designed to stand alone at teaching residents how to write higher quality MCQs. If learners are interested in additional training, the following resources are provided by the National Board of Medical Examiners.

- Item Writing Guide and Item Writing Tutorial.[11–13]

Results and tips for successful implementation:
The proposed training module is effective in teaching emergency medicine residents to write higher quality single best answer MCQs. Providing opportunities for residents to participate in MCQ development allows for creation of an emergency medicine focused question bank, while providing an active learning experience that may be beneficial to the resident and may build their emergency medicine core content knowledge base. It should be recognized that further psychometric evaluation of pre- and post-intervention items was not performed, although this module does address some commonly identified item writing flaws including negative stem structure and inclusion of implausible distractors that have been shown to result in decreased assessment validity.

Technology necessary:
Learners need a computer with audio output capability in addition to software capable of playback of an mp4 file. There are no additional tools required for instructors.

Assessment:
Learners should be asked to write 3-5 MCQs prior to completing the training module and then revise their MCQs based on the information provided in the training module. The provided Item Assessment Quality Tool can be used to evaluate each written item. Additionally, a six-item "post-test" has been provided. Learners should read the items and then utilize the Item Quality Assessment Tool to determine the quality of the items. Explanations for the score given to each item are provided and designed to reinforce the concepts covered in the lecture.

References/suggestions for further reading:

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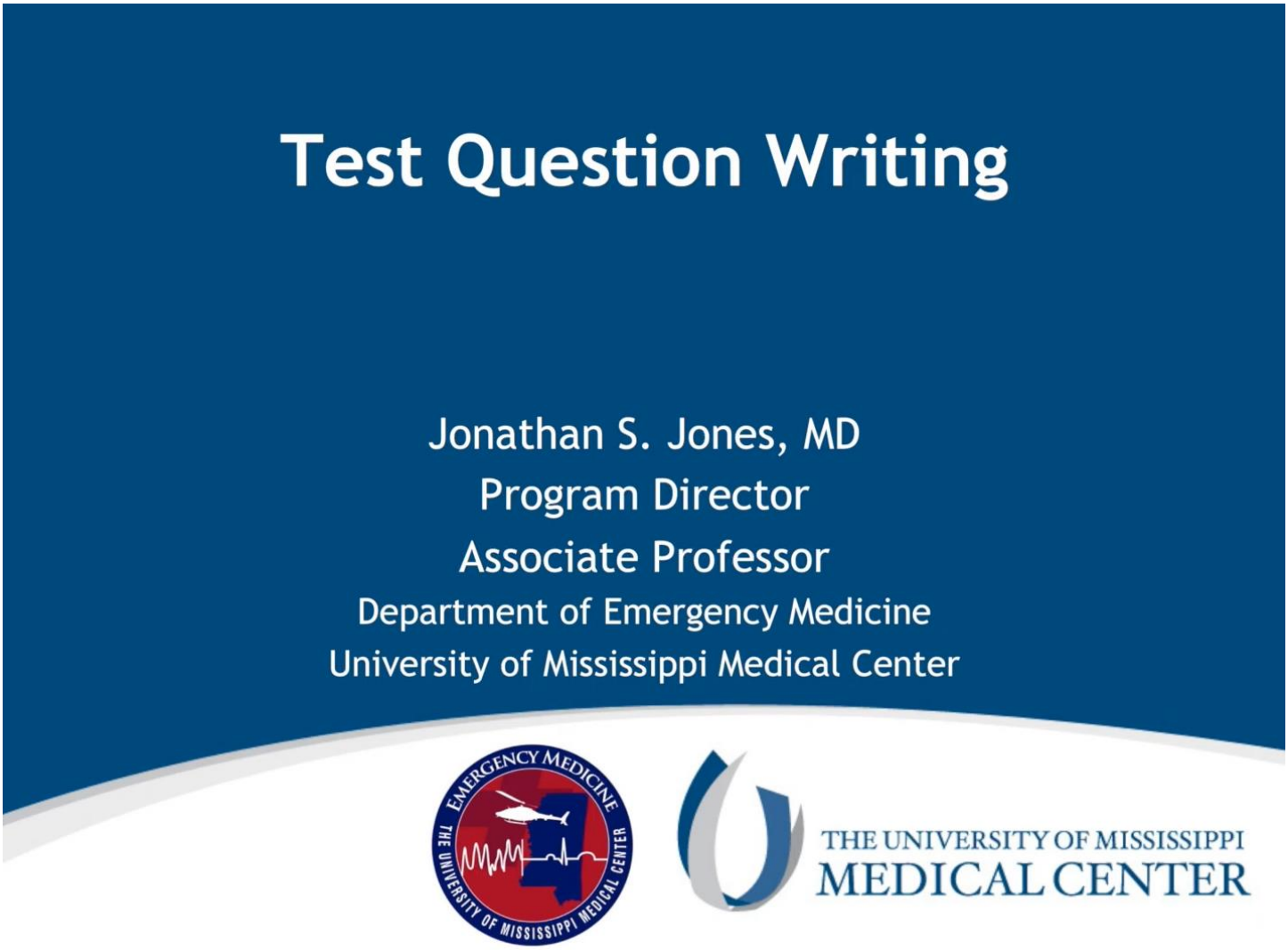
LEARNER MATERIALS

Test Question Writing Video



Video Link: https://youtu.be/03vt-3czGWo

To download a copy of the video please go to:
https://www.dropbox.com/s/v11qqqdk3mqco50/Test%20Question%20Writing%2C%20Video%20Lecture.%20JETem%202018.mp4?dl=0

LEARNER MATERIALS

Item Writing Assessment

1. A 70-year-old male is brought into the emergency department by ambulance from a care facility. He has a past medical history of advanced dementia and atrial fibrillation on dabigatran and he presents after an unwitnessed mechanical fall at the facility. Per the caretaker, the patient is more lethargic and confused from his baseline and has suffered more falls over the last month. On exam, you find ecchymosis and hematoma over left frontal region. He opens his eyes to loud voice, appears more confused than his reported baseline, and moves all his extremities spontaneously. You perform a CT scan which would most likely show acute injuries secondary to the following:

    a. Diffuse blood in the subarachnoid spaces
    b. Increased diffuse cortical cerebral atrophy
    c. Microvascular bleed in the posterior capsule
    d. Pressurized blood between the skull and dura
    e. Venous blood layering of old and new blood

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

2. A 15-year-old female presents to the ED after a motor vehicle accident. She was a restrained passenger. While performing the primary survey, you note her respiratory rate and work-of-breathing increasing. Her breath sounds, which were initially reported as clear by EMS, are now coarse. She has no obvious injuries to her thorax. What is the most likely etiology of her respiratory distress?

    a. Pneumothorax
    b. Pulmonary contusions
    c. Rib fracture
    d. Sternal fracture
    e. Vascular injury

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

3. Which of the following is not an anatomic characteristic of pediatric airways?

    a. Small occiput
    b. Anterior larynx
    c. Narrow subglottic area
    d. Large, floppy epiglottis

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

4. A 5-year-old male comes to the ED with a bleeding scalp. Per the mother, the patient was a restrained passenger in an MVC just prior to arrival. On physical exam, you notice that the patient is not arousable and not breathing spontaneously. You prepare to intubate. What anatomical characteristic of pediatric airways may contribute to a difficult intubation?

    a. Small occiput
    b. Inferior and posterior larynx
    c. Small tongue and large mouth
    d. Large, floppy epiglottis
    e. Long trachea

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

5. A 1-year-old male is brought to the ED with a chief complaint of not wanting to walk or use his right leg. The parents state that he fell off the bed. Physical exam leaves uncertainty to a specific area of tenderness so you decide to image the entire right leg. You see multiple fractures in different stages of healing. Which of the following physical exam/imaging findings would be the most specific finding for your diagnosis of non-accidental trauma?

    a. Forearm laceration
    b. Pulmonary contusion
    c. Radius fracture
    d. Retinal Hemorrhages
    e. Scalp contusion

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

6. A 9-month-old boy is brought into the ED with increased irritability and vomiting. The mother denies history of fall or trauma. Vitals signs are notable for a temp of 98.6F, BP 90/60, HR 106, RR 20. The child is well-appearing but drowsy. Physical exam is largely unremarkable except for bilateral retinal hemorrhage. Additional workup including a CBC, BMP, UA is unremarkable. A preliminary read of a CT head reveals no acute process. You resuscitate with IV fluids and the child becomes more interactive and is tolerating PO. What is the next step in management?

    a. Reassure the mother and discharge home to follow with the pediatrician
    b. Admit the child for further workup of non-accidental trauma
    c. Consult neurosurgery for further evaluation
    d. Observe the patient for at least 4 more hours
    e. Administer 20mg/kg IV vancomycin

	YES =1, NO =0
POSITIVELY WORDED STEM	
STEM PHRASED AS A QUESTION	
5 ANSWER CHOICES	
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	
FOILS ARE SIMILAR IN COMPLEXITY	
ONE CLEAR, CORRECT ANSWER	
TOTAL SCORE	

INSTRUCTOR MATERIALS

Item Writing Assessment: Explanations

1. A 70-year-old male is brought into the emergency department by ambulance from a care facility. He has a past medical history of advanced dementia and atrial fibrillation on dabigatran and he presents after an unwitnessed mechanical fall at the facility. Per the caretaker, the patient is more lethargic and confused from his baseline and has suffered more falls over the last month. On exam, you find ecchymosis and hematoma over left frontal region. He opens his eyes to loud voice, appears more confused than his reported baseline, and moves all his extremities spontaneously. You perform a CT Scan which would most likely show acute injuries secondary to the following:

    a. Diffuse blood in the subarachnoid spaces
    b. Increased diffuse cortical cerebral atrophy
    c. Microvascular bleed in the posterior capsule
    d. Pressurized blood between the skull and dura
    e. Venous blood layering of old and new blood

	YES =1, NO =0
POSITIVELY WORDED STEM	***1***
STEM PHRASED AS A QUESTION	***0***
5 ANSWER CHOICES	***1***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***1***
FOILS ARE SIMILAR IN COMPLEXITY	***1***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***5***

Explanation: Although the stem is positively worded, it is not phrased as a question. This question could be improved by rephrasing to the following: "You perform a CT scan. What is the most likely acute pathology?" An acute on chronic subdural hematoma is the most likely pathology, making "e" the single best answer.

2. A 15-year-old female presents to the ED after a motor vehicle accident. She was a restrained passenger. While performing the primary survey, you note her respiratory rate and work-of-breathing increasing. Her breath sounds, which were initially reported as clear by EMS, are now coarse. She has no obvious injuries to her thorax. What is the most likely etiology of her respiratory distress?

    a. Pneumothorax
    b. Pulmonary contusions
    c. Rib fracture
    d. Sternal fracture
    e. Vascular injury

	YES =1, NO =0
POSITIVELY WORDED STEM	***1***
STEM PHRASED AS A QUESTION	***1***
5 ANSWER CHOICES	***1***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***1***
FOILS ARE SIMILAR IN COMPLEXITY	***1***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***6***

Explanation: This item meets each standard of the item assessment tool. The stem is positively worded and phrased as a question. Five answer choices are listed alphabetically. There is a single best correct answer (b) and the foils are similarly complex.

INSTRUCTOR MATERIALS

3. Which of the following is not an anatomic characteristic of pediatric airways?

    a. Small occiput
    b. Anterior larynx
    c. Narrow subglottic area
    d. Large, floppy epiglottis

	YES =1, NO =0
POSITIVELY WORDED STEM	***0***
STEM PHRASED AS A QUESTION	***1***
5 ANSWER CHOICES	***0***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***0***
FOILS ARE SIMILAR IN COMPLEXITY	***1***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***3***

Explanation: This item is phrased as a question and has a single, best answer (d) with similarly complex foils. The stem is NOT positively worded, and only four answer choices are provided and they are not listed alphabetically.

4. A 5-year-old male comes to the ED with a bleeding scalp. Per the mother, the patient was a restrained passenger in an MVC just prior to arrival. On physical exam, you notice that the patient is not arousable and not breathing spontaneously. You prepare to intubate. What anatomical characteristic of pediatric airways may contribute to a difficult intubation?

    a. Small occiput
    b. Inferior and posterior larynx
    c. Small tongue and large mouth
    d. Large, floppy epiglottis
    e. Long trachea

	YES =1, NO =0
POSITIVELY WORDED STEM	***1***
STEM PHRASED AS A QUESTION	***1***
5 ANSWER CHOICES	***1***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***0***
FOILS ARE SIMILAR IN COMPLEXITY	***1***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***5***

Explanation: This item asks the same question as the previous item, but now it is positively worded with five answer choices. There is one best answer (e) and the foils are similarly complex, but the answer choices are still not listed alphabetically.

INSTRUCTOR MATERIALS

5. A 1-year-old male is brought to the ED with a chief complaint of not wanting to walk or use his right leg. The parents state that he fell off the bed. Physical exam leaves uncertainty to a specific area of tenderness so you decide to image the entire right leg. You see multiple fractures in different stages of healing. Which of the following physical exam/imaging findings would be the most specific finding for your diagnosis of non-accidental trauma?

    a. Forearm laceration
    b. Pulmonary contusion
    c. Radius fracture
    d. Retinal Hemorrhages
    e. Scalp contusion

	YES =1, NO =0
POSITIVELY WORDED STEM	***1***
STEM PHRASED AS A QUESTION	***1***
5 ANSWER CHOICES	***1***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***1***
FOILS ARE SIMILAR IN COMPLEXITY	***1***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***6***

Explanation: This item meets each standard of the item assessment tool. The stem is positively worded and phrased as a question. Five answer choices are listed alphabetically. There is a single best correct answer (d) and the foils are similarly complex.

INSTRUCTOR MATERIALS

6. A 9-month-old boy is brought into the ED with increased irritability and vomiting. The mother denies history of fall or trauma. Vitals signs are notable for a temp of 98.6F, BP 90/60, HR 106, RR 20. The child is well-appearing but drowsy. Physical exam is largely unremarkable except for bilateral retinal hemorrhage. Additional workup including a CBC, BMP, UA is unremarkable. A preliminary read of a CT head reveals no acute process. You resuscitate with IV fluids and the child becomes more interactive and is tolerating PO. What is the next step in management?

    a. Reassure the mother and discharge home to follow with the pediatrician
    b. Admit the child for further workup of non-accidental trauma
    c. Consult neurosurgery for further evaluation
    d. Observe the patient for at least 4 more hours
    e. Administer 20mg/kg IV vancomycin

	YES =1, NO =0
POSITIVELY WORDED STEM	***1***
STEM PHRASED AS A QUESTION	***1***
5 ANSWER CHOICES	***1***
ANSWER LISTED ALPHABETICALLY/NUMERICALLY	***0***
FOILS ARE SIMILAR IN COMPLEXITY	***0***
ONE CLEAR, CORRECT ANSWER	***1***
TOTAL SCORE	***5***

Explanation: The stem is positively worded and phrased as a question. Five answer choices are listed, but not alphabetically. There is a single best correct answer (b), but the foils are not similarly complex. Answer "e" does not seem to follow the trend of other answer choices in making progress towards a disposition for the patient, nor is the administration of vancomycin a reasonable answer based on the information provided in the stem.